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## A NEW FRAMEWORK FOR DETERMINING REASONABLE ROYALTIES IN PATENT LITIGATION

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## Abstract

Over the past decade, eight-, nine- and even ten-figure damages awards have become a recurring feature in patent infringement litigation, and yet the principal methods for calculating reasonable royalties (the most common form of damages in patent cases) remain unsatisfying and incoherent. Most frequently, courts employ what we refer to as a "pure ex ante" approach, which aims to construct the hypothetical bargain the parties themselves would have struck prior to infringement (ex ante), based on whatever information would have been available to them at that time. This approach has the advantage of avoiding patent "holdup"—basing the royalty partly on the infringer's sunk costs—but cannot easily explain other longstanding features of how royalties are calculated, and can result in awards that reflect the parties' erroneous ex ante expectations. Alternatively, some commentators have proposed a "pure ex post" approach, which aspires to recreate the bargain the parties might have reached as of some later date, such as the date of judgment. This approach uses more accurate information about the technology's actual value, but contrary to sound innovation policy it also would enable the patentee to capture some of the patent's holdup value. In this Article, we show that a "contingent ex ante" framework, under which the court attempts to construct *the ex ante bargain the parties would have struck on the basis of all relevant information that is available ex post*, is superior to both of the above approaches. More specifically, our framework enables courts to base the royalty on the most accurate information available while avoiding the holdup risk arising from the pure ex post approach. We analyze how courts can apply this approach

in various settings, including cases involving FRAND-committed standard essential patents, sequential infringement, regulatory uncertainty, and unexpected exogenous events.

> An imaginary bid by an imaginary buyer, acting upon the information available at the moment of the breach, is not the limit of recovery where the subject of the bargain is an undeveloped patent. Information at such a time might be so scanty and imperfect that the offer would be nominal. The promisee of the patent has less than fair compensation if the criterion of value is the price that he would have received if he had disposed of it at once, irrespective of the value that would have been uncovered if he had kept it as his own.

*Sinclair Refining Co. v. Jenkins Petroleum Process Co.*, 289 U.S. 689, 699 (1933).

"The real value—the actual value—of what has been taken is always the ultimate question."

*United States Frumentum Co. v. Lauhoff*, 216 F. 610, 616 (6th Cir. 1917).

INTRODUCTION

Following a jury trial in 2012, a federal district court entered judgment in the amount of $1 billion in favor of Monsanto in a patent infringement dispute against DuPont.[1] The $1 billion damages award reflected the jury's best estimate of the lump-sum amount that DuPont would have agreed to pay and that Monsanto would have accepted, just before the infringement began, in the counterfactual world in which DuPont had negotiated for a license rather than infringed.[2] The jarring feature of this case is not so much the amount of the damages—billion dollar awards, though hardly an everyday occurrence, are not unheard of in U.S. patent litigation[3]—but rather that, while DuPont *made* some quantities of infringing seed, it never *sold* any of this seed and therefore enjoyed no sales revenue, much less profit, as a result of the infringement.[4] The damages award was based entirely on a hypothetical bargain that the parties would have struck ex ante (before infringement), based on DuPont's expected (but, as it turned out, unconsummated) sales volume.[5]

While this result may seem odd at first blush, it is consistent with one of the standard approaches for calculating reasonable royalties in patent infringement litigation.[6] As the U.S. Court of Appeals for the Federal

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1. The case was *Monsanto Co. v. E.I. DuPont De Nemours & Co*., No. 4:09-CV-00686-ERW, 2012 WL 2979080 (E.D. Mo. July 20, 2012). There is no reported opinion following the entry of judgment, and the case settled shortly thereafter. For a discussion of the case, see Bernard Chao & Jonathan R. Gray, *A $1 Billion Parable*, 90 DENVER U. L. REV. ONLINE 185 (2013).

2. *See* Chao & Gray, *supra* note 1, at 185–86.

3. *See* OWEN BYRD ET AL., LEX MACHINA: PATENT LITIGATION DAMAGES REPORT 10 (2014) (noting three such cases, including *Monsanto*, as well as several others with awards in excess of $100 million).

4. *See* Chao & Gray, *supra* note 1, at 185–88. According to Professor Bernard Chao and Jonathan Gray, DuPont had a license with Monsanto but engaged in experimentation on Monsanto's patented technology in an effort to develop an improved product. *Id.* at 186. DuPont thereafter abandoned the project. *Id.* at 188. However, under the terms of its settlement with Monsanto, DuPont may continue to develop improvements on genetically modified seeds. *See* Casey Gilliam, *Monsanto, DuPont Strike $1.75 Billion Licensing Deal, End Lawsuits*, REUTERS (Mar. 26, 2013, 5:40 PM), http://www.reuters.com/article/us-monsanto-dupont-gmo-idUSBRE92 P0IK20130326.

5. *See* Chao & Gray, *supra* note 1, at 186–87.

6. *See id.* at 186–88 (arguing, however, that the award might have been flawed absent evidence that DuPont would have agreed to a lump-sum royalty in such a large amount, as opposed to a running royalty based on actual sales). In U.S. law, compensatory damages for patent

Circuit observed in *Lucent Technologies, Inc. v. Gateway, Inc.*,[7] "the hypothetical negotiation or the 'willing licensor-willing licensee' approach[] attempts to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before infringement began," recreating "as best as possible . . . the *ex ante* licensing negotiation scenario and . . . resulting agreement." [8] Most economists and patent scholars who have expressed a view on the matter support the ex ante perspective for two reasons. First, it (ideally) restores the status quo but for the infringement and thus preserves the patent incentive. [9] Second, it reduces the social costs of patent "holdup," meaning in this context the patent owner's ability to extract a royalty that reflects not just the value of the patented technology but also a portion of

infringement usually take one of two forms: lost profits or reasonable royalties. 35 U.S.C. § 284 (2012) ("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 . . . ."). Lost profits are appropriate where the infringement deprived the patent owner of sales—or, to put it another way, where but for the infringement the patent owner would have excluded the infringer (rather than agreeing to license the infringer's use in exchange for a royalty). Reasonable royalties are appropriate where the patent owner would have agreed to a license ex ante, or where the patent owner cannot prove the amount of its lost profits. For discussion, see ROGER D. BLAIR & THOMAS F. COTTER, INTELLECTUAL PROPERTY: ECONOMIC AND LEGAL DIMENSIONS OF RIGHTS AND REMEDIES 58–59, 242–43 (2005).

7. 580 F.3d 1301 (Fed. Cir. 2009).

8. *Id.* at 1324–25 (quoting Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970)). As the court notes, the willing licensor–willing licensee framework is the "more common approach" for calculating royalties under U.S. law, but courts sometimes have permitted use of a less common method known as the "analytical" approach, which "focuses on the infringer's projections of profit for the infringing product." *Id.* at 1324; *see, e.g.*, TWM Mfg. Co. v. Dura Corp., 789 F.2d 895, 899 (Fed. Cir. 1986) (approving special master's use of the analytical approach involving subtraction of "the infringer's usual or acceptable net profit from its anticipated net profit realized from sales of infringing devices"); Linear Grp. Servs., LLC v. Attica Automation, Inc., No. 13-10108, 2014 WL 4206871, at *4–5 (E.D. Mich. Aug. 25, 2014) (granting motion to exclude evidence that would be irrelevant to the patentee's use at trial of the analytical method). *But see* Martha K. Gooding, *Analyzing the "Analytic Method" of Calculating Reasonable Royalty Patent Damages*, BLOOMBERG BNA PAT., TRADEMARK & COPYRIGHT L. DAILY (May 11, 2012) (arguing that governing precedent does not authorize use of the analytical method to the exclusion of the willing licensor–willing licensee framework). As discussed herein, our proposed framework for calculating reasonable royalties generally requires the use of ex post information and therefore would eliminate the analytical approach.

9. *See, e.g.*, FED. TRADE COMM'N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 138 (2011) ("For remedies to protect the patent system's incentives to innovate and avoid distorting competition among technologies, they must replicate the reward the patentee would have earned in the market absent infringement."); Ted Sichelman, *Purging Patent Law of 'Private Law' Remedies*, 92 TEX. L. REV. 517, 540–41 (2014) (referring to the "standard model of patent remedies" as one in which, to preserve the patent incentive, "patent damages should return the patentee to the hypothetical state of affairs that would have obtained but for the infringement").

the infringer's sunk costs of implementing the infringing technology.[10] Because these sunk costs are not related to the value of the patented technology, awarding a royalty that is based in part on the value the defendant would derive from avoiding these costs distorts the patent incentive by overrewarding the patentee, thus raising both the private and social costs of implementing patented technology without any corresponding public benefit.[11]

We generally agree with the mainstream view described above—that courts should calculate patent royalties based on an ex ante bargaining framework—and have so argued in other work.[12] We also agree that the reason for using the ex ante framework is to preserve the patent incentive and avoid holdup. But just because an ex ante *timing* for the hypothetical negotiation is necessary to prevent holdup, it does not follow that only ex ante *information* should be used.[13] The traditional approach to the hypothetical negotiation implicitly assumes that, because a hypothetical negotiation is assumed to take place ex ante, it can be based only on ex ante information—that is, on the *expected* value of the invention.[14] We argue, however, that this coupling of ex ante timing and ex ante information is neither necessary nor desirable, and that instead the reasonable royalty should reflect *an ex ante negotiation, based on ex post information.* The ex ante timing of the hypothetical negotiation is aimed at ensuring that only the value *of the invention* is captured—that is, that the negotiation does not enable the patentee to hold up the user for sunk

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10. *See* FED. TRADE COMM'N, *supra* note 9, at 144 (referring to the "higher royalty based on switching costs" as the "'hold-up' value of the patent"); *see also* U.S. DEP'T OF JUSTICE & U.S. PAT. & TRADEMARK OFF., POLICY STATEMENT ON REMEDIES FOR STANDARDS-ESSENTIAL PATENTS SUBJECT TO VOLUNTARY FRAND COMMITMENTS 4 (2013), http://www.justice.gov/sites/default/files/atr/legacy/2014/09/18/290994.pdf (discussing the problems associated with patent holdups).

11. *See* FED. TRADE COMM'N, *supra* note 9, at 190 (stating that a "damages award that is based on high switching costs, rather than the ex ante value of the patented technology compared to alternatives, overcompensates the patentee" because "[i]t improperly reflects the economic value of investments by the infringer rather just than the economic value of the invention").

12. *See, e.g.*, Thomas F. Cotter, *Patent Remedies and Practical Reason*, 88 TEX. L. REV. SEE ALSO 125, 130 (2010); Norman V. Siebrasse et al., *Damages Calculations in Intellectual Property Cases in Canada*, 24 CAN. INTELL. PROP. REV. 153, 155, 168 (2009).

13. By the same token, a case that invokes an ex ante hypothetical negotiation to address the holdup problem is not good authority for the proposition that the parties should be assumed to have only ex ante information. In particular, in *Riles v. Shell Exploration & Prod. Co.*, 298 F.3d 1302, 1312–13 (Fed. Cir. 2002), the court explicitly justified the holding that the hypothetical negotiation takes place before the infringement began as a means of avoiding the holdup problem, and one cannot take the holding to imply that courts should use only ex ante information.

14. *See* FED. TRADE COMM'N, *supra* note 9, at 166 (stating that courts assume "that the hypothetical negotiation takes place at the time the infringement began," and that "[t]his timing determines the information available to the parties during the negotiation" (citing *Riles*, 298 F.3d at 1313)).

costs unrelated to the value of the invention. Conversely, the reasonable royalty should ensure that the patentee is not underrewarded, in order to preserve the patent incentive. But the overarching principle is that damages should reflect the true value of the invention, and ex post information provides a better measure of the true value of the invention.[15]

Our thinking on this issue first arose in the context of standard-setting organizations (SSOs), which often require or permit participating members to declare which, if any, of their patents are essential to the practice of any standards the SSO promulgates and to commit to licensing those patents on "fair," "reasonable," and "non-discriminatory" (FRAND) terms.[16] Because SSOs typically do not define the term "FRAND," however, courts may be called upon to determine what an appropriate FRAND royalty is when the owner of a FRAND-encumbered SEP files suit for infringement.[17] As one might imagine, the debate over whether FRAND royalties, like reasonable royalties more generally, should be calculated on an ex ante or an ex post basis has been particularly intense given the size of the relevant markets and the amounts of licensing revenue at stake.

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15. *See* David O. Taylor, *Using Reasonable Royalties to Value Patented Technology*, 49 GA. L. REV. 79, 117–18 (2014) (arguing that the fundamental goal of patent remedies should be to accurately value the patented technology because doing so serves the public policy purpose of providing optimal incentives to invent). We agree with Professor Taylor's thesis but develop the point differently. Professor Taylor focuses primarily on the distinction between the value of patent rights and the value of the patented technology, emphasizing that the value of patent rights turns on uncertainty regarding liability, relief, and enforceability, as well as negotiation and litigation costs, which are all irrelevant to the value of the underlying technology. *See id.* at 118–26. In contrast, we focus on the contrast between ex post and ex ante information, a point that Professor Taylor expressly leaves open. *See id.* at 136–37.

16. *See, e.g.*, EUR. TELECOMM. STANDARDS INST., INTELLECTUAL PROPERTY RIGHTS POLICY § 6.1 (2015), http://www.etsi.org/WebSite/document/Legal/ETSI_IPR-Policy.pdf; INST. OF ELEC. AND ELECS. ENG'RS STANDARDS ASS'N, STANDARDS BOARD BYLAWS ¶ 6.2(b) (Dec. 2015), http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf; INT'L TELECOMM. UNION, COMMON PATENT POLICY FOR ITU-T/ITU-R/ISO/IEC § 2.1, http://www.itu.int/en/ITU-T/ipr/Pages/policy.aspx (last visited Mar. 7, 2016); *see also* RUDI BEKKERS & ANDREW UPDEGROVE, A STUDY OF IPR POLICIES AND PRACTICES OF A REPRESENTATIVE GROUP OF STANDARDS SETTING ORGANIZATIONS WORLDWIDE 48–99 (Sept. 17, 2012), http://sites.nationalacademies.org/PGA/step/PGA_058712 (discussing the disclosure and licensing obligations among twelve leading SSOs).

17. *See* Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., 809 F.3d 1295, 1304–05 (Fed. Cir. 2015) [hereinafter *CSIRO*]; Ericsson, Inc. v. D–Link Sys., Inc., 773 F.3d 1201, 1235 (Fed. Cir. 2014); *In re* Innovatio IP Ventures, LLC Patent Litig., No. 11 C 9308, 2013 WL 5593609, at *6–8 (Oct. 3, 2013); *cf.* Microsoft Corp. v. Motorola, Inc., 795 F.3d 1024, 1036–38 (9th Cir. 2015), *aff'g* No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013) (involving a breach of contract action brought by would-be licensee).

Proceeding from an idea originally proposed by Mario Mariniello,[18] we will argue that neither a "pure" ex ante nor a pure ex post methodology for calculating FRAND royalties, or reasonable royalties more generally, is ideal. To be sure, a pure ex ante approach—one that attempts to construct the bargain the parties would have reached ex ante, based only on the information set that was available to them ex ante—is preferable to a pure ex post approach, which as noted above enables some degree of patent holdup. But the pure ex ante approach misses something too, namely the (non-holdup) value conferred upon an individual SEP by virtue of its incorporation into the SSO's chosen standard. Some portion of an SEP's value, in other words, is attributable to the fact that the SEP is complementary to other SEPs that read on the chosen standard, and that its inclusion within the standard ensures widespread use. By contrast, if a patent that is *potentially* an SEP ex ante winds up *not* being included in the standard, its market value ex post might fall to zero. Given these effects of standardization, we will argue that the ideal framework does not entail constructing the ex ante bargain the parties would have reached *based on ex ante information* (in this context, based on the probability that the patent would be included within the standard). Rather, it is the ex ante bargain they would have negotiated *contingent on the patent under consideration being included in the chosen standard*—or, to put it another way, the ex ante bargain the parties would have negotiated if they had been in possession of the information set that is available ex post (at the time of trial), namely that the patent *did* wind up being included in the standard.[19] More specifically, we will show that, in the standard-

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18. *See* Mario Mariniello, *Fair, Reasonable and Non-discriminatory (FRAND) Terms: A Challenge for Competition Authorities*, 7 J. COMPETITION L. & ECON. 523, 526 (2011) (stating that "the licensing terms offered after the adoption of the standard (ex-post) should not be worse than those which the patent holder would have committed to ex-ante in the context of a standard setting contest conditional on the information that is available ex-post").

19. We have further developed the application of our approach to SEPs in a companion paper, Norman V. Siebrasse & Thomas F. Cotter, *The Value of the Standard*, 101 MINN. L. REV. (forthcoming 2016). As discussed in that paper, the Federal Circuit's two most recent decisions on FRAND royalties, *CSIRO* and *Ericsson*, purport to forbid courts from taking into consideration "any value added by the standard's adoption of the patented technology." *Ericsson*, 773 F.3d at 1232; *CSIRO*, 809 F.3d at 1304 (citing *Ericsson* with approval). We argue, however, that from an economic perspective the principle that a FRAND royalty should not reflect "the value of the standard" is best understood as meaning that the royalty should not reflect holdup value and should be proportionate to the patent's contribution to the standard. The primary concern should be to prevent what we refer to as "sunk costs hold-up," and elaborating on the contingent ex ante approach developed here, we argue that the royalty *should* reflect the increased use of the technology resulting from the network effects attributable to the technology's incorporation into a standard. Indeed, to the extent a FRAND royalty is calculated by multiplying a royalty rate by the value of an ex post royalty "base," that ex post base necessarily will reflect, up to a point, those network effects.

setting context, our "contingent ex ante" approach—constructing the ex ante bargain the parties would have struck with the benefit of ex post information—is superior to the pure ex ante approach because it better serves a system of patent incentives, which ideally would award the patent owner in an amount that is commensurate with[20] the social value of its invention.[21] The contingent ex ante approach better achieves this goal both in the individual case, because it takes into account the fact that a patent incorporated into a standard is, all other things being equal, of greater social value than one that is not, and in the aggregate, due to selection bias in the population of cases that parties are likely to litigate.

Our analysis doesn't stop there, however. We will argue that the benefits of the contingent ex ante approach, in terms of aligning rewards with social value while also avoiding holdup, counsel in favor of adopting the approach, subject to administrability constraints,[22] in all other contexts in which courts are called upon to award reasonable royalties as well. Indeed, as we will show, courts already *do* apply a contingent ex ante approach (without referring to it as such) in relation to two common practices: first, by framing the standard willing licensor–willing licensee inquiry as an attempt to construct the ex ante bargain the parties would have reached on the assumption that both of them knew the patent claims at issue to be valid and infringed (a fact that *actually* can be known only ex post, namely at the entry of judgment);[23] and second, by (frequently) awarding patent owners a "running" royalty equal to a hypothetical ex

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20. We say "commensurate with" rather than "equal to" because we are *not* arguing that patent owners should be able to extract the full social value of their inventions. For discussion, see, for example, Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 257 (2007); John M. Golden, *Principles for Patent Remedies*, 88 TEX. L. REV. 505, 529–39 (2010); Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1036 (2005); Taylor, *supra* note 15, at 138–39.

21. In this respect, we agree entirely with Professor Ted Sichelman that, ideally courts should align patent remedies with the need for an incentive to invent, or the lack thereof. *See* Sichelman, *supra* note 9, at 529–60. The remedial implications we derive from this premise, however, are quite different from his.

22. As discussed herein, although it is usually easier to use (real) ex post information than to use (hypothetical) ex ante information, this isn't *always* the case, particularly where some portion of the patent's value resides in its "insurance" function. *See infra* Section II.H. We also recognize that attempts to construct an ex ante bargain of *any* sort may suffer from information gaps, particularly in the context of SEPs. Nevertheless, even in such cases it is important to have a sense of what the theoretical ideal is so that one can look for proxies (such as comparable licenses) that are more likely to be consistent with, rather than contrary to, this ideal.

23. *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1325 (Fed. Cir. 2009). Relatedly, in litigation over the value of FRAND royalties, a court may take into account whether a patent that the owner declared essential really *is* essential (and therefore necessarily infringed by the defendant's standard-compliant product) based on ex post evidence. *See In re* Innovatio IP Ventures, LLC Patent Litig., Case No. 11 C 9308, 2013 WL 5593609, at *6–7 (N.D. Ill. Oct. 3, 2013).

ante rate multiplied by an ex post "base" consisting of the defendant's actual sales revenue.[24] Up to now, commentators have usually defended the former practice on the ground that the assumption of validity and infringement is necessary to avoid a double-discounting problem,[25] while the latter might be defended on the ground that it is consistent with the manner in which many real-world licenses are structured.[26] While we don't disagree with these justifications, we will argue that our approach offers a deeper explanation that both unites the foregoing practices while also providing a principled framework for valuing SEPs and for determining reasonable royalties more generally. And while our approach might suggest that in some SEP cases courts should award higher royalties than they would under a pure ex ante approach, in other instances the use of ex post information can result in much lower awards. For example, in cases such as the *Monsanto* litigation described at the beginning of this Article, our approach would ensure that patent owners are not overrewarded merely because the defendant would have erred, during the ex ante state of the world, in estimating the actual value of the patent. By the same token, if the defendant underestimates the actual value of the patent, under the pure ex ante approach the patentee will be underrewarded.[27] Similarly, as we will demonstrate, there are a variety of other real-world situations in which framing the hypothetical bargain as one in which the parties negotiated ex ante with the benefit of ex post information could either reduce or increase royalties based on the nature of the ex post events. These include cases, for example, in which the status of an alternative as noninfringing is revealed only ex post, or when regulatory approval for the marketing of a patented product is either

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24.  *See* Spectralytics, Inc. v. Cordis Corp., 649 F.3d 1336, 1347 (Fed. Cir. 2011) (affirming a 5% running royalty); *Lucent*, 580 F.3d at 1338–39 (discussing running royalties). A third situation in which courts make use of ex post information involves the so-called "book of wisdom," a term that comes from the *Sinclair* opinion cited at the beginning of this Article. On one (commonly held) view, the book of wisdom approach permits a court to use ex post information only to the extent it is probative in constructing the ex ante information to which the parties would have had access. *See* Aqua Shield v. Inter Pool Cover Team, 774 F.3d 766, 772 (Fed. Cir. 2014); Martha K. Gooding, *Reasonable Royalty Patent Damages: A Proper Reading of the Book of Wisdom*, BLOOMBERG BNA PAT., TRADEMARK & COPYRIGHT L. DAILY (Apr. 21, 2014). In our view, however, the book of wisdom properly understood is entirely consistent with—indeed, foreshadows—our approach. *See infra* Subsection I.C.1.

25.  *See* Stephen H. Kalos & Jonathan D. Putnam, *On the Incomparability of 'Comparable': An Economic Interpretation of 'Infringer's Royalties*,*'* 9 NO. 4 J. PROPRIETARY RTS. 1, 2 (1997). We explain what the "double discounting" problem is *infra* Subsection I.C.1.

26.  *See* Thomas F. Cotter, *Four Principles for Calculating Reasonable Royalties in Patent Infringement Litigation*, 27 SANTA CLARA HIGH TECH. L.J. 725, 748 (2011) (suggesting that "the use of running royalties should reflect the types of royalty rates and bases that the parties realistically would have chosen ex ante").

27.  *See infra* Section II.D.

granted or denied ex post.[28] Our analysis also provides a principled way of calculating damages in cases involving "sequential" infringement and thus avoids the formalistic distinctions that now govern such cases.[29]

In short, the contingent ex ante framework offers a superior alternative to other options for calculating patent royalties by, on the one hand, offering a way to avoid holdup problems and excessive awards such as the one in *Monsanto*, while also taking into account the non-holdup value that standardization confers upon SEPs. It also provides a deeper rationale for the assumption of validity and infringement and for awards of running royalties, both of which aspects of current law depart from a pure ex ante approach; and it offers a more persuasive reading of *Sinclair Oil*—the case quoted at the beginning of this Article, in which Justice Cardozo coined the term "book of wisdom" to refer to the use of ex post information in damages calculations.[30] It is also consistent with the standard articulated by courts in Europe's largest patent litigation system, Germany, which requires estimating what reasonable contracting parties would have agreed to, at the conclusion of a licensing agreement, if they had foreseen the future development and specifically the duration and amount of the use of the patent."[31] We have come to conclude that, on

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28.  *See infra* Sections II.D, II.G.

29.  *See infra* Section II.C.

30.  According to some observers, courts have tended to invoke the "book of wisdom" asymmetrically to benefit patentees but not infringers. *See* Taylor, *supra* note 15, at 126 (citing Paul M. Janicke, *Contemporary Issues in Patent Damages*, 42 AM. U. L. REV. 691, 726 (1992)). *Sinclair Oil* itself does not mandate this, and in our view it is completely unjustifiable to limit the use of ex post evidence in that way.

31.  *See* BGH Mar. 14, 2000, GRUR 685 (688), 2000 ("Geschuldet ist das, was vernünftige Vertragspartner vereinbart hätten, wenn sie bei Abschluß eines Lizenzvertrages die künftige Entwicklung und namentlich die Zeitdauer und das Maß der patentbenutzung vorausgesehen hätten") (citations omitted). For discussion of this principle under German law, see, for example, Markus Schönknecht, *Determination of Patent Damages in Germany*, 43 IIC 309, 322 (2012) ("Since the hypothetical parties are deemed to have foreseen the further course of events, this includes factual changes that occurred during the time of infringement (e.g., changes in the business situation that would have increased or decreased the royalties")) (citing THOMAS KÜHNEN & EVA GESCHKE, DIE DURCHSETZUNG VON PATENTEN IN DER PRAXIS, No. 1402 (4th ed. 2010)). *See also* THOMAS F. COTTER, COMPARATIVE PATENT REMEDIES: A LEGAL AND ECONOMIC ANALYSIS 267−68 (2013) (suggesting that in practice German courts may give ex post evidence more weight when it favors the patentee). For discussion of a similar principle under Japanese law, see Masabumi Suzuki & Yoshiyuki Tamura, *Japan*, *in* THE ENFORCEMENT OF PATENTS 119, 125 (Kung-Chung Liu & Reto M. Hilty eds., 2012) (asserting that Japanese courts calculate reasonable royalties "ex post, namely at the time of the infringement lawsuit and taking into account past circumstances, as opposed to ex ante, that is, at the time of concluding a license agreement and in the expectation of future circumstances").

Interestingly, in patent infringement actions litigated against the United States government under 28 U.S.C. § 1498, the U.S. Court of Federal Claims on occasion has articulated the standard for awarding a reasonable royalty in terms similar to what we propose above. *See, e.g.*, Standard

the topic at issue, both Justice Cardozo and the German Federal Supreme Court have got things exactly right.

That said, our argument is based primarily on policy and principle, and we do not review the existing case law in detail; this task has been sufficiently addressed by other authors, who show that while the case law is clear that the hypothetical negotiation is ex ante in the sense of timing, it is muddled on what we view as the separate question of whether ex post information should be used. [32] A good summary of the status quo is that "a hypothetical negotiation [takes place] at the time of first infringement using only facts available at that time, except for certain future facts that may be taken into account under the 'book of wisdom' principle," but "there are few references to the book of wisdom in the case law, and of those, none provide clear guidance as to the nature and extent to which future facts and circumstances may be taken into account when assessing the appropriate reasonable royalty."[33] In light of the unsettled case law, it is, in our view, open to future courts to address the question of whether ex post information can be used as a matter of principle, which is the focus of this Article.

Part I sets out in greater detail why a pure ex ante approach is better than a pure ex post approach and why the contingent ex ante approach is superior to both. Part II then discusses some refinements and specific applications of our analysis to a range of issues, including FRAND-encumbered SEPs, sequential infringement, and the calculation of royalties in the face of exogenous technological or regulatory change.

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Mfg. Co. v. United States, 42 Fed. Cl. 748, 762 (1999) ("Consideration of later-occurring events may be necessary to approximate a fair royalty to which negotiators with access to such knowledge would have agreed"); Dow Chem. Co. v. United States, 36 Fed. Cl. 15, 20 (1996) (citing Hughes Aircraft Co. v. United States, 31 Fed. Cl. 481 (1994), *aff'd*, 86 F.3d 1566 (Fed. Cir. 1996); Penda Corp. v. United States, 29 Fed. Cl. 533, 573–74 (1993); and ITT Corp. v. United States, 17 Cl. Ct. 199, 202, 223 (1989), for the proposition that "the controlling precepts applicable . . . are that . . . if there is no established royalty, the rate will typically be determined through a process of hypothetical negotiation between a suppositious 'willing buyer' and 'willing seller' as of the date of initial infringement but using knowledge of events which occurred after the initial infringement and which, thus, could not have been known by actual negotiators as of that date"), *vacated on other grounds*, 226 F.3d 1334 (Fed. Cir. 2000). The ultimate source of the quoted material is a Federal Circuit decision, *Fromson v. Western Litho Plate & Supply Co.*, 853 F.2d 1568, 1575 (Fed. Cir. 1988), which today is often interpreted only as permitting evidence of ex post events as circumstantial evidence of ex ante expectations. *See* Gooding, *supra* note 24.

    32.  *See, e.g.*, John C. Jarosz & Michael J. Chapman, *The Hypothetical Negotiation and Reasonable Royalty Damages: The Tail Wagging the Dog*, 16 STAN. TECH. L. REV. 769, 799–803 (2013).

    33.  SEDONA CONFERENCE, COMMENTARY ON PATENT DAMAGES AND REMEDIES: A PROJECT OF THE SEDONA CONFERENCE WORKING GROUP ON PATENT DAMAGES AND REMEDIES (WG9), PUBLIC COMMENT VERSION 15 (2014).

## I. THE CONTINGENT EX ANTE APPROACH

Suppose that a patent owner successfully sues an infringer, and is awarded damages for the infringement. If the patentee and the defendant are competitors, and the patentee can quantify the sales and hence profit it lost as a result of the infringement, the court may award the amount of that lost profit.[34] Alternatively, if there is an established royalty that the patentee normally charges in exchange for licenses, and circumstances indicate that the patentee would have charged that same rate to the defendant, the court may enter judgment in the amount of that established royalty.[35] Most of the time, however, the patentee cannot prove (or chooses not to try to prove) lost profits, and there is no established royalty; in these instances, the court will award a "reasonable" royalty instead.[36] As noted above, a common articulation of the methodology for calculating reasonable royalties involves attempting "to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before infringement began," that is, ex ante.[37] In this Part, we first describe the advantages of ex ante over ex post methodologies generally for purposes of calculating reasonable royalties and then explain why the "contingent ex ante" approach is superior to both.

### A. *Ex Ante Versus Ex Post*

The conventional rationale for the ex ante approach is that it preserves the patent incentive system by ensuring that the patentee is no worse off (but also no better off) than it would have been but for the infringement. This rationale explains both the availability of lost profits, in cases in which the patentee would have excluded the defendant but for the infringement, and the practice of measuring reasonable royalties based on the license fee the defendant would have paid had the defendant licensed the patent ex ante instead of infringing. Both remedies, ideally, restore the patentee to the position it would have occupied if the infringement had never happened and thus prevent infringers from undermining the patent incentive.

By contrast, what we will refer to as a "pure" ex post approach—calculating the royalty based on what the court believes the parties would agree to at some point after the infringer has incurred costs in reliance on its ability to use the infringing technology—risks making patentees much

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34. *See* COTTER, *supra* note 31 at 108–09.

35. *See id.* at 107–08, 108 n.130.

36. *See id.* at 108; *see also* PRICEWATERHOUSECOOPERS LLP, 2014 PATENT LITIGATION STUDY: AS CASE VOLUME LEAPS, DAMAGES CONTINUE GENERAL DECLINE 9–10 (2014) (reporting that reasonable royalties were awarded in 81% of cases in which damages were awarded from 2010–13, and lost profits in 37%).

37. Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009).

better off than they would have been but for the infringement. To illustrate, suppose that prior to the infringement the parties both believe that if the defendant uses the patented invention it will earn $1 million more than it would have earned from using the next-best available noninfringing alternative. This expected incremental profit, $1 million, is the economic value of the patented invention to the defendant at this point in time.[38] Ex ante, we would expect the parties to agree to a royalty that splits this expected incremental profit in some manner that reflects their relative bargaining power—50/50, if they have equal bargaining power. Now suppose instead that the defendant infringes and that judgment is entered for the patentee. If the patentee were now to authorize the defendant's continued use of the invention postjudgment (as it might, under the *eBay* decision),[39] the royalty it could demand would reflect not only a portion of the expected incremental profit from the use of the patent postjudgment but also some portion of the defendant's ex ante sunk costs.[40] An ongoing royalty that reflects these "holdup" costs in addition to the expected incremental profit from the use of the patent confers a benefit on the patentee that is not related to the economic value of the patent. For example, suppose for the sake of simplicity that the defendant could expect to earn $2.2 million in revenue from the use of

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38. *See, e.g.*, FED. TRADE COMM'N, *supra* note 9, at 21 (defining the economic value of the invention as the increase in profit the user "anticipates from using the patented invention compared to the next best alternative").

39. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388 (2006). Post-*eBay*, courts award ongoing, postjudgment royalties when they deny prevailing patent owners injunctive relief. *See* Paice LLC v. Toyota Motor Corp., 504 F.3d 1293, 1315 (Fed. Cir. 2007). In calculating these royalties, the Federal Circuit has instructed district courts to "take into account the change in the parties' bargaining positions, and the resulting change in economic circumstances, resulting from the determination of liability." Amado v. Microsoft Corp., 517 F.3d 1353, 1362 (Fed. Cir. 2008). Unfortunately, the Federal Circuit's rule risks the very problem noted in the text above, namely that the postjudgment royalty will be based in part on holdup costs. It also ignores the fact that, when calculating the royalty due for past (prejudgment) infringement, the trier of fact is told to estimate the amount the patentee and the defendant would have agreed to ex ante, on the assumption that they believed the patent to be valid and infringed. Because a judgment in favor of the patent owner validates this assumption, economic logic suggests that it should *not* alter the postjudgment royalty rate. *See* Mark A. Lemley, *The Ongoing Confusion over Ongoing Royalties*, 76 MO. L. REV. 695, 702–04 (2011); *see also* Christopher B. Seaman, *Ongoing Royalties in Patent Cases After* eBay*: An Empirical Assessment and Proposed Framework*, 23 TEX. INTELL. PROP. L.J. 203, 219–29 (2015) (discussing awards of ongoing royalties and discussing unresolved issues).

40. More precisely, what we refer to in the text above as "sunk costs holdup" arises when the patentee, armed with an injunction, can extract the user's sunk costs plus the opportunity cost of not having chosen a noninfringing alternative ex ante. For a formal analysis, see Norman Siebrasse & Thomas Cotter, *Why Switching Costs Are Irrelevant to Patent Holdup*, COMP. PAT. REMEDIES (Sept. 24, 2015, 6:38 AM), http://comparativepatentremedies.blogspot.com/2015/09/why-switching-costs-are-irrelevant-to_24.html.

the patented invention, at a cost of implementation of $200,000, while the next-best alternative would earn $1.1 million at a cost of $100,000. On these facts, the value of the patented invention is $1 million, and a negotiated royalty should be some portion of that value, divided up in accordance with the parties' relative bargaining power. If, however, the defendant has already invested $200,000 to implement the patented technology and *then* is hit with an infringement suit that may lead to an injunction against the use of that technology, the patentee could extract up to an additional $200,000 from the defendant.[41] That extra $200,000— more precisely, whatever portion of it the patentee bargains for—is simply a windfall to the patentee.

In addition, if the patentee also was entitled to a royalty for past infringement based on what the parties would agree to *now* for the retroactive authorization of the defendant's use, the patentee could attempt to extract the entire ex post value of the invention (or even more, unless constrained by the court).[42] However, this approach threatens to render patent owners systematically better off than they would have been but for the infringement because they would garner the *entire* surplus earned from the defendant's use.[43]

Consequently, the assumption that the parties negotiate ex ante is necessary to ensure that the damages award reflects only the value of the patented invention, and not holdup costs. As the Federal Circuit has explained, a patentee may not "leverage its patent for competitive gain beyond that which the inventive contribution and value of the patent

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41. Intuitively, if the defendant were to abandon the technology, it could earn $1 million from the next-best alternative but would have invested $200,000 in sunk costs, for a net profit of $800,000. If instead it agrees to pay a royalty for the use of the patented invention, it will earn $2 million minus the royalty. The patentee therefore could extract up to $1.2 million ex post, with the extra $200,000—the "holdup" portion of the royalty—representing the infringer's sunk costs. *See id.*

42. For a formal analysis, see Jay Pil Choi, *FRAND Royalties and Injunctions for Standard Essential Patents* 9–10 (Ctr. for Econ. Stud. & Ifo Inst., Working Paper No. 5012, 2014), http://ssrn.com/ abstract=2512789.

43. If we assume that the parties' ex ante estimates of patent value are on average accurate reflections of ex post value, allocating the entire ex post surplus to the patentee clearly makes the patentee better off than it would have been but for the infringement, because in the absence of infringement the parties almost surely would not have agreed to allocate all of the surplus to the patentee. Alternatively, even if the parties' ex ante estimates are not systematically accurate, allocating all of the ex post value to the patentee is still, on average, likely to make patentees better off than they would have been but for the infringement, unless the systematic errors are extremely optimistic or patentees are systematically much better bargainers than implementers. *See infra* text accompanying note 60. If the parties would divide up the expected surplus on a 50/50 basis, for example, the actual surplus would have to be *half* of the expected surplus for the award of actual surplus to equal the royalty the patentee would have bargained for ex ante.

warrant."[44] On this point we agree with the general consensus. Where we depart from some other analysis is that, in our view, this is the *only* justification for the assumption of the ex ante negotiation. That the hypothetical negotiation takes place ex ante is nothing more, and nothing less, than a reflection of the broader principle that the damages award must reflect the value of the patented technology.

One implication of this approach relates to the definition of what it means for a negotiation to be "ex ante." If the negotiated license is to reflect only the value of the technology, and not holdup value, the hypothetical negotiation must take place before the infringer has incurred expenses in reliance on its uses of the infringing technology. That is, ex ante means prior to reliance by the user, and ex post means after reliance. This is how we use these terms in the remainder of this Article.[45] In contrast, the conventional articulation of the willing licensor–licensee framework assumes that the negotiations take place just before the date on which the infringement begins.[46] To the extent that the "just before infringement began" standard is taken literally, however, so that it may imply a negotiation after reliance by the user, it is, in our view, misguided. As we shall see below in the context of SEPs, for example, the hypothetical negotiation is[47] assumed to take place before the standard is adopted, because the holdup problem arises as soon as the standard is adopted. (To be more precise, the holdup problem arises as soon as the user incurs sunk costs in reliance on its ability to access the standard, and strictly speaking under our proposed approach a court should assume that

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44. Apple Inc. v. Samsung Elecs. Co., 735 F.3d 1352, 1361 (Fed. Cir. 2013) (quoting Apple Inc. v. Samsung Elecs. Co., 695 F.3d 1370, 1375 (Fed. Cir. 2012)).

45. If damages are calculated based on what the parties would agree to as of the date of judgment, for example, this is clearly an ex post approach.

46. *See, e.g.*, Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009) (stating that "the hypothetical negotiation or the 'willing licensor-willing licensee' approach, attempts to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before infringement began").

47. At least, the case law thus far has expressed this position, although the Federal Circuit has yet to expressly endorse it. *See* Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901, 913 (N.D. Ill. 2012), *aff'd in part, rev'd in part on other grounds*, 757 F.3d 1286 (Fed. Cir. 2014), *overruled on other grounds*, Williamson v. Citrix Online, LLC, 792 F.3d 1339 (Fed. Cir. 2015) (en banc); *see also In re* Innovatio IP Ventures, LLC, No. 11 C 9308, 2013 WL 5593609, at *19 (N.D. Ill. Oct. 3, 2013) ("Modified *Georgia–Pacific* Factor 9 requires the court to consider the utility and advantages of the patented property over alternatives that could have been written into the standard instead of the patented technology in the period before the standard was adopted."); Microsoft Corp. v. Motorola, Inc., No. C10–1823JLR, 2013 WL 2111217, at *19 (W.D. Wash. Apr. 25, 2013) (stating that "the parties to a hypothetical negotiation under a RAND commitment would consider alternatives that could have been written into the standard instead of the patented technology. The focus is on the period before the standard was adopted and implemented (i.e., *ex ante*)"), *aff'd*, 795 F.3d 1024 (9th Cir. 2015).

the hypothetical negotiation takes place prior to the incurring of these sunk costs. This date could be either before or after the date on which the SSO actually adopts the standard, though the two dates often may be close together.) The conventional approach requires only that the hypothetical negotiation take place prior to the first infringement, so that subsequent acts are deemed to be authorized. Assuming that the negotiation takes place prior to the adoption of the standard in the case of SEPs therefore is not strictly inconsistent with the conventional approach. [48] But neither is that timing justified or explained by the conventional approach; using the date of adoption of the standard rather than the date of first infringement is an ad hoc response to the holdup problem. In contrast, under our approach, using the date of adoption of the standard (or, better yet, the date on which the reliance costs are incurred) follows directly from the basic principle that the damages should reflect only the value of the patent technology. [49]

## B. *Pure Ex Ante Versus Contingent Ex Ante*

The preceding analysis demonstrates the virtues of an ex ante approach to royalties in comparison with an ex post approach; but nothing we have discussed so far necessarily requires the hypothetical ex ante bargain to reflect only the information that was actually available ex ante (what we call the "pure" ex ante approach). [50] So long as the hypothetical

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48.  *Compare* Riles v. Shell Expl. & Prod. Co., 298 F.3d 1302, 1311 (Fed. Cir. 2002) (stating that the hypothetical negotiation takes place "at a time before the infringement began"), *with* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009) (explaining the common approach of ascertaining the royalty "just before" the infringement began).

49.  That said, the "just before infringement began" standard can serve as an approximation of an ex ante approach, with the date infringement began serving as an administrable proxy for the date on which the defendant incurred reliance costs, insofar as the latter often might be difficult to pinpoint with any greater precision. *See* Thomas F. Cotter, *Reining in Remedies in Patent Litigation: Three (Increasingly Immodest) Proposals*, 30 SANTA CLARA HIGH TECH. L.J. 1, 12 n.45 (2013). Administrability concerns notwithstanding, though, we believe that in the context of SEPs, courts should assume the negotiations occur just before the standard is adopted, rather than just before infringement occurs, since the adoption of the standard effectively locks firms in to the chosen standard. Other scholars have made the same point. *See* FED. TRADE COMM'N, *supra* note 9, at 22, 189–91; *see, e.g.*, Jorge L. Contreras & Richard J. Gilbert, *A Unified Framework for RAND and Other Reasonable Royalties*, 30 BERKELEY TECH. L.J. 1451, 1491 (2015); Mark A. Lemley & Carl Shapiro, *A Simple Approach to Setting Reasonable Royalties for Standard-Essential Patents*, 28 BERKELEY TECH. L.J. 1135, 1147 (2013); Taylor, *supra* note 15, at 129–30.

50.  *See* Jarosz & Chapman, *supra* note 32, at 801 (using the same term for this approach). We hesitate to define the pure ex ante approach too precisely, for fear of being accused of setting up a straw person, but in broad terms, the pure ex ante approach contemplates an ex ante hypothetical negotiation in which the parties are assumed to have only the information that would actually have been available to them at that time. There is some variability in exactly what date is taken to be the correct date, *see id.* at 803–05, but it is in any event around the time of the first

negotiation takes place ex ante, the holdup problem is addressed equally well whether the parties are assumed to have only ex ante information, or ex post information as well. To be sure, a pure ex ante approach is one possibility: a court could try to make the hypothetical negotiation resemble, as much as possible, a real negotiation that would have taken place ex ante by restricting the parties' information set to information that was available only as of the date on which the hypothetical negotiations are assumed to have taken place (call this $t_1$). For example, the parties might agree to a $500,000 royalty based on their expectation that the defendant would earn $1 million over and above what it would earn if it used the next-best available noninfringing alternative.

Alternatively, however, a court could imagine a hypothetical negotiation that takes place ex ante but in which the information set consists of all relevant information known to the parties and to the court ex post, i.e., as of the date of judgment ($t_2$). Under this latter approach, the court tries to replicate the ex ante bargain the parties would have reached contingent on the state of the world being as it is at $t_2$ (which is why we refer to this approach as the "contingent" ex ante approach). In other words, if at $t_2$ it is proven that the defendant earned $1,500,000,[51] instead of $1,000,000, the court would estimate what royalty the parties would have agreed to contingent ex ante on the defendant's earning $1,500,000 from the use of the patented invention. (With equal bargaining power, the answer is $750,000.) If instead the defendant earned only $500,000, the royalty would be adjusted downward (with equal bargaining power, to $250,000). Holdup is avoided under either approach.

Although the contingent ex ante approach might seem less "real" than the pure ex ante approach, it is important to note that *both* approaches are fictions—that's what a "hypothetical negotiation" means[52]—and that the

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infringement. The exact date is not a key feature distinguishing the pure and contingent ex ante approaches, except in relation to sequential infringement. *See infra* Section II.C.

51. That is, $1,500,000 over what the defendant would have earned, ex post, from using the next-best noninfringing alternative. The difficulty of estimating what the defendant would have earned (or expected to earn) from the use of some alternative technology is an unavoidable feature of any approach, including both pure ex ante and pure ex post, which focuses on the value of the patented invention over an alternative the defendant did not actually choose.

52. Courts have long recognized that the hypothetical negotiation is an artificial construct. For example, in *United States Frumentum Co. v. Lauhoff*, 216 F. 610, 617 (6th Cir. 1914), an important early case affirming the availability of reasonable royalties, the court stressed that a reasonable royalty "is not, in precise terminology, a royalty at all" but is merely the term used to assess damages based on general evidence "in a case where the clearer criteria did not exist." *See* Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1554 n.13 (Fed. Cir. 1995) (en banc) (highlighting the artificiality of the willing licensor–willing licensee framework); Fromson v. W. Litho Plate & Supply Co., 853 F.2d 1568, 1575 (Fed. Cir. 1988) (referring to the "fantasy" of imagining "what warring parties would have agreed to as willing negotiators"), *overruled on other grounds by*

courts should employ the fiction that best serves the goals of the patent system. By most accounts, the principal goal is to promote the social good by encouraging individuals to create and disclose new inventions that otherwise would not be created and disclosed, or that would be created and disclosed only at higher cost or with greater delay.[53] Of course, patents are not the only means available for inducing creation and disclosure. Governments and private organizations sometimes award inventors prizes and grants, for example, instead of exclusive rights to their inventions, with the advantage being that there is no resulting monopoly control over those inventions.[54] One disadvantage, though, is that the entity awarding the prize or the grant must decide in advance what sorts of projects are worth encouraging, and how much of a prize or reward will suffice to induce the invention. By contrast, a patent system offers exclusive rights to anyone who develops a new, useful, and nonobvious invention of any sort, and then leaves it up to the market to determine what value, if any, these inventions have. Put another way, patent systems are decentralized, in the sense that individual inventors and the firms that employ them decide what inventive projects to invest in; and consumers, by deciding whether they are willing to pay for the products that incorporate those inventions, ultimately decide the value of those inventions. Taking the analysis one step further, if we assume (as the patent system does) that market value correlates with social value,[55]

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Knorr-Bremse Systeme Fuer Nutzfahrzeuge v. Dana Corp., 383 F.3d 1337 (Fed. Cir. 2004); Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1159 (6th Cir. 1978) (stating that the determination of a reasonable royalty after infringement "rests on a legal fiction").

53. For discussion and citation to some of the relevant literature, see COTTER, *supra* note 31, at 25–28.

54. *See id.* at 26.

55. We recognize that market value and social value are not identical. The social value of some inventions in terms of their contribution to human well-being may far exceed their market value, as measured by consumers' willingness to pay. In theory, prizes and grants could be better at encouraging the development of these types of inventions than is the patent system. *See* Benjamin N. Roin, *Intellectual Property Versus Prizes: Reframing the Debate*, 81 U. CHI. L. REV. 999, 1029–30 (2014). To the extent, however, that social value is reflected in market value, the market value we have in mind is consumer surplus. A patentee normally cannot capture the full consumer surplus because doing so requires perfect price discrimination, which is not possible. *See id.* at 1024. (This is so whether or not ex post information is used to calculate patent value and thus has no effect on the choice between the two approaches discussed in the text above.) In addition, the patentee will often share the surplus that can be captured with a licensee such as a manufacturer or distributor. That division of the surplus normally reflects some contribution made by the licensee that is necessary to the success of the patented invention, such as marketing, or risky investment in invention-specific manufacturing equipment. As others have noted, innovation—the commercialization of invention—is not the same as invention itself, and merely taking the invention to the point of patenting and no further is not sufficient to deliver the intended social benefit of the patent system. *See, e.g.*, Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 353–54 (2010). The other factors that are necessary to commercial success of a

it is fair to state that the patent system is intended to motivate inventors to create and disclose new inventions that will have substantial social value.

If this reasoning is correct, several observations follow. The first is that remedies, including damages, should support the incentive system sketched out above by ensuring that inventors receive appropriate compensation for their inventions. Second, in determining what appropriate compensation is, it is important to recognize that the ultimate goal is not to enrich inventors, but to provide them with an incentive to innovate for the social good.[56] Rewarding inventors is a means, not an end. Third, it follows from these premises that the compensation awarded inventors should be commensurate with the invention's market, and hence social, value.[57] An inventor who creates something that consumers do not want, or for which there are better substitutes, should receive much less than someone whose invention substantially advances the state of art. Fourth, in general one would expect actual licenses, voluntarily negotiated by the parties without resort to the courts, to reflect informed actors' best estimates of the market value of the licensed inventions. Fifth, if this last premise is correct, the pure ex ante approach to reasonable royalties serves the patent system by (ideally) recreating exactly what would have happened but for the infringement. If the patentee would have licensed the invention to a willing licensee in the position of the defendant, the patentee receives (what the court estimates to be) the value of that license. This award preserves the patent incentive by providing compensation that should reflect actual market value, and which therefore should be commensurate with social value.

It is one thing to note that restoring the but-for world generally serves the purpose of providing compensation that is commensurate with the value of the invention; it is quite another to elevate restoration to a foundational principle in its own right. To do so mistakes the means for the end. Going back to our example from above, suppose that ex ante the parties would have believed that using the patent would increase the defendant's profits by $1 million. Ex post, things may turn out better or

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patented invention require their own reward. *See infra* Subsections I.C.3, II.E.1. Finally, a longer-term view of social value would include not just static but also "dynamic" or long-run efficiency, which itself depends on innovation. Arguably a system that would allow the patentee to extract all of the social value of an invention would undermine dynamic efficiency by unnecessarily increasing transaction costs and reducing spillover benefits. *See* Frischmann & Lemley, *supra* note 20, at 268, 278.

    56.  *See, e.g.*, Sichelman, *supra* note 9, at 529 (arguing that the "aim of patent law is optimally promoting innovation, not protecting private harms"); Taylor, *supra* note 15, at 116–17 (citing other sources that support the proposition that reasonable royalties should provide incentive for patent owners to invent and nothing more).

    57.  *See supra* note 55.

worse: for example, the patent actually may earn the defendant an added $1,500,000, or only $500,000. Either way, the contingent ex ante approach better correlates the patentee's reward with the invention's actual social value as disclosed by subsequent events. If the invention is more valuable than the parties expected, the patentee receives a greater reward; if it is less valuable, she receives a lesser one. By contrast, the pure ex ante approach confers an award that reflects the parties' ex ante *mistakes*, potentially resulting in either a modest award for a highly valuable invention or an undeserved windfall for a relatively useless one. The problem may be magnified if, as is perhaps more likely, the parties' ex ante estimates of patent value would not have been identical.[58] As we will see, for example, under the pure approach, it is possible for the patentee to receive much less than the true value of the invention solely because the *infringer* is mistaken ex ante about the patent's value, even though the patentee is not.[59]

To be sure, in principle, the pure ex ante approach and the contingent ex ante approach will both provide exactly the same incentive to invent so long as the ex ante expectations of the parties are systematically accurate; inaccuracies in individual cases would, in the aggregate, cancel each other out. Behavioral economics, however, suggests that it is overly optimistic to suppose that the parties' expectations are systematically accurate.[60] In any event, the parties' expectations cannot possibly be *more* accurate than the actual value as revealed with full information. The contingent approach must be at least as good as the ex ante approach, and barring heroic assumptions about rationality, it is almost certainly superior because it more accurately reflects the true value of the invention.

In addition, even if the parties' expectations are accurate on average, which is unlikely, the fact that they are inaccurate in individual cases implies that the contingent approach is also more efficient when courts award ongoing reasonable royalties in lieu of an injunction. If a court uses the pure ex ante approach, then the royalties may be too high or too low relative to the value contributed by the invention.[61] For example, suppose

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58. For example, if the patent owner estimates that the defendant will earn $2 million and the defendant estimates it will earn only $1 million, a deal (if one is struck at all) will be for less than $1 million. If the estimates are the other way around, the deal will tend toward the higher figure. Depending on whose estimate is better, the patentee's earning will be closer or farther away from the invention's social value.

59. *See infra* Section II.D.

60. *See* Russell Korobkin, *Libertarian Welfarism*, 97 CAL. L. REV. 1651, 1655–56 (2009) (citing some of the relevant literature); *cf.* Gregory Mitchell, *Why Law and Economics' Perfect Rationality Should Not Be Traded for Behavioral Law and Economics' Equal Incompetence*, 91 GEO. L.J. 67, 76–78 (2002) (arguing in favor of a more empirically grounded approach to rationality and against unreflectively assuming systematic rationality or irrationality).

61. *See supra* note 39.

the parties believed that a particular invention would be a very attractive feature of a product such as a smartphone and so would have negotiated a substantial royalty; but that by the time of trial, it is apparent that consumers are entirely indifferent to the feature. If the feature is difficult to design around in the near term, consumers wind up paying a substantial royalty for a feature they do not want–and which we know they do not want–and this will depress demand and inefficiently restrict distribution of the device.

In summary, the patent system is intended to encourage the production of valuable inventions by providing a reward that is commensurate with the invention's social value. Using ex post knowledge about the actual value of the invention provides a more accurate incentive. It is true that in the great majority of cases, where the parties actually license rather than infringe, they bargain using only ex ante information, and consequently damages assessed using ex post knowledge will be different from the reward that would have been gained from the actual negotiation. But the incomplete information encountered in actual negotiations is not in itself a desirable feature that merits emulation and encouragement. Actual licenses are desirable despite the fact that they provide an imperfect reward because the administrative and holdup costs associated with attempting to assess all licenses with ex post information would create even worse problems. The reward is less perfect with actual licensing, but the transaction costs are much lower, so that on the whole actual licensing is better than litigation. But if litigation has actually occurred, it is better to use the most accurate information available in assessing the patent reward.

## C. *Additional Reasons to Prefer the Contingent Ex Ante Approach*

Although the principal reason for preferring the contingent to the pure ex ante approach is that the former better correlates rewards with social value, there are several other reasons why the contingent approach is superior. Among these are, first, that the contingent approach provides a unified explanation for certain features of existing law; second, that it reduces adjudication costs; and third, that it ensures that patentees will "pay" only for services actually provided by the infringer.

### 1.  Unified Explanation

First off, the contingent approach provides a unified explanation for certain features of existing law that otherwise can be justified only on an ad hoc basis. As noted in the Introduction, for example, for purposes of determining reasonable royalties, courts assume that the parties to the hypothetical negotiation believed the patent in suit to be valid and infringed, even though ex ante there usually would be some doubt as to both validity and infringement; validity and infringement can only be

conclusively established through litigation.[62] The conventional explanation for this assumption is that it is necessary to avoid a double-discounting problem. To illustrate, suppose that the parties would agree to a $1 million royalty ex ante if they knew the patent to be valid and infringed, but in reality they each believe there is only a 70% probability of validity and an independent 80% probability of infringement. The license they would actually negotiate would be appropriately discounted, to $560,000. If the defendant infringes, however, and the patentee files suit, the patentee knows that it only has a 56% chance (70% x 80%) of obtaining a favorable judgment. If the *amount* of a favorable judgment is the actual $560,000 the parties would have negotiated, the patentee's expected payoff from going to trial is only $313,600 (56% x 560,000), which means that she can expect to be worse off as a result of the infringement (in comparison with having licensed the patent). The assumption of validity and infringement corrects for this problem by awarding the patentee $1 million if she prevails, so that her expectation pretrial is $560,000, exactly the amount she would have agreed to ex ante.[63] While we have no quarrel with the economic logic of the preceding analysis, the assumption of validity and infringement follows directly and more simply from the contingent ex ante approach. $1 million is the royalty the parties would have agreed to ex ante had they *known*—not just made probabilistic determinations—that the patent was valid and infringed.

A similar analysis can be used to justify awards of running royalties. Outside the litigation context, licensors and licensees sometimes agree that the licensee will pay, in lieu of a lump-sum, paid-in-full royalty, a periodic royalty consisting of an agreed-upon rate multiplied by the dollar value of an agreed-upon base, the value of which base is determined ex post (for example, annual sales revenue).[64] Courts often mimic this approach when awarding reasonable royalties by awarding a reasonable royalty determined by an ex ante rate multiplied by an ex post base.[65]

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62. Empirical evidence indicates that over 40% of all patents that are litigated to judgment are found to be invalid, and that patentee win rates hover around the 30% mark. *See* John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1787 (2014).

63. *See* Kalos & Putnam, *supra* note 25, at 4; *see also* Jay Pil Choi, *Alternative Damage Rules and Probabilistic Intellectual Property Rights: Unjust Enrichment, Lost Profits, and Reasonable Royalty Remedies*, 21 INFO. ECON. & POL'Y 145, 155 (2009) (arguing that the use of ex post information is necessary to cure this problem); Taylor, *supra* note 15, at 115–16 (noting that there is also a circularity issue in that the discounted value negotiated by the parties is reflected in the damages award and knowing this, the parties further discount the negotiated price, and so on).

64. There are various reasons why the parties might prefer a running royalty to a lump-sum (paid-in-full) royalty and vice versa. *See infra* Part II; *see also* Ted Hagelin, *Valuation of Patent Licenses*, 12 TEX. INTELL. PROP. L.J. 423, 425–27 (2004) (discussing and providing an illustration of the "25 Percent Rule running royalty rate").

65. *See supra* note 24 and accompanying text.

Again, the practice is fully consistent with the contingent approach: the court is constructing the royalty the parties would have agreed to ex ante, had they been able to foresee the extent of the infringer's sales.

To be sure, one could view the practice of awarding reasonable royalties on a "running" basis as consistent with the pure ex ante approach, to the extent it is the approach the parties themselves would have agreed to ex ante. The contingent approach nevertheless provides a single rationale for both the assumption of validity and infringement and for awards of running royalties. It also suggests that courts could award running royalties even when there is no evidence from which to determine whether the parties would have negotiated a running or a lump-sum royalty, a practice that would be harder to justify on a pure ex ante basis.

Finally, the contingent approach is consistent with Justice Cardozo's discussion of the "book of wisdom" principle in *Sinclair Refining*.[66]

> To correct uncertain prophecies in [assessing damages] is not to charge the offender with elements of value non-existent at the time of his offense. It is to bring out and expose to light the elements of value that were there from the beginning.
>
> . . . . An imaginary bid by an imaginary buyer, acting upon the information available at the moment of the breach, is not the limit of recovery where the subject of the bargain is an undeveloped patent. Information at such a time might be so scanty and imperfect that the offer would be nominal. The promisee of the patent has less than fair compensation if the criterion of value is the price that he would have received if he had disposed of it at once, irrespective of the value that would have been uncovered if he had kept it as his own.[67]

Our argument is that these statements are correct, for the right reasons, when taken at face value. The first quoted paragraph encapsulates our argument for the use of ex post information, which is that it more accurately captures the true value of the invention. The second quoted paragraph explicitly contemplates that even if the bargain that actually would be struck at the time of the breach would be for a very small amount, the appropriate measure of damages is the higher amount reflecting the value that would later have been uncovered. This is consistent with the contingent approach and inconsistent with the pure ex ante approach.

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66. Sinclair Ref. Co. v. Jenkins Petroleum Process Co., 289 U.S. 689, 698–99 (1933).

67. *Id.*

It is true that *Sinclair* can be reconciled with the pure ex ante approach by interpreting it to mean that ex post information should be used solely as a proxy for ex ante expectations.[68] Indeed, there are numerous lower court decisions that either expressly or implicitly interpret *Sinclair* in precisely this manner.[69] But our interpretation of *Sinclair* is more straightforward: it means exactly what it appears to say on its face. Moreover, the contingent ex ante approach accounts for the use of ex post information much more directly, as evidence of the value of the invention, and thus offers a simpler and more elegant unifying theory of various aspects of the law of damages.

## 2. Adjudication and Error Costs

A second reason to favor the contingent ex ante approach, which follows from the discussion above, relates to administrability; rather than trying to construct the parties' ex ante expectations of the invention's profitability, the trier of fact can employ real, ex post, information instead. The use of real information, where it is available, should reduce both adjudication costs (because it's easier to prove real numbers than hypothetical ones) and error or uncertainty costs (for the same reason). More subtly, the contingent approach also may reduce adjudicative costs by discouraging persons with patents that had probabilistic value ex ante but prove to be worthless ex post from litigating.[70] This selection bias in the mix of cases parties will litigate also is beneficial if, as we argued above, there is no good reason to confer a substantial reward on patents that turn out to have little value.[71]

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68.  *See* Gooding, *supra* note 24 ("In general, the cases establish that the only purpose of the book of wisdom is to permit consideration of ex post data that constitute inferential evidence of a particular value determined in the past.").

69.  *See, e.g.*, Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1333–34 (Fed. Cir. 2009); Fromson v. W. Litho Plate & Supply Co., 853 F.2d 1568, 1575–76 (Fed. Cir. 1988), *overruled on other grounds by* Knorr-Bremse Systeme Fuer Nutzfahrzeuge v. Dana Corp., 383 F.3d 1337 (Fed. Cir. 2004).

70.  This assumes that persons holding patents that ex ante appeared to have low value but that ex post are shown to have high value will be likely to sue under either approach—a reasonable assumption, we think, as long as injunctive relief or substantial ongoing royalties are potentially available.

71.  By contrast, a pure ex ante approach could marginally *undermine* the incentive to invent. Even assuming that the parties' estimates of the value of the invention are correct on average, on the pure ex ante approach an individual patentee whose invention turns out to be more valuable than the parties anticipated will be undercompensated relative to her contribution to the art. The average incentive to invent therefore will be maintained only if individual patentees whose inventions turn out to be less valuable than anticipated also sue successfully and are awarded damages that are over-compensatory in the individual case. Cases such as *Monsanto* notwithstanding, one might wonder whether courts often would be willing to award damages that are clearly over-compensatory in specific cases, even if such awards are required by legal

2016]DETERMINING REASONABLE ROYALTIES IN PATENT LITIGATION 953

That said, we recognize that there may be cases in which the use of ex ante information is superior because evidence of ex post information is poor, nonexistent, or otherwise extremely costly to obtain. If a court had clear evidence of the parties' ex ante expectations, for example, but for some reason could not obtain an accurate estimate of the number of sales the defendant actually made ex post, it clearly would be better to use the ex ante information than to blindly guess about ex post. In Part II, we provide some specific examples of when, contrary to general expectations, the pure ex ante approach may generate lower adjudicative and other administrability costs.[72] Nevertheless, in the general run of cases, the contingent ex ante approach should reduce those costs. In either case, there is a single overarching principle: the courts should use the information that best reflects the true value of the invention.

### 3. Payment for Services Rendered

For reasons that parallel parts of the analysis above, some commentators have argued in favor of abandoning the hypothetical negotiation framework altogether.[73] While we agree with many of the

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principle and necessary to maintain the incentive to invent on average. In any event, a direct implication of the pure ex ante approach is that a patentee should receive a substantial damages award if the parties thought the invention was valuable at the time of the hypothetical negotiation, even if the invention turns out to be entirely worthless. This seems pointless as a matter of patent policy and generates unnecessary adjudicative costs to boot.

72. *See infra* Section II.H.

73. *See* Jarosz & Chapman, *supra* note 32, at 810–12 (proposing, however, the "continued consideration of a *hypothetical license* heuristic as a means to evaluate the reasonableness of a proposed damages award" based on incremental benefits, licensing comparables, and design-around costs); SEDONA CONFERENCE, *supra* note 33, at 15 (proposing that courts should consider "what fully informed and reasonable persons in the position of the patent owner . . . and the infringer would agree to at the time of trial"); *see also* 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, 1028–31 (1999) (proposing that awards of "partial damages" equal to a substantial but less than 100% portion of the patentee's loss would increase social welfare while maintaining incentives); Bernard Chao, *The Infringement Continuum*, 35 CARDOZO L. REV. 1359, 1365 (2014) (emphasizing the need for damages to optimize incentives for innovation); Sichelman, *supra* note 9, at 552, 554 (arguing that, ideally, courts would align ex ante and ex post incentives, that is, award damages sufficient to maintain the patent incentive, which could be higher or lower than the patentee's but-for damages).

By contrast, in a recent paper Greg Sidak argues that courts only should consider ex ante value because otherwise defendants will have a "free option to infringe" and pay relatively low damages whenever the ex post world reveals that the invention was less valuable than would have been assumed ex ante. *See* J. Gregory Sidak, *How Relevant Is Justice Cardozo's "Book of Wisdom" to Patent Damages?*, 17 COLUM. SCI. & TECH. L. REV. 256, 286 (2016), https://www.criterioneconomics.com/docs/justice-cardozos-book-of-wisdom-and-patent-damage s.pdf. As we demonstrate in the text above, however—and as Sidak himself recognizes—the damages awarded under a contingent ex ante approach could be lower *or higher* than under the

specific criticisms levelled at the hypothetical negotiation construct,[74] we are inclined to think that it is better to fix the hypothetical negotiation framework than to abandon it.[75]

One reason for retaining the hypothetical negotiation construct is largely negative: it must be made to serve at least until something better comes along. For example, Professor Ted Sichelman argues that patents are intended to promote innovation but that the current remedial structure is "fundamentally flawed" because of its focus on the essentially private goal of making the patentee whole.[76] He argues that the courts should therefore deviate from "make-whole" damages when necessary to align the remedy with the optimal incentive to innovate.[77] Doing so would be informationally very demanding, however, as Professor Sichelman acknowledges.[78] While we agree that the focus of patent damages should be on promoting innovation rather than making the patentee whole, our proposal is both more modest—it preserves the basic structure of the "make-whole" remedy—and more tractable—it would make assessment of damages easier, not more complex.

This leads us to our second, and more positive, argument in favor of the hypothetical negotiation framework. In broad terms, a common economic approach to reasonable royalties posits that one would first determine the incremental profit due to the patented invention as compared with the next best noninfringing alternative, and then split that incremental profit between the parties.[79] In an actual license agreement,

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pure ex ante approach; and in our view, awarding damages in excess of the patent's worth as revealed ex post, which Sidak appears to approve, is a shortcoming, not a desirable aspect, of the pure ex ante framework. Moreover, in other work one of us has critiqued an earlier statement of Sidak's "free option" argument for failing to account for other factors that may deter infringement even if royalties are set at the amount willing parties themselves would have negotiated. *See* Thomas F. Cotter, *Patent Holdup, Patent Royalties, and Antitrust Responses*, 34 J. CORP. L. 1151, 1183–84 n.157 (2009). For analogous reasons, we disagree with Mr. Lee and Professor Melamed's argument that ex post information necessarily leads to higher damages awards. *See* William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385, 412, 416 (2016).

    74.  *See, e.g.*, Jarosz & Chapman, *supra* note 32, at 785–89 (critiquing certain aspects of the hypothetical ex ante bargain approach).

    75.  For example, it is understood that the parties to an actual negotiation will take into account uncertainty as to the validity of the patent, but it is now established law that the parties to the hypothetical negotiation should assume that the patent is valid and infringed. *See supra* note 63 and accompanying text. We view our proposal that ex post information should be taken into account as an improvement to the hypothetical negotiation construct in a similar vein.

    76.  *See* Sichelman, *supra* note 9, at 566.

    77.  *See id.* at 566–67.

    78.  *See id.* at 564–66.

    79.  *See* Suzanne Michel, *Bargaining for RAND Royalties in the Shadow of Patent Remedies Law*, 77 ANTITRUST L.J. 889, 901 (2011); Zelin Yang, *Damaging Royalties: An Overview of Reasonable Royalty Damages*, 29 BERKELEY TECH. L.J. 647, 671 (2014) (discussing incremental

both parties bring something to the table in the process of turning an invention into a commercially valuable revenue-generating product. The patentee's most obvious contribution is the invention, but bringing the final product to market generally requires further development and technical implementation, such as clinical trials, as well as marketing, manufacturing, and distribution, all of which require further investment at risk beyond the investment made by the patentee in the invention itself. Either of the parties may provide these further services, and the way the parties split the incremental profit in an actual negotiation depends on who provides what services and the relative importance and cost of those services. As is correctly reflected in the *Georgia-Pacific* factors, the hypothetical negotiation construct ensures that the provision of these services will be taken into account for purposes of awarding reasonable royalties, just as they are taken into account by the parties to an actual negotiation.[80] In our view, this means ensuring that the contribution made by the infringer to the incremental profit from sales of the patented invention is recognized, as well as the patentee's contribution of the invention itself.

With regard to services provided by the infringer, however, the contingent ex ante approach does a better job than does the pure ex ante approach in ensuring that the patent owner "pays" only for services the infringer actually provides, and not for services it doesn't. For example, suppose that the infringer's marketing efforts result in the patented invention being much more widely used than the parties would have

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profits and noting that "a patent is only as valuable as what it is able to contribute over the next-best non-infringing alternative").

80. *See* Georgia-Pacific Co. v. U.S. Plywood Co., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (listing, as factor number 13, "[t]he portion of the realizable profit that should be credited to the invention as distinguished from non-patented elements, the manufacturing process, business risks, or significant features or improvements added by the infringer"), *modified on other grounds*, 446 F.2d 295 (2d Cir. 1971). *See also* U.S. Frumentum Co. v. Lauhoff, 210 F. 610, 617 (6th Cir. 1914) ("The jury can learn how much of the realizable profit should be credited to the manufacturing process and business risk and how much to the patent, also, what share of the profits or of the selling price it may be customary in that or similar business to allow for the use of such an invention."); Jarosz & Chapman, *supra* note 32, at 815−16; Mark A. Lemley, *Distinguishing Lost Profits from Reasonable Royalties*, 51 Wm. & Mary L. Rev. 655, 663 (2009); Eric E. Bensen & Danielle M. White, *Using Apportionment To Rein in the* Georgia-Pacific *Factors*, 9 Colum. Sci. & Tech. L. Rev. 1, 47 (2008); Ted Hagelin, *Valuation of Patent Licenses*, 12 Tex. Intell. Prop. L .J. 423 (2004). Other countries' laws recognize the point as well. *See, e.g.*, Thomas Kühnen, Patent Litigation Proceedings in Germany 542 (6th ed., Frank Peterreins trans., 2013) (noting that among the factors that counsel in favor of reducing royalty damages is "the achievement of particularly high turnover levels . . . if the high turnover is attributable to the fact that the infringer is a company of repute (with the corresponding financial muscle, advertising, manufacturing capacity and distribution organization and corresponding customer service and corresponding business connections)").

expected ex ante. The profit earned from the unauthorized use therefore will be higher than expected, and under the contingent ex ante approach, the patentee should receive some of the benefit of that unanticipated success. At the same time, the rate also should reflect the provision of marketing services by the infringer, whether the parties themselves would have foreseen them ex ante or not; otherwise the *infringer*'s incentive to efficiently market products is marginally reduced. By contrast, if an actual licensee similarly situated to the infringer would have provided marketing services for the invention, but the infringer did *not* do so, a court should be careful in using a license that requires licensees to perform these services as evidence of the ex ante deal the patentee and infringer would have struck.[81] Otherwise, the infringer in effect receives payment for services it never provided simply because the parties would have anticipated that an authorized licensee would.[82]

As with our running royalty example, one might argue that even under the pure ex ante approach this latter result is avoided *if* it is clear that the parties would have negotiated a royalty that reflects only the value of services that the infringer actually provided. Our approach, however, allows courts to reach this result without having to consider whether, on the information set they would have had before them ex ante, the parties actually would have negotiated such terms, explicitly or implicitly. The pure ex ante approach, in contrast, would either permit the use of ex post information only on an ad hoc basis, or risk paying the infringer for services that it did not provide.

There is a more general point to be made. Whether the reasonable royalty is assessed using the hypothetical negotiation construct or by some other methodology, the incremental profits made available by the patented technology must be split between the parties according to their relative contribution to the commercially successful product that embodies the patented technology. Whatever particular methodology is used, the use of ex post information under the contingent ex ante approach provides more accurate compensation for the provision of only those services (including the service of developing the invention!) that were actually rendered, than does a pure ex ante approach, which looks to the contribution that the parties would have expected to make. The contingent ex ante approach allows a better assessment of the true value of the patented invention, and by the same token, it allows a better assessment of the true value of each parties' contribution to the commercially successful innovation.

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81. Courts frequently use comparable licenses for guidance in determining what the patentee and infringer would have agreed to. *See Georgia-Pacific*, 318 F. Supp. at 1120 (discussing factors one, two, and twelve).

82. *Cf.* COTTER, *supra* note 31, at 269 & n.186 (noting that German and French courts may adjust the amount of a reasonable royalty when the infringer has avoided certain risks or costs that a real-world licensee would have shouldered).

In summary, the simple intuition that a patentee should receive a large reward for a valuable invention, and a small reward for a useless one, is correct. There is no good reason why the parties' errors regarding the value of the invention, whether idiosyncratic or systematic, should affect the patentee's reward. With that said, we recognize that there will be instances in which the ex ante and contingent ex ante approaches converge on the same result and that, notwithstanding the contingent approach's greater administrability, there may be specific instances in which administrability cuts in favor of the pure ex ante approach instead. Nonetheless, the point remains that the presumption should be in favor of using ex post information, and any departure from that principle must be specially justified.

## II. SPECIFIC APPLICATIONS

In this Part, we explain a variety of specific applications of the contingent ex ante approach. As we shall see, some of these applications make the most intuitive sense if we emphasize the contingent approach's role in estimating the true value of the patented invention. Others make more intuitive sense if we emphasize how the contingent approach avoids requiring the patentee to "pay" for services not provided by the infringer, while a few fall into both camps. Finally, some fact patterns demonstrate the need to fall back on the pure ex ante approach as a matter of administrability.

We begin with a discussion of SEPs before moving on to consideration of the impact of unexpected exogenous events, separate and distinct infringements, regulatory uncertainty, lump-sum versus running royalties, and noninfringing alternatives. We conclude with some thoughts on administrability.

### A. *Standard Essential Patents*

As noted in the Introduction, although SSOs typically require their members to commit to licensing their SEPs on a FRAND basis, to date most SSOs have not attempted to define what a FRAND royalty is or how it should be calculated.[83] Our analysis so far, however, has suggested that courts faced with the task of determining what a FRAND royalty is in a given case should avoid the pure ex post approach—that is, calculating

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83. *See supra* note 17 and accompanying text. One notable exception is the Institute of Electrical and Electronics Engineers, which recently amended its bylaws relating to FRAND royalties in certain respects. INST. OF ELEC. AND ELECS. ENG'RS STANDARDS ASS'N, *supra* note 16, § 6.1; Siebrasse & Cotter, *supra* note 19, at 9, 43–44, 50 (discussing the new bylaw's requirement that a FRAND royalty should comprise "appropriate compensation to the patent holder for the practice of an Essential Patent Claim excluding the value, if any, resulting from the inclusion of that Essential Patent Claim's technology in the IEEE Standard").

the royalty based on what reasonable parties would agree to after the infringer has incurred costs in reliance on the infringing technology—because that approach would enable the patent owner to extract value that is unrelated to the invention's contribution to the state of the art. This is consistent with the general trend of the scholarship and case law so far.[84] As discussed above, as a general matter the ex post approach would allow the patent owner to extract a royalty that is based in part on the infringer's sunk costs, which bear no relationship to the value of the invention over that alternative.[85] For products that incorporate hundreds or thousands of SEPs, such royalties may be wildly disproportionate to the value of the invention.[86]

The preceding analysis implies that in assessing royalties for the infringing pre- and postjudgment use of SEPs, courts should avoid holdup by assuming that the hypothetical negotiation on which the royalty is based takes place before the user has incurred costs in reliance on the infringing technology. The question nevertheless remains whether the pure or contingent ex ante approach is preferable for calculating FRAND royalties. As we have seen, under the pure approach the goal is to restore the patentee to the position it would have enjoyed but for the infringement, so that the hypothetical negotiations take place subject to whatever uncertainties would have confronted the parties ex ante.[87] The contingent approach, in contrast, attempts to replicate the bargain the parties would have made ex ante, subject to full information regarding patent value.[88] Because both approaches assume that the hypothetical negotiation takes place before any reliance on the part of the user, they both avoid holdup. Both therefore are superior to the ex post approach, but the contingent approach better serves the goals of the patent system.

To see the reasons for adopting the contingent approach, consider the kind of contract the parties would enter into if it were practical to do so before the standard was adopted. Assume that a potential user begins incurring costs in reliance on its ability to market a standard-compliant device, whatever standard winds up being adopted, prior to the adoption of the standard, and the user therefore wishes to enter into ex ante licenses to avoid the possibility of being held up. Prior to adoption, the value of any particular potential SEP will be discounted by the fact that it is one of many contenders for inclusion in the standard. (Even a team favored

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84.   *See, e.g.*, sources cited *supra* notes 47, 49.

85.   *See supra* text accompanying notes 38–44.

86.   Since the defendant could not afford to pay another such royalty for the infringement of any other SEP, one might think that the parties and other members of the affected industry would have an incentive to avoid such unsustainable royalty stacking. Maybe so, but even if one could be confident that such efforts would succeed, there is no obvious reason for courts to create a problem that they could avoid simply by using a better valuation technique.

87.   *See* discussion *supra* Section I.A.

88.   *See* discussion *supra* Section I.B.

to win the Super Bowl faces long odds at the start of the playoffs.) In the extreme, the ex ante value of any particular patent might be effectively zero. The result is that because of this discounting problem, a pure ex ante negotiation will not reflect the actual contribution of the patent to the standard. As above, the fundamental principle motivating our analysis is that the damages award should reflect the value of the invention, neither more nor less.

Formally, the problem is exactly the same as the double-discounting problem, which is solved by the assumption that the parties to the hypothetical negotiation know that the patent is valid and infringed.[89] We begin with the simplest possible case. Suppose that an SSO is deciding between two standards: Standard X, which incorporates Patent X, and Standard Y, which incorporates a public-domain technology. Assume further that each SSO member/standard user is allowed to vote on, but cannot by itself control, which standard the SSO will adopt. Ex ante, each user U estimates the probability $p$ that the SSO will choose Standard X or Standard Y and the profit $\pi$ it expects to earn under each scenario. Assume also that Patent X is known to be valid at the time the SSO is choosing the standard, and it is known to be truly essential to Standard X.[90] Finally, assume that each user decides just prior to standard adoption whether to negotiate a license for Patent X. User U's expected payoff from negotiating a license therefore is

$$p_x(\pi_x - R_x) + (1 - p_x)(\pi_y - R_x) = p_x\pi_x + (1 - p_x)\pi_y - R_x \quad (1),$$

where $R_x$ is the royalty the licensee pays to the patent owner. (For simplicity, we assume here that the royalty is a lump sum. Changing it to a running royalty would introduce a mathematical complication that is unnecessary to the point we are illustrating.) U's expected payoff if it does not negotiate a license—and therefore, absent infringement, does not participate in the market at all if the SSO chooses Standard X—sets U's maximum willingness to pay for a license. This is simply

$$(1 - p_x)\pi_y \quad (2).$$

On these facts, and assuming that the patentee's minimum willingness to accept is 0, we would expect the parties to negotiate a license under which $0 < R_x < p_x\pi_x$. We can further define this negotiated royalty $R_x$ as $bp_x\pi_x$, where $b$ is a measure of the patentee's bargaining power and $0 < b < 1$. (Thus with equal bargaining power, $b = 0.5$ and $R_{x = 0.5p_x\pi_x}$.) As

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89. *See* discussion *supra* Subsection I.C.1.
90. This is unlikely to be true in practice, but we make this assumption so that the standard problem of double discounting due to uncertainty regarding validity and infringement does not arise. This ensures that the parallel double discounting problem which we identify is distinct.

a result, and regardless of whether the SSO chooses Standard X or Standard Y, the patent owner's expected licensing revenue from U is

$$R_x = bp_x\pi_x \qquad (3),$$

and U's expected payoff is

$$p_x\pi_x + (1 - p_x)\pi_y - R_x = (1 - b)p_x\pi_x + (1 - p_x)\pi_y \qquad (4).$$

This is the contract the parties would write if they constrained themselves to contract using only information they actually had at the time of ex ante negotiation. It corresponds to the pure ex ante approach of assessing a reasonable royalty.

Alternatively, suppose that contingent contracts are possible and that U agrees to pay $R_x$ only on the contingency that the SSO chooses Standard X. Such a contract effectively allows the parties to use ex post information, and it corresponds to the contingent approach to assessing a reasonable royalty. U's expected payoff from entering into such a contract is

$$p_x(\pi_x - R_x) + (1 - p_x)\pi_y = p_x\pi_x + (1 - p_x)\pi_y - p_xR_x \qquad (5),$$

and its expected payoff from not agreeing to the contract is, as before, $(1 - p_x)\pi_y$. Now we would expect the parties to agree to a contingent license under which $0 < R_x < \pi_x$ and $R = b\pi_x$. U's expected payoff with a contingent contract is

$$p_x\pi_x + (1 - p_x)\pi_y - bp_x\pi_x = (1 - b)p_x\pi_x + (1 - p_x)\pi_y \qquad (6).$$

Even though the royalty for the use of Patent X is higher under the contingent contract if the SSO adopts Standard X ($b\pi_x$, rather than $bp_x\pi_x$), the expected profit to both the user (compare equation 4 and equation 6) and the patent owner ($bp_x\pi_x$) is the same under either approach because the lower payment is paid and received with certainty under the pure approach.[91]

We are now ready to introduce some complications. Suppose that the parties do not negotiate a contract ex ante, the SSO adopts Standard X, U infringes, and a court must determine the appropriate royalty. Should the court award the patent owner $bp_x\pi_x$ (the amount the parties would have agreed to ex ante under the pure approach) or $b\pi_x$ (the amount they would have agreed to under the contingent approach)? The correct answer is the

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91. Of course, the parties may choose one option over the other to shift risk. *See* discussion *infra* Subsection II.E.1.

latter. Under the pure approach, the patent owner's ex ante (pre-adoption) expected revenue if U subsequently infringes her patent is $bp_x^2\pi_x$ because she can expect to receive payment only if the SSO chooses Standard X, the ex ante probability of which is $p_x$. The probability that the SSO will adopt Standard X is reflected twice, once in the probability of actually receiving payment, and again in the court's assessment of damages. This is exactly the problem which justifies the assumption of validity and infringement, with the probability that the SSO adopts the standard, playing the role of uncertain enforcement and validity.[92] Alternatively, if the court awards $b\pi_x$, the patent owner's ex ante expected revenue is $bp_x\pi_x$, exactly what she could have expected to earn if the parties *had* negotiated ex ante.

It is therefore clear that the court should not discount the royalty based on the ex ante probability that the SSO would reject Standard X—assuming that it were even possible to estimate that probability—because doing so would introduce a double-discounting problem and thus make the patent owner worse off than she would have been, absent the infringement.[93] Instead, the court should attempt to construct the royalty the parties would have agreed to ex ante, contingent on the patent in suit being incorporated into the standard.

The question is how this conclusion should be justified. One might attempt to justify it under the pure ex ante approach on the ground that a FRAND commitment is in fact a contingent contract, and that in awarding a royalty of $b\pi_x$, the courts are simply awarding damages based on the contract the parties would have entered into (or, in fact, did enter into)—just as courts routinely award damages based on a running royalty when the facts suggest that the parties would have agreed to such a royalty.[94]

There are two problems with this response. First, it depends on the construction of the particular FRAND commitment or comparable commitments. If the commitment in question is not construed as a contingent contract, then the patent owner would only be entitled to the discounted royalty, thus impairing the patent incentive by providing a reward that is less than the patent's actual contribution. Alternatively, what if the patent in question is in fact essential to the standard but was not declared as such and was not subject to a FRAND commitment? Does this mean that such a patent is entitled to only the discounted royalty

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92. *See supra* note 63 and accompanying text.

93. As stated earlier, restoring the but-for world is not an end in itself, but it often does serve the purpose of ensuring that the patentee receives compensation commensurate with the social value of the invention. *See supra* pp. 14–15. In the present context, the contingent approach may result in a higher or lower value for $\pi_x$ than the parties might have anticipated, but surely there is no reason to think that the double discounting effect the contingent approach eliminates would advance the goal of correlating private and social value.

94. *See, e.g.*, Spectralytics, Inc. v. Cordis Corp., 649 F.3d 1336, 1347 (Fed. Cir. 2011).

because it was not subject to a contingent contract? It seems counterintuitive to suppose that a patent owner who had not made a FRAND commitment should be in a substantially worse position than one who had. A response to this might be to say that all FRAND commitments are necessarily contingent contracts, and for patents that are in fact SEPs, though not declared as such and so not expressly subject to the FRAND commitment, the comparable licenses are also FRAND licenses. In effect, all patents that are in fact SEPs would be deemed subject to a contingent contract. But such an approach would not really be consistent with the pure ex ante approach, which seeks to place the parties in the position they in fact would have been in but for the infringement. An approach that ignores the particular facts to arrive at the result that is correct as a matter of policy amounts to a rejection of the pure ex ante approach, or at best an ad hoc distortion of it.

A second response is to accept the assumption that the parties negotiate with knowledge that the patent will be incorporated into the standard, even though this is not true in fact, but to characterize it as a narrow exception to the general rule against using ex post information, just as one might view the assumption of validity and infringement  as a narrow exception. On this view, this analysis shows only that the reasonable royalty should be calculated on the assumption that the parties knew that the patent would be incorporated into the standard that was adopted, but that it does not compel the conclusion that the parties should be assumed to have had all ex post information, including information about the success of the standard itself and the products incorporating it. The difficulty with this position is that the counterfactual assumption that the parties know the patent will be adopted as part of the standard is purely ad hoc. It has no principled basis in the pure ex ante approach. The pure ex ante approach rests on the principle of compensation, but it cannot justify either the assumption of validity and infringement or the assumption that the patent would be included in the standard, both of which would constitute unprincipled and ad hoc exceptions.

In contrast, in our analysis the assumption that the patent is included in the SEP flows directly from the basic proposition that the parties are assumed to negotiate with knowledge of all ex post information. Exactly as with the assumption of validity and infringement, it reflects one general principle: that the damages should reflect the value of the invention. That same principle justifies using all information about the value of the invention.

Now consider another complication. When a standard is established, the competition is often not between one patented technology and one public domain technology, but between multiple technologies protected

by different patents.[95] On a pure ex ante perspective, the parties do not know which particular patent will be incorporated into the standard.[96] If the parties truly negotiated ex ante, the user would seek a license to all the possible contenders, all on a discounted rate. The aggregate royalties paid by the user would be equal to the expected value of the standard, but the royalty paid to any particular patentee would be the discounted rate reflecting the probability of its adoption. But in fact, the parties do not enter into such widespread speculative licensing ex ante. Moreover, after the standard is adopted, the parties will only litigate the selected patent because the user will not infringe the patents that were not included in the standard. Under the pure ex ante approach, however, the royalty awarded would be calculated on the basis of the discounted rate, with the result that users pay much less in aggregate royalties than they would have paid in the but-for world of the hypothetical negotiation. This follows because damages will be assessed only with respect to the one patent that was actually selected, rather than all the patents that potentially could have been selected and thus would have been subject to (discounted) licenses in the but-for world. In this regard, the pure ex ante approach constitutes a windfall to the infringing user.[97]

On the other hand, sometimes the contingent ex ante approach will result in a lower royalty than would have been awarded under the pure ex ante approach. For example, in *In re Innovatio IP Ventures*,[98] Judge Holderman used a royalty base calculated on the basis of an average chip price of $14.85—rather than a weighted average of $3.99, which would have given more weight to lower chip prices in the period just prior to the standard being established—on the ground that "the hypothetical negotiation must take place in the *ex ante* world . . . without taking into account the success of the standard."[99] Under the contingent ex ante approach, however, the parties are assumed to know all relevant

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95. *See* Siebrasse & Cotter, *supra* note 19, at 26.

96. *See id.* at 29.

97. Note that if "Shapley value" pricing is used, all patented technologies that might plausibly have been incorporated into the standard will be entitled to a royalty proportionate to their potential contribution, whether or not the technology actually becomes part of the standard. *See* Anne Layne-Farrar et al., *Pricing Patents for Licensing in Standard-Setting Organizations: Making Sense of FRAND Commitments*, 74 ANTITRUST L.J. 671, 693–700 (2007). This corresponds roughly to assessing the royalty as being the patent owner's ex ante expected revenue (though the Shapley calculation is not exactly the same). In our companion paper, we propose that an ideal framework for calculating FRAND royalties would apply a variation we refer to as "ex post Shapley pricing" to ensure that the royalty for any given SEP is proportionate to its contribution to the standard. *See* Siebrasse & Cotter, *supra* note 19, at 37–41.

98. *In re* Innovatio IP Ventures, LLC Patent Litig., No. 11-C-9308, 2013 WL 5593609 (N.D. Ill. Oct. 3, 2013).

99. *Id.* at *39–41.

information available at trial, including the fact that chip prices would have continued to drop.[100] Using ex post information in *Innovatio* would have resulted in a lower royalty rate.

We do not purport to address all the difficult questions that arise in assessing a reasonable royalty in the SEP context in this Article. For example, the complementary nature of patents incorporated in a standard makes assessing the value of any individual SEPs a difficult undertaking.[101] This makes it all the more important that the court asks the right question, and our point is that the contingent ex ante framework provides a simpler, more coherent approach to estimating patent value than does the pure approach.

More generally, the court's task is to determine the ex ante value of, say, Patent A contingent on Patent A's incorporation into Standard X, with the awareness that as part of Standard X, Patent A may derive some of its value from its complementarity with other patents in the standard.[102] Importantly, however, this value is distinct from the ex post value of owning an SEP that is difficult or impossible to design around. The contingent ex ante approach therefore attempts to measure that portion of patent value that derives from the patent's incorporation into a standard— a fact that can be estimated with greater accuracy post-adoption[103]—but without enabling the patent owner to extract ex post rents that are unrelated to that value.

## B. *Unexpected Exogenous Events*

A case that starkly illustrates the distinction between the pure and contingent ex ante approaches is *Honeywell International, Inc. v. Hamilton Sundstrand Corp.*[104] Honeywell, the owner of a patent on a

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100. *Id.* at *41.

101. *See* J. Gregory Sidak, *The Meaning of FRAND, Part I: Royalties,* 9 J. COMP. L. & ECON. 931, 953 (2013).

102. Determining what this value is may require the use of proxies, such as appropriate comparable licenses. Nevertheless, it is helpful to recognize what the ideal inquiry would entail to evaluate whether a suggested proxy is more or less consistent with that ideal. For a more complete discussion of our recommended approach to calculating FRAND royalties, with a critique of competing approaches, see Siebrasse & Cotter, *supra* note 19.

103. The contingent ex ante approach attempts to construct the bargain the parties would have reached ex ante with full knowledge of all relevant information revealed ex post, including the value of the patent in suit over the next-best available noninfringing alternative. A court can only estimate the value of the latter. *See supra* note 51 and accompanying text. If the technology actually chosen turns out to be much more (or less) successful than anticipated, it would be necessary to disentangle the degree of success attributable to unanticipated benefits of standardization, which the alternative would presumably have realized, and how much is due to unanticipated benefits of the selection technology, which would not. In any event, the same or analogous difficulties arise under the pure ex ante and pure ex post approaches as well.

104. 378 F. Supp. 2d 459 (D. Del. 2005).

control system used in gas turbine engines, accused the defendant, a direct competitor, of infringing the patent in auxiliary power units (APUs) it supplied under a contract with Embraer, an aircraft manufacturer. [105]   Demand for large regional aircraft increased substantially following the events of 9/11, as a result of which the defendant expected its sales of APUs to increase. The court allowed the plaintiff to use the defendant's 2004–2005 sales projections as a royalty base, even though those projections anticipated a much larger volume of sales than what the defendant would have expected when it began infringing in 2000. [106] The court justified the introduction of this evidence under the book of wisdom. [107] As we have seen, however, one view of the book of wisdom is that it enables the use of ex post events only as evidence of the parties' ex ante expectations and not—as was the case in *Honeywell*—to contradict them. [108] Not surprisingly, advocates of the more restrained understanding of the book of wisdom have criticized this case. [109] In our view, however, *Honeywell* reflects a sound application of the contingent ex ante approach and is correct in its result. Under the contingent approach, the hypothetical ex ante negotiation *should* be based on more accurate (ex post) information about the value of the invention, so that the resulting damages award is more closely correlated with the actual value of the invention.

Two possible objections to our argument are unpersuasive. The first is that, because inventors cannot foresee truly unexpected events, damages awards reflecting such events can have no effect on, and therefore are unnecessary to preserve, the incentive to invent. The observation that one cannot foresee the unforeseeable is, of course, a tautology. But even if we concede that some events are unforeseeable, standing alone the observation suggests only that application of the contingent rule in such cases is unnecessary, not necessarily that it is bad policy. More importantly, foreseeability itself is hardly an all-or-nothing proposition. Although a rule that correlates awards with actual rather than anticipated value sometimes may benefit the lucky, it also will benefit the prescient—inventors who *are* able to foresee changes that others do not. (For all we know, perhaps the patentee in *Honeywell* accurately foresaw an increased demand for regional jets as a result of global instability, even if it could not have anticipated 9/11 specifically.) Whether or not a particular inventor accurately foresaw a particular contingency, the contingent rule provides a strong incentive for inventors to make accurate predictions of the future state of the world. In this sense, it is more

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105.  *Id.* at 462–63.
106.  *See id.* at 463, 466.
107.  *See id.* at 465.
108.  *See* Gooding, *supra* note 24.
109.  *See id.*

consistent with the justification for the patent system in comparison with other means of promoting innovation, namely that patents provide high-powered incentives for private parties to make their best assessment of where future value will lie. The view that the patentee should not be rewarded correspondingly if a court subsequently determines that the patentee would not have foreseen a particular development dilutes the patent incentive by making it turn on an error prone judicial assessment of what the patentee would have foreseen, rather than rewarding the patentee for its actual results.

A second objection is that in cases in which the inventor was not prescient but merely lucky, the contingent approach is undesirable because it renders the inventor better off than she would have been but for the infringement. This objection too is unsound, for several reasons. First, as we have argued above, the fundamental purpose of patent remedies should be to preserve the patent incentive; restoring the status quo often may be a means to that end, but it is not an end in and of itself. If, then, we are correct in arguing that the contingent approach generally does a better job of preserving incentives by rewarding prescience, the fact that non-prescient inventors will sometimes be rendered better off in comparison with the status quo is not by itself a reason to reject that approach. Second, to the extent an exogenous event really was unanticipated, *someone*—either the patent owner or the infringer—winds up enjoying an unanticipated benefit, whether one applies the contingent or the pure approach. The identity of the party who receives that benefit can have no impact on ex ante incentives, however, if the event at issue truly was unforeseeable. If the patentee receives a windfall under the contingent ex ante approach, this is no more objectionable than if the infringer receives a windfall under the pure ex ante approach. The choice between the two approaches therefore should rest on the basis of other criteria. Third, as we hope we have made clear by now, there is no reason to assume that the contingent approach always favors patent owners. One could easily imagine a variation on the facts of *Honeywell* in which the demand for regional aircraft *decreased* after some unforeseen event so that ex post the infringer, rather than the patent owner, would prefer application of the contingent rule. This should dispose of any concern that basing the award on ex post information necessarily increases deadweight loss.[110]

## C. *Separate and Distinct Infringements*

Infringement of a patent may take place over an extended period of time, sometimes under substantially changed circumstances that affect

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110. *See* Jarosz & Chapman, *supra* note 32, at 801 (arguing that reliance on ex ante information may drastically over- or under-compensate the patentee).

the value of the invention. The basic difference between the contingent and pure ex ante approaches is that under the former, but not the latter, these new circumstances will be taken into account in assessing the reasonable royalty. But sometimes the circumstances are so different that the infringements are taken to be separate and distinct, in which case there will be two separate hypothetical negotiations, even under the pure ex ante approach, and the second negotiation can use information that is ex post with respect to the first infringement. The puzzle for the pure ex ante approach is to explain exactly when the infringements are separate and distinct so that "ex post" information can be taken into account. In this Section, we argue that the pure ex ante approach has no satisfactory solution to this puzzle, while the contingent ex ante approach provides a straightforward principled analysis of this scenario.

*Applied Medical Resources Corp. v U.S. Surgical Corp.* (*Applied II*),[111] the leading case on point, illustrates this problem. Applied Medical held a patent on a surgical instrument.[112] In *Applied I*, it successfully sued U.S. Surgical on the basis that U.S. Surgical's Versaport instrument (Versaport I) infringed the patent.[113] Applied Medical was "awarded damages in the form of a 7% reasonable royalty."[114] U.S. Surgical redesigned its Versaport instrument and began selling the redesigned instrument (Versaport II) shortly after the verdict in *Applied I*.[115] Applied Medical sued again on the basis of the same patent.[116] At trial in *Applied II*, the court found that the redesigned instrument infringed Applied's patent.[117] U.S. Surgical, the infringer, sought to argue that the same 7% royalty that had been determined in *Applied I* should also be used in *Applied II*.[118] The Federal Circuit rejected this argument, saying "reasonable royalty damages are not calculated in a vacuum without consideration of the infringement being redressed. We are required to identify the infringement requiring compensation, and evaluate damages based on a hypothetical negotiation at the time that infringement began, not an earlier one."[119] In our view the Federal Circuit was correct to hold that the royalties might be different, and the question is how to best explain this result.

111.  435 F.3d 1356 (Fed. Cir. 2006).
112.  *Id.* at 1358.
113.  *See id.*
114.  *Id.*
115.  *Id.*
116.  *Id.* at 1359.
117.  *Id.*
118.  *Id.*
119.  *Id.* at 1361.

The pure ex ante approach can provide what appears at first glance to be a straightforward explanation of this holding: if there are two separate infringements, then information that was ex post in the first may be ex ante in the second, and so available to the hypothetical negotiators.

The difficulty for the pure ex ante approach is in explaining when infringements should be considered to be separate. One point the court noted in holding that the infringements were distinct is that the sales of the Versaport I and II began at "separate and distinct times."[120] But this cannot be a determinative factor. In the first place, the infringement was continuous in time, so the putatively separate timing of the infringement expressly did not turn on any temporal break in the infringement.[121] Conversely, even if there were a temporal break in the infringement, this presumably would not suffice on its own to establish two distinct infringements; if the infringer had temporarily stopped shipping the Versaport I, perhaps because of the bankruptcy of a parts supplier or a fire at its plant and then resumed selling exactly the same instrument, it is difficult to see how this could constitute separate and distinct infringements. The reasonable royalty should not depend on events that are unrelated to the infringement. And clearly the separate timing of the sales cannot depend on the name of the infringing product; a simple rebranding of the infringing device would not suffice to make subsequent sales of the rebranded product a separate infringement.

A more promising approach is to focus on the redesigned product itself. The Federal Circuit pointed out that by U.S. Surgical's own admission, the redesigned instrument was substantially improved and different from the original instrument, even though both incorporated the patented invention.[122] Again, however, it is difficult to see how this could be determinative. Suppose exactly the same instrument were sold but after a hiatus of several years, during which market conditions had changed substantially. Should we say there was only one infringement because the product itself was the same? Conversely, if many small improvements were gradually made to the original instrument over a period of continuous sales, it would be difficult to say when the distinct infringement began, even if the initial product and the final product were very different.

It might be suggested that the question should turn on whether the second infringement would have been in contempt of an injunction

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120. *Id.* at 1361–62.

121. *See id.* at 1362 ("That the infringement activity caused by Versaport I and Versaport II may appear to be continuous in time does not mean that it is a continuous infringement in law.").

122. *See id.*

against the first infringement. [123] But what if there was no initial injunction? In *Applied I* and *Applied II* the distinct infringements were the subject of distinct actions, but this will by no means always be true; it must be quite common for a patentee to bring one action in respect of both putatively distinct infringements. [124] It would be intolerable to address this by suggesting that the reasonable royalty should turn on the hypothetical terms of an injunction, which a court would have issued had there been separate litigation. Moreover, this test would make the question of separate infringements, and hence the reasonable royalty, depend on the exact terms of the previous injunction, even though injunctive relief is by no means uniform in its scope. The reasonable royalty should not depend on the precise terms of a discretionary grant of injunctive relief.

There is a more fundamental problem with looking to the changes in the infringing product. The obvious policy justification for considering distinct products to constitute distinct infringements is that changes to the product might affect the royalty, and the hypothetical negotiation should take this into account: if the redesigned instrument sold at a higher price because of new noninfringing features, it could not be presumed that the royalty on the new instrument and the old instrument would be the same. But if the infringements are considered to be distinct, *all* new information may be taken into account in the second hypothetical negotiation, not just new information about the redesigned product. If the market conditions have changed so that the reasonable royalty would have changed even if the product had remained entirely the same, the new hypothetical negotiation will take that into account, even though it is unconnected with the redesigned product. The resultant change in the reasonable royalty might be substantially greater than the change justified by the redesign alone; indeed, while the changed product alone might justify a higher royalty, the royalty might actually go down because of the changed circumstances, or vice versa. The mechanism of allowing a new negotiation is overbroad if the rationale is to take account of changes to the product itself.

Of course, we might also say that whether there are discrete infringements should be assessed in light of the totality of the circumstances. This is probably most consistent with *Applied II*. However, a totality of the circumstances test highlights the arbitrary and formalistic nature of the separate infringements analysis. Suppose the

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123. *See id.* ("To argue otherwise, U.S. Surgical would have to concede that it has willfully violated the permanent injunction in *Applied I*.").

124. *Id.* at 1362–63. Clearly, the question of whether there are two infringements cannot depend on whether two separate actions are brought, and there is nothing in *Applied II* to suggest otherwise.

invention is a pharmaceutical, and the user carries out a single small-scale experiment that infringes, and then two years later goes into large-scale production.[125] The information regarding the value of the invention may have changed dramatically in the interim. Should the hypothetical negotiation be assumed to take place at the time of the experiment[126] or at the time of large-scale production? If this turns on whether the infringements are separate, the answer presumably would depend on the relationship between the experiment and the production. If the experiment is directly aimed at and leads to the commercial product, then presumably it would be part of the same infringement. What if the experiment was aimed at commercial production, but the user had forgotten it by the time of the later commercial production, and all the experiments were redone at that later time? What if the experiment has two purposes: to see if the user can manufacture it, and to see if it had promise for the treatment of disease A? What if the subsequent commercial use is to treat disease B, but the user uses the manufacturing knowledge? Hypotheticals can be multiplied, but the point is that the damages award should not turn on these kinds of distinctions.

Under the pure ex ante approach, therefore, the award may vary greatly depending on whether courts consider two somewhat related infringing acts as truly separate and distinct. No doubt there are some cases where it is intuitively obvious that the infringing acts are separate and many where it seems clear that there is a single continuous act, but at the margins, many millions of dollars may turn on what is a purely formalistic distinction.

Another problem with the pure ex ante approach is that separate hypothetical negotiations may allow the patentee to extract royalties from the infringer that reflect holdup value rather than the value of the invention. Suppose that the infringer invests substantial sunk costs in reliance on the patented technology, such as investment in a specialized plant or personnel training, perhaps because the infringer independently invented the technology without awareness of the prior patent. Suppose further that, after the initial launch, the infringer subsequently develops a substantially redesigned new product incorporating the same patented technology, as in *Applied II*, and the new product relies on the same plant and personnel costs as the original product. The ex ante nature of the hypothetical negotiation means that the royalty assessed for the first

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125. *See infra* Section II.D (discussing Integra Lifesciences I, Ltd. v. Merck KGaA, 331 F.3d 860 (Fed. Cir. 2003), *vacated on other grounds*, 545 U.S. 193 (2005).

126. This scenario assumes that the experiment is not permissible under the experimental use defense. Note that in *Integra*, the Federal Circuit concluded that the experiment was not permissible, but the Supreme Court vacated the ruling on this point. *See Merck KGaA*, 545 U.S. at 208.

infringement will not reflect any holdup value, but because the infringer has already incurred the sunk costs at the time of the second hypothetical negotiation, the royalty emerging from that negotiation will reflect holdup value.[127] The concepts of separate and distinct infringements may actually defeat the purpose of the ex ante approach.

None of these problems arise under the contingent ex ante approach. As discussed at the outset, under the contingent approach, the hypothetical negotiation takes place before any sunk costs are incurred (which implies, as a general matter, just one hypothetical negotiation per infringement action, though this is nothing more than a matter of convenience). Nevertheless, the court also will take into account any relevant new information concerning the product, the market, or anything else that emerges after the time of the initial infringement, on the ground that any resultant change in value should be reflected in the damages awarded. Consequently, the formal question of whether infringements are separate and distinct will not affect the royalty.

## D.  *Regulatory Uncertainty*

*Integra Lifesciences I, Ltd.*[128] is an important modern case holding that only ex ante information should be used in assessing a reasonable royalty.[129] *Integra* specifically concerned regulatory uncertainty regarding FDA approval, which was required to market the invention in question.[130] We argue that the holding in *Integra* was wrong on this point, for two reasons. The first is that regulatory uncertainty should be treated exactly as any other source of uncertainty—which is to say that, under the contingent ex ante approach, courts should use ex post information (whether the drug was in fact approved) because it provides a better assessment of the true value of the invention. In this Section, we will show that if only ex ante information can be used in the hypothetical negotiation, an infringer's subjective and incorrect assessment of the value of the invention can dramatically affect the value of the royalty, *even if the patentee's assessment of the value is correct ex ante.* Secondly, the court in *Integra* runs together two different considerations, namely risk shifting and uncertainty, which should be kept distinct. [131]  Even if risk-shifting considerations would weigh in favor of using only ex ante information (this is addressed in detail below), that would not justify using only ex ante information if doing so would grossly misvalue the invention itself. This is a general consideration, which is a recurrent refrain in our analysis.

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127.  Note that this problem apparently did not arise on the facts of *Applied II.*
128.  331 F.3d 860 (Fed. Cir. 2003).
129.  *See id.* at 869.
130.  *Id.* at 863, 865.
131.  *See id.* at 869–70.

Integra and others owned patents relating to a compound that promotes cell adhesion, referred to as the "RGD peptide."[132] Integra alleged that Scripps Research Institute infringed these patents by conducting experiments funded by Merck to uncover potential drug candidates derived from EMD 66203, an RGD polypeptide.[133] The Federal Circuit affirmed a judgment that the defendants' conduct infringed Integra's patents—a finding the Supreme Court later vacated based on its interpretation of the statutory experimental use defense[134]— but reversed the damages award of $15 million.[135] The court's discussion of damages focused on the importance of determining when the infringement began and the information that would have informed a hypothetical negotiation taking place as of the correct date:

> The first step in a reasonable royalty calculation is to ascertain the date on which the hypothetical negotiation in advance of infringement would have occurred. The correct determination of this date is essential for properly assessing damages. The value of a hypothetical license negotiated in 1994 could be drastically different from one undertaken in 1995 due to the more nascent state of the RGD peptide research in 1994. Indeed, factoring in the rapid development of biotechnological arts, a year can make a great difference in economic risks and rewards.
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> [An expert witness for the plaintiffs] proffered a hypothetical license figure based, in part, on Merck's 1995 expectations of obtaining FDA approval of a cyclic peptide therapeutic. As already noted, however, if the hypothetical negotiation occurred in 1994, Merck did not have that expectation. Thus, an earlier date will change the risks and expectations of the parties.
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> At the point before Merck ever attempted its first test on RGD technology, it would have assumed all the risks of failure—either scientific failure to identify a suitable therapeutic candidate or economic failure to market a

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132. *Id.* at 862.
133. *See id.* at 863.
134. *See* Merck KGaA v. Integra Lifesciences I, Ltd., 545 U.S. 193, 206–08 (2005).
135. *See Integra*, 331 F.3d at 869–72.

successful product. If those risks as perceived before any experimentation differed from the risks quantified in the [1995] ImClone agreement, then the ImClone example does little to set the value of the pre-clinical RGD research project at a comparable figure. The parties' inability to project success at the pre-clinical research stage of the RGD project weighs heavily in determining a reasonable royalty, particularly if the time for the valuation of the project moves back to 1994.[136]

The *Integra* court's discussion conflates two distinct issues: risk shifting and errors in the parties' expected value. To clarify the distinction between these issues, consider the following hypothetical facts loosely based on *Integra*.[137] Suppose, as in *Integra*, that the patentee has developed a drug candidate and that the defendant is a major drug company that in 1994 begins using the drug in ways that are possibly infringing. At the time of this use, there are two sources of uncertainty. One is technical uncertainty over the range of potential medical uses, which would affect the market for the drug. In particular, assume there is a one-third chance that the drug will be a complete failure; a one-third chance it has the potential to treat disease A, in which case it will be worth $2 billion; and a one-third chance it can also treat disease B, in which case it will be worth $4 billion. The expected value of the market is therefore $2 billion. In addition, there is regulatory uncertainty due to potential toxicity concerns, resulting in a 50% chance the FDA will approve the drug and a 50% chance the FDA will not approve it. Discounting the value of the market by the regulatory uncertainty, the expected value in 1994 is $1 billion, which is available for the parties to split. For simplicity, assume that the patentee's minimum willingness to accept is zero—perhaps because there are no other potential partners with the specialized expertise necessary to take the drug through clinical trials—while the licensee's maximum willingness to pay is equal to the full expected value of the invention. Assume also that the parties have equal bargaining power, and they will split the available surplus equally on a Nash bargaining model.[138] If they are both risk neutral, this

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136. *Id.* at 870–71.

137. In the actual case, there were several potential therapeutic uses of the allegedly infringing polypeptide, a voluntary licensing agreement between a research institute and a major drug company, and a third-party patent owner who claimed that both of the parties to the license infringed. *See id.* at 863, 870, 874. For illustrative purposes, this hypothetical simplifies matters and assumes the probabilities of certain outcomes.

138. *See generally* John F. Nash, Jr., *The Bargaining Problem*, 18 J. ECONOMETRIC SOC. 155 (1950) (introducing the "Nash bargaining model"). We acknowledge that the Nash model, like the 25% rule of thumb before it, has drawn criticism from the courts for not being sufficiently tied

implies a royalty of $500 million if the parties had actually bargained in 1994. If one of the parties is risk averse, then the royalty would shift accordingly. To put a number on it, suppose the patentee is risk averse and the drug company is not, and at this level of risk, the royalty reflecting risk shifting would be $400 million.

Now suppose that the defendant performs clearly infringing acts in 1995. We can further break down this hypothetical into two competing scenarios. In Scenario 1, suppose that by 1995 the medical uncertainty has been resolved—it is known that the drug will treat disease A but not disease B—but the regulatory uncertainty remains. The expected value of the market in 1995 will still be $2 billion, as it was in 1994, but the uncertainty as to that value has been reduced. After discounting for regulatory risk, the expected value of the invention remains $1 billion, though with a lower risk than in 1994. If the parties are both risk neutral, we would expect them to split this expected value 50/50. If the patentee is risk averse, however, the reduction in uncertainty will have shifted bargaining positions in favor of the patentee, who will take a somewhat larger share than it would have taken in 1994, when there was more uncertainty. The risk is still not zero, so the terms will still favor the risk-neutral party, although not by as much as in 1994. To put a number on it, suppose that with the uncertainty partially resolved, the risk-averse patentee would receive a royalty of $450 million if the parties had negotiated in 1995.

In Scenario 2, further experiments by 1995 have resolved the regulatory uncertainty, so that it is clear that toxicity concerns will not block the drug, but the medical indications are still not established. The value of the market remains the same, but with the regulatory uncertainty resolved, the expected value is now $2 billion. The risk also has been reduced, by roughly the same amount as in the first scenario. If the parties are risk neutral, this implies a royalty of $1 billion; if the patentee is risk averse, the split will shift roughly 10% in favor of the patentee, implying a royalty of $900 million if the parties had actually bargained in 1995.

All or most of the difference between the royalties in the two scenarios reflects the correction of the parties' earlier expectations in light of new information; little or none of it reflects a risk-shifting premium. Indeed, if both parties are risk neutral (which is entirely plausible) there will be no risk-shifting premium at all. The royalty in the first scenario (medical uncertainty resolved) will be $500 million, and in the second (regulatory uncertainty resolved), it will be $1 billion. Thus, despite the absence of a risk-shifting premium, there will still be a $500 million difference in the

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to the facts of the particular case. Nothing in our example turns on the particular split between the parties, and we chose a 50/50 split purely for simplicity of arithmetic. The same analysis would follow from any particular split that a court might find appropriate on the facts of a particular case.

royalty. This illustrates that risk shifting and resolving uncertainty are fundamentally different considerations.

In our view, in the reasonable royalty calculation, both of these factors—risk shifting and updated information—are best dealt with using ex post information. First consider the updated information. To focus on updated information, assume the parties are both risk neutral, so risk shifting will have no effect. Under the contingent ex ante approach, the parties are assumed to have all of the information available at the time of trial. We can combine the two scenarios and assume that at the time of trial the regulatory uncertainty has been resolved by approval of the product (as it normally would be for the infringer to infringe on a commercial scale), and it is known that the drug will treat condition A but not condition B, so that the market value is known to be $2 billion. Under the contingent ex ante approach the parties are assumed to know this, and they will therefore agree to a $1 billion royalty; that is, the patentee will receive 50% of the actual value of the invention. This result will follow regardless of whether the 1994 experiment was infringing and regardless of whether the regulatory or medical uncertainty is resolved at the time of the first infringement.[139]

In contrast, under the pure ex ante approach, as stated in *Integra*,[140] the reasonable royalty will depend on whether the 1994 experiments were infringing. If they were, the damages will be $500 million; if they were not, damages will be $500 million under Scenario 1 and $1 billion under Scenario 2. Depending on the exact state of the parties' knowledge at the time of the first infringement, the patentee may receive substantially less than its intended share of the actual value of the invention. Indeed, if by the time of trial the FDA has approved the drug for both conditions A and B, its true value will be $4 billion and the reasonable royalty $2 billion under the contingent ex ante approach; but the award on the pure ex ante approach will still be only $500 million if the infringement took place in 1994. This illustrates our basic critique of the pure ex ante approach: why should the royalty depend on the mistaken nature of the parties' belief? If those beliefs are systematically mistaken, then the patent incentive will be systematically wrong too.

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139. To state the matter another way, there is no reason to treat regulatory or medical uncertainty differently from any other type of uncertainty. Indeed, in the present example, one could characterize both forms of uncertainty as going to the pharmacological properties of the drug—is it toxic? Does it treat disease B?—and it is only happenstance that the former but not the latter is subject to regulatory approval. In fact, the latter is subject to regulatory approval—a firm cannot (formally) market the drug for an unauthorized indication—but in practice that does not really matter because if the drug does not actually work for the unauthorized indication, then no one will buy it, and if it does actually work, then it will often be prescribed off-label. So there is no firm distinction between regulatory approval and other uncertainty, and no reason to draw one.

140. *See* Integra Lifesciences I, Ltd. v. Merck KGaA, 331 F.3d 860, 869 (Fed. Cir. 2003).

The district court explicitly made this point in *Honeywell*, in which the question was whether sales projections that were unavailable at the time infringement began could be used as a royalty base in assessing damages.[141] The court held they could, expressly rejecting *Integra* on the basis, *inter alia*, that using the ex post information "protects the *quid pro quo* underlying patent law by preventing a premature valuation of the patent."[142] This Article's analysis implies that the court in *Honeywell* was exactly right. We acknowledge that *Integra* stands as authority against the contingent ex ante approach, but we note that its authority on this particular point is weakened because the Supreme Court's reversal on the experimental use defense mooted the court's order remanding the case for the recalculation of damages.[143] Moreover, the district court in *Honeywell* held that it could avoid *Integra*'s authority because it was inconsistent with other appellate authority that supported the use of ex post information, and as between two decisions of equal authority, a lower court should follow that which is better reasoned.[144] We agree on both points.

The merit of the *Honeywell* court's position is even clearer if the parties have differing expectations, which is often likely to be the case. In the example above we assumed that the parties agreed on the expected value both in 1994 and in 1995. Suppose instead that in 1994 the patentee, on the basis of its own experiments, is very confident that the toxicity problem is not serious and that the FDA will approve the drug. It estimates the regulatory risk at essentially zero, and so places a $2 billion expected value on the invention. The prospective licensee, on the other hand, does not trust the patentee's information and in good faith estimates the regulatory risk at 50%. Consequently, the licensee places an expected value of only $1 billion on the invention. If, as above, the hypothetical negotiation takes place in 1994, the parties have equal bargaining power, and the patentee's minimum willingness to accept is still zero, the licensee's maximum willingness to pay is only $1 billion. A 50/50 split will result in a royalty of $500 million, as in the original example. Now assume, as before, that the FDA later approves the drug for indication A. In this case, if the 1994 experiment is infringing, under the pure ex ante approach, the patentee will receive a royalty that grossly undervalues the actual value of the invention, *for the sole reason that the licensee was wrong about the expected value, even though the patentee was entirely right*.

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141.  378 F. Supp. 2d 459, 463 (D. Del. 2005).

142.  *Id.* at 469.

143.  *See* Merck KGaA v. Integra Lifesciences I, Ltd., 545 U.S. 193, 206 (2005).

144.  *Honeywell*, 378 F. Supp. 2d at 469 (citing Fromson v. Western Litho Plate & Supply Co., 853 F.2d 1568, 1575 (Fed. Cir. 1988), which in turn quotes extensively from Sinclair Refining Co. v. Jenkins Petroleum Process Co., 289 U.S. 689, 698–99 (1933)).

This example highlights the fundamental flaw with the pure ex ante approach. The disadvantage of the patent system as compared with government grants or prizes as a means of encouraging innovation is that the patent system requires above-marginal-cost pricing, which inefficiently restricts dissemination. The compensating advantage of the patent system is that it gives the inventor a high-powered incentive to accurately estimate the value of the invention. It is wrong that an inventor, who in fact accurately assesses the value of the invention should nonetheless be denied a commensurate reward because of errors made by the infringer. The best defense of the pure ex ante approach from an incentive perspective is that the ex ante expected value of the invention is likely to be accurate on average. We have argued above that it is unrealistic to expect ex ante expectations to be generally accurate, even if the parties share the same expectations. [145] When the parties have divergent expectations, they cannot both be right, so the reasonable royalty payable under the pure ex ante approach *must* be wrong because it depends on the expectation of both parties. Moreover, negotiations are likely to break down precisely when the expectations of the parties are different. If no actual license is entered into because the patentee correctly assigns a higher value to the invention than does the potential licensee, to hold the patentee to a reasonable royalty that reflects the infringer's mistaken expectation effectively allows the infringer to insist that the patentee accept a deal based on the infringer's mistaken negotiating position.

As noted above, the courts routinely acknowledge the artificiality of imagining "what warring parties would have agreed to as willing negotiators."[146] It is not only artificial but wrong in principle to posit a willing negotiation that splits the parties' expected value attributable to the invention when the parties were unwilling to negotiate precisely because they did not agree on that value. On the contingent ex ante approach, in contrast, we can assume that the parties agree on the value of the invention in the hypothetical negotiation, even though they did not in the actual negotiation, because the value that they are taken to agree on is the true value of the invention.

Now briefly consider the risk-shifting aspect, which we will return to in more detail in a subsequent section.[147] Risk shifting is illustrated by the scenario in which the medical uncertainty is resolved but the regulatory uncertainty is not, so that the expected value of the invention remains unchanged but the risk is reduced. If one of the parties is risk averse, this will result in a shift in the royalty that the parties would negotiate, by $50 million in our example. In effect, if the negotiation had

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145.  *See* discussion *supra* Section II.D.
146.  *See Fromson*, 853 F.2d at 1575; cases cited *supra* note 52.
147.  *See infra* Subsection II.E.1.

taken place in 1994, the patentee would have been willing to pay the licensee $50 million to bear the risk.

There are two problems with using a hypothetical negotiation based only on ex ante information to replicate this risk-shifting function. The first, discussed in more detail below, is that the award of damages should not reflect the risk that a party would have agreed to bear at the time, unless that party actually bore that risk in fact; and whether the party bore the risk in fact turns on ex post information.

The second problem is to insist that courts use only ex ante information to replicate the risk bearing function is the proverbial "tail wagging the dog."[148] As we have seen, using only ex ante information affects the license in two distinct ways: the parties' ex ante errors as to the true value of the invention will affect the royalty; and there will be greater overall risk, which affects the royalty if (but only if) the parties are differentially risk averse. These effects are independent, and the risk-shifting effect may be very small compared to the effect of erroneous information. If the parties are risk neutral, then there will be no risk-shifting effect at all. If we accept that using only ex ante information would undesirably distort the patent incentive, then it would be wrong to insist that courts nonetheless exclude the ex post information simply to replicate the risk-shifting effect. In our original example, of the difference of $550 million in the royalty between the pure and contingent approaches, only $50 million is due to risk shifting, and $500 million is due to new information about the true value of the invention. If we accept that the patentee should receive the extra $500 million to preserve the patent incentive, it would be wrong to throw this away by insisting on the pure ex ante approach simply to reflect the $50 million risk-shifting premium.

### E. *Lump-Sum Versus Running Royalties*

As noted earlier, if the evidence establishes that the parties would have agreed to a running royalty, the pure and contingent ex ante approaches often will lead to the same result because ex post information regarding sales volume is used under either approach.[149] Conversely, situations in which the parties in fact would have agreed to a fully paid-in lump-sum royalty present a clear contrast between the two approaches. Whether the parties use a lump sum or a running royalty,[150] they will attempt to split

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148.  *See* Jarosz & Chapman, *supra* note 32, at 803.

149.  *See supra* Sections I.B., I.C. Results under the two approaches may differ, however, if there is some other ex post information that would be relevant under the contingent approach, such as regulatory change or the identification of a noninfringing alternative.

150.  The literature often distinguishes between per unit running royalties, in which the royalty is expressed in dollars per unit sold, and an ad valorem royalty, which is expressed as a

the true incremental value of the invention. In negotiating a lump sum, the parties will do their best to estimate the value of the invention to the licensee. This will involve some projection of future sales. The pure ex ante approach will attempt to recreate that speculation. The contingent approach, in contrast, will split the value of the invention based on ex post knowledge, which is to say that the parties will be assumed to have accurate knowledge of the sales volume or any other factors, which would affect the amount of the royalty.[151]

Our basic argument, as always, is that the contingent approach is generally preferable to the pure approach because it provides a more accurate assessment of the true value of the invention; assessing damages based on a lump sum royalty cannot be justified merely because that is what the parties would have done. With that said, we nevertheless should ask *why* the parties would have negotiated a lump sum payment, to see whether any of the specific functional reasons why the parties would have used a lump sum royalty would justify the courts in assessing damages without using ex post evidence, notwithstanding the consequent distortion of the patent incentive. As discussed below, the economic literature on licensing suggests a variety of factors that may affect the parties' decision as to how to structure their royalty payments. These include: (1) risk shifting; (2) avoiding double marginalization (and, more generally, strategic considerations in the downstream market); (3) reducing borrowing costs; and (4) administrative (monitoring) costs.[152] In general, any of these considerations may factor into any particular decision as to royalty structure. The parties may also balance these considerations by using a blend of lump sum and running royalty. It is nonetheless convenient to address each of these factors individually.

To cut to the chase, we will argue that none of these considerations, either individually or collectively, justifies ignoring ex post information for two basic reasons. First is what we referred to above as the problem of the tail wagging the dog.[153] For example, if the courts use a hypothetical negotiation based only on ex ante information to replicate the risk-shifting effect of a lump-sum royalty, this would entail distorting the patent incentive by ignoring information about the true value of the invention, even though the risk-shifting effect might be very small, as

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percentage of the sale price of the final product. *See, e.g.*, Stefano Colombo & Luigi Filippini, *Revenue Royalties*, J. Econ., Oct. 2015, at 1, 2. This distinction is not necessary for our analysis, and in referring to a running royalty, we mean to include both types of royalty.

151. Suppose, for example, that the parties would have agreed to a 60/40 split in favor of the licensee on expected sales revenue of $100,000. The licensee could pay a lump sum of $40,000, or a running royalty of 40% of sales revenue. The implicit royalty rate in the lump sum royalty is 40%, so under the contingent approach, the court would apply a 40% rate against the sales revenue actually earned (possibly adjusted, however, for other factors discussed below).

152. *See infra* Subsections II.E.1–II.E.4.

153. *See* Jarosz & Chapman, *supra* note 32, at 803.

discussed above. This is a general problem with all of the reasons why the parties might choose a lump sum. We will not repeat this point with respect to every issue discussed below, but it should be understood to apply.

Secondly, an award of damages based solely on ex ante information generally will not have the same functional effect as a license actually agreed to ex ante. For example, a lump-sum payment actually made at the outset would reduce the patentee's risk because payment would not be contingent on uncertain future sales, while infringement increases the patentee's risk by making payment contingent on extended and uncertain litigation. It is not sensible to assess damages on the basis of a lump-sum agreement that willing parties would have entered into to decrease the patentee's risk, when the parties' actual course of conduct had the effect of increasing that risk. With that said, the infringer might in fact end up bearing some of the risk or performing other valuable services, but the services actually performed will not generally be the same as those that the parties would have agreed to ex ante. To be fair to both the infringer and the patentee, it is necessary to use ex post information to determine which services were actually provided. This argument exactly parallels the rationale for using ex post information about the value of the invention. Rather than determining what the parties would have expected the profits to be and then determining what other services each party would have expected to have undertaken, we should ask what the value of the invention actually was, and what services actually were provided.

## 1. Risk Shifting

Uncertainty as to the future state of the world, such as future demand for the patented product, creates risk. If one of the parties is more risk averse than the other, the parties may wish to partially shift that risk by structuring the royalty payments appropriately. One way of doing this is to choose between a lump sum and a running royalty. As a general matter, a running royalty shifts risk (such as demand or cost uncertainties) from the licensee to the licensor/patentee and thus might be appropriate when the patentee is risk neutral and the licensee is risk averse.[154] Conversely, if the patentee is risk averse and the licensee is risk neutral, a lump sum

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154. *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1326 (Fed. Cir. 2009); Alain Bousquet et al., *Risk Sharing in Licensing*, 16 INT'L J. INDUS. ORG. 535, 542 (1998). This may seem counterintuitive because a lump-sum payment provides the licensor with more certainty as to its royalty payment. However, the licensee is concerned with risk relating to its overall profits. Profitability risk is reduced with a running royalty, because royalty payments are reduced if sales are low, and vice versa, thus dampening the effect of uncertainty as to sales. *See generally* Bousquet et al., *supra*, at 550–51 (discussing the uncertainty of royalty rationales).

will place more of the risk on the licensee. [155]

Even if the parties would have used a lump sum to shift risk to the licensee, a court should not ignore ex post information in an attempt to recreate the lump sum, which the parties would have arrived at had they actually bargained, because such an award would not actually shift risk. To shift risk, a payment must substitute a certain present sum for an uncertain future sum.[156] At the time of the first infringement, any court-awarded damages are also an uncertain future event. Consequently, from a risk-shifting perspective, damages awarded ex post cannot substitute for a lump sum actually paid ex ante.

To illustrate, return to our example based on *Integra*[157] and suppose that the patentee is a small and risk-averse research firm, while the infringer/licensee is a large risk-neutral pharmaceutical company. The parties to an actual license might well agree to a lump-sum royalty to shift risk to the licensee. In that case, the lump-sum royalty will be smaller than the expected value of the equivalent running royalty, with the difference being the implicit payment made by the patentee in return for the licensee agreeing to bear the risk of the invention's success. If damages replicate that lump sum, the court would be saying that the infringer should receive a larger share of the profits from the invention because if it had not infringed, it would have paid a lump sum which would have reduced the risk to the patentee. But the infringer may not in fact have borne any risk. For example, the patentee might actually have licensed to a different pharmaceutical company, which carried out the clinical trials and developed the market, while the infringer, though it carried out early infringing trials, ultimately did not commercialize a product until after the market was mature. If the infringer did not in fact bear any risk, and the patentee's royalty is nonetheless reduced as if it had, then the infringer will effectively be paid for a service that it never provided. Indeed, by taking market share away from the patentee and substituting a future uncertain damages award, the infringer would actually have increased the patentee's risk. In such circumstances, to assess damages based on a lump sum would reward the infringer as if it had decreased the patentee's risk when in fact the opposite is true.

One possible response is that even an infringement decreases the risk to the patentee if the likelihood of detecting the infringement and

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155. While it is convenient to discuss risk shifting in the context of the choice between a lump sum and a running royalty, risk shifting may also be reflected in the royalty rates. The parties might want to use a running royalty for risk-shifting reasons, but the monitoring burden might be too high. In that case, the parties might agree to a lump sum royalty that is somewhat lower than it would be if both parties were risk neutral; rather than shifting the risk, the licensee would be directly compensated for bearing undesirable risk. The analysis in this Section is applicable regardless of how the risk shifting is implemented.

156. *See Lucent Techs.*, 580 F.3d at 1325–26.

157. *See* discussion *supra* Section II.D.

establishing liability are sufficiently high. In effect, the patentee could say to itself, "Excellent, my patent is being infringed, so I know I have a guaranteed market for my invention, once I have enforced it." If that guarantee of recovery were sufficiently secure, then the patentee might prefer to have damages assessed on the basis of a lump sum with a lower expected value because it would recover even in those instances in which the realized sales were lower than expected (which is the point that makes a lump sum attractive to the patentee). In that case, the infringement would actually reduce the patentee's risk, and so a lower expected award based on a lump sum would be justified. But if the probability of enforcement was so high ex ante that it effectively reduced the risk faced by the patentee as much as a lump-sum payment would have done, then surely the infringer would have licensed rather than infringed to save the inevitable litigation costs.[158] This is just a corollary of the point that a future uncertain damages award cannot substitute for a present actual payment.

Another counterargument might be that it is unnecessary to abandon the pure ex ante approach to address this problem because risk shifting is implicitly reflected in the choice of comparable licenses. If the infringer did not in fact bear the risk, then the only licenses which should be considered comparable for the purposes of the hypothetical negotiation are those in which the actual licensee did not bear the risk. But how do we know that comparable licenses are those in which the licensee did not bear the risk? The only way we can know this is if we know that the actual infringer did not bear the risk, and that is ex post knowledge. This response attempts to save the pure ex ante approach but only by smuggling in ex post information through the back door. Indeed, this response reinforces our point that it is necessary to use ex post information to assess the value of the risk shifting that actually occurred.

While the patentee's risk cannot be reduced by a lump-sum payment that was never actually made, the infringer might nonetheless bear substantial risk through other means. In the example above we supposed that the research-focused patentee was successful in licensing to a third party, and the infringer entered only after the market was mature. But it is also entirely possible that the patentee never licensed, and it is the infringer that brought the product to market, perhaps unaware that it was infringing, and bore substantial risk in so doing. In such a case, the infringer should be compensated for the risk it bore. But to reward the infringer for risk bearing, there is no need to pretend that the parties would have negotiated based only on information available as of the time

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158. It might be possible to test this empirically by asking whether a patentee faced with a putative infringement could borrow money against that potential action at rates comparable with the implicit discount it is paying as compared with the return it would earn with a running royalty.

infringement started. To do so would risk distorting the patent incentive; in our hypothetical variation on the facts of *Integra*, for example, the pure ex ante approach would apply a 10% risk discount to a $500 million expected market value, resulting in a $400 million royalty,[159] even if the invention actually turned out to be worth $2 billion or even $4 billion. Moreover, such an award, based only on ex ante information, would not reflect the risk actually borne by the infringer. If the parties had negotiated at that time, the licensee might have agreed both to carry out the clinical trials at its expense and to provide a lump-sum payment, both of which reduce the risk to the patentee, and it may be that in fact the only service actually provided was carrying out clinical trials. Or the patentee might have borne some risk in establishing one indication for a drug, while the infringer bore a similar risk in developing a different indication.

The better approach is to consider ex post information both for the purpose of establishing the true value of the invention and to account for the infringer's actual—not hypothetical—risk-bearing role. So, in our *Integra* hypothetical, suppose that at the time of trial it was known that the drug was not toxic, and it was effective for treating disease A but not disease B. The parties would base the royalty on a split of the known market value of $2 billion, so that the patentee would be entitled to a reasonable royalty of $1 billion, which would then be adjusted by the infringer's actual risk-bearing role, as revealed by ex post information. If the infringer had in fact borne all the risk of taking the product to market, and the parties would have assessed the value of risk bearing at 10%, then the reasonable royalty should be reduced to $900 million to reflect the fact that the infringer bore the risk of bringing the product to market. Conversely, if the infringer had not in fact borne any risk, then the patentee should be entitled to the full $1 billion. The approach accurately preserves the patent incentive while also recognizing the risk actually—not hypothetically—borne by the infringer.

There is a more general point here. Risk bearing is a service that the licensee may provide, just as it may provide other services such as marketing or carrying out clinical trials. The licensee's share of the surplus reflects the various services provided by the licensee. In our example based on *Integra*, the licensee presumably had the specialized expertise that would have enabled it to take the patented drug through clinical trials. The licensee's share of the royalty reflects this service, along with other services such as marketing and distribution. The exact nature of the services provided will depend on the terms of the contract. The user should only be rewarded for providing such services if it in fact provided them. If the user did the work necessary to make the drug a commercial success, including taking it through clinical trials, marketing,

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159. *See supra* Section II.B.

and distribution, then it should be compensated for having done so, but not otherwise. That a hypothetical licensee would have provided a particular service cannot justify compensating an infringer for a service that it did not provide.

The principle behind the use of ex post information is the same whether that information relates to sales volume or risk shifting. Higher sales than expected should be reflected in a higher royalty; and by the same token, if the infringer in fact bore a greater share of the risk, it should be compensated for having provided that service. But conversely, the infringer should not have to pay an inflated royalty for a product that the public did not want simply because the parties were overly optimistic about demand; nor should the patentee have to pay the infringer for bearing risk if it did not actually do so. The general principle is that the damages award should reflect the true value, not just of the invention, but also of the contributions made by both parties to the infringing sales.[160]

### 2. Double Marginalization and Strategic Considerations

One reason the parties may use a lump-sum royalty is that a running royalty effectively increases the licensee's marginal cost, thereby increasing the licensee's profit maximizing price and reducing the quantity sold.[161] Because a lump-sum royalty is a fixed cost, the licensee's marginal cost is lower, and it can expand output, thereby generating more revenue for the parties to split. This is sometimes referred to as a problem of double marginalization.[162] More generally, the patentee may use its licensing practices to affect conditions in the downstream market, particularly when the licensing regime can affect competition among multiple licensees, thereby introducing strategic considerations into the licensing calculus.[163] In general terms, the

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160. *See supra* Subsection I.C.3.

161. *See* Kenneth Fjell et al., *On the Choice of Royalty Rule to Cover Fixed Costs in Input Joint Ventures* 3 (Ctr. for Econ. Studies & Info Inst., Working Paper No. 4332, 2013).

162. *See* Morton I. Kamien & Yair Tauman, *Fee Versus Royalties and the Private Value of a Patent*, 101 Q.J. ECON. 471, 472, 484 (1986); *see also* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2013–14, 2014 n.48 (2007) (describing the relationship between double marginalization and complementary patents).

163. *See* Morton I. Kamien, *Patent Licensing*, *in* 1 HANDBOOK OF GAME THEORY WITH ECONOMIC APPLICATIONS 331, 346 (Robert J. Aumann & Sergiu Hart eds., 1992). Note that even apart from the uncertainty related to future demand, the double marginalization problem will not necessarily lead the parties to adopt a flat fee, as the optimal negotiating position for the parties will depend on the nature of the market. Running royalties, however, do increase the licensee's marginal costs, and so depending on the nature of the licensing and product markets, can induce licensees to restrict their levels of output, thereby decreasing overall industry profits and consequently the amount the patentee can extract. *See* Michael L. Katz & Carl Shapiro, *On the Licensing of Innovations*, 16 RAND J. ECON. 504, 505 (1985); Carl Shapiro, *Patent Licensing and*

patentee will want to license in such a way as to constrain competition in the downstream market to make that market more profitable, but only to the extent that it can also extract some of the excess profits. In the theoretical literature, the license structure that is optimal for the patentee often will be a combination of fixed fee with a per unit or ad valorem running royalty, and the optimal strategy may also involve entirely different licensing strategies, such as an auction or other more exotic mechanisms.[164]

Even if the parties to an actual negotiation would have used a lump sum to avoid the problem of double marginalization, this would not justify an attempt by a court to recreate that lump sum in assessing damages because, as with risk shifting, damages awarded ex post cannot substitute for a lump sum actually paid ex ante. An actual royalty that a licensee factors into its cost calculations will increase the licensee's marginal cost, but a hypothetical royalty will not affect the licensee's actual sales because that unanticipated hypothetical royalty does not increase the marginal cost of the goods that have already been sold. Again, as with risk shifting, the only way in which a reasonable royalty damages award based on a running royalty could influence the past sale price is if the infringer fully anticipated it—if ex ante the infringer had concluded a court would likely find it liable for infringing a valid patent, and the infringer anticipated that a court would award damages on the basis of a running royalty, it might have increased its sales price to build up a reserve against this anticipated liability. But again, as noted in the discussion of risk shifting, if the infringer were so certain of having to pay the royalty, it surely would have actually licensed to save the litigation costs. The same logic applies to structures adopted for strategic reasons more generally; the point of strategic licensing is to affect the market structure and the price at which the products are sold. When damages are assessed, the products have already been sold, and the market structure cannot be changed retroactively.

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*R&D Rivalry*, 75 Am. Econ. Rev. 25, 27 (1985); Rubén Hernández-Murillo & Gerard Llobet, *Patent Licensing Revisited: Heterogeneous Firms and Product Differentiation* 2 (CEMFI, Working Paper No. 0301, 2003), http://ssrn.com/abstract=386441.

    164.  See, for example, the discussion of the "chutzpah" mechanism in Kamien, *supra* note 163, at 348–52. The particular implications of strategic behavior for optimal licensing by the patentee generally depend on the degree and nature of competition in the downstream market (e.g., the number of potential licensees). *See id.* at 348–49; Hernández-Murillo & Llobet, *supra* note 163, at 12. A variant occurs when a practicing entity seeks an elevated royalty when licensing to competitors to raise their marginal cost. *See* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 Colum. L. Rev. 2117, 2134 (2013) (noting that in some instances "practicing entities are far more likely to insist on running royalties because they might have a strategic interest in raising the marginal cost of their competitors' products").

### 3. Time Value of Money

Another reason the parties might want to use a lump-sum payment is that the patentee gets the use of the money immediately.[165] Presumably the patentee earns less than if it used a running royalty because the licensee has to give up the use of the money immediately; but the implicit interest rate in terms of forgone royalties must be less than the patentee could obtain from outside sources, or the patentee would prefer to use a running royalty with a higher expected value, while borrowing from outside sources for its cash needs. Again, even if the parties would have agreed to a lump sum for this reason, a court in assessing damages should not attempt to replicate that lump sum for the now familiar reason that damages ex post are not functionally equivalent to a lump sum actually paid ex ante. The point of the lump sum is to give the patentee immediate access to funds, and damages by their nature will be awarded long after the time at which the lump sum payment would have been made. In assessing damages, the time value of money can only be reflected in prejudgment interest.[166] Since prejudgment interest is normally awarded in any event,[167] it is not sensible to attempt to recreate the time value of money implicit in a lump sum that a patentee would actually have received at the time of the first use by using only ex ante information to assess that lump sum.

### 4. Monitoring

Yet another advantage of a fully paid-in lump-sum royalty as opposed to a running royalty is that it reduces monitoring costs.[168] Monitoring typically imposes costs on both parties and thus reduces the net surplus to be divided.[169] If monitoring costs are high, the parties may use a lump sum to avoid them.[170] But even if the parties would have chosen a lump sum to address monitoring concerns, it does not follow that the courts should attempt to replicate that agreement in awarding damages. A court does not face the same monitoring problem because the tools available to the court, in particular discovery, are very different. The court therefore need not award a royalty based on expected value rather than actual use in an effort to replicate the agreement the parties would have entered into, when the rationale for using a lump sum is inapplicable.

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165. *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1326 (Fed. Cir. 2009) (comparing a lump-sum analysis to a running royalty analysis and finding that a lump-sum license allows the patentee to raise cash quickly).

166. *See* General Motors Corp. v. Devex Corp., 461 U.S. 648, 655–56 (1983).

167. *See id.* at 656–57 (holding that courts normally should award the prevailing patent owner prejudgment interest).

168. *Lucent*, 580 F.3d at 1326.

169. *See id.*

170. *See id.*

With that said, while the courts will not face the same monitoring costs that the parties would have faced, the evidentiary costs facing the litigants in assessing actual use may also be substantial. Indeed, in some situations the cost of gathering relevant ex post information may be prohibitive, in which case assessing damages based on expected value will be justified. This is discussed in more detail below.[171]

### 5. Summary

In this Section we have argued that a court should not attempt to replicate a lump sum that similarly situated parties would have agreed to in a hypothetical negotiation because an award of damages ex post cannot functionally replicate an actual lump sum received ex ante. *A fortiori*, it would be wrong to distort the patent incentive by using only ex ante information in a futile attempt to replicate the effect of a lump-sum royalty. This brings us back to the problem of the tail wagging the dog. Suppose, for example, that similarly situated parties expected sales of 1000 units and that they would have negotiated a lump-sum royalty based on that projection to give the patentee immediate access to funds. If actual sales were 10,000 units, it would be absurd to distort the patent incentive by basing the royalty calculation on sales of 1000 units on the ground that doing so is necessary to capture the time value of the money the patentee would have earned from a lump-sum payment received at the time of the hypothetical negotiation, when the patentee never in fact received such a payment, and the time value of money is already reflected in the prejudgment interest rate. The same point can be made with respect to risk shifting, strategic licensing, and monitoring. This is not to say that such considerations should be ignored. Rather, they should be taken into account using ex post information. Actual sales volume should be used to determine the value of the invention, and then to the extent that the infringer actually bore risk or provided early funds or any other service, the royalty based on actual sales should be adjusted to account for services actually provided.

Different issues arise when the court is awarding a royalty going forward in lieu of an injunction. If monitoring is inefficient for the parties in a real world license, it may well also be inefficient for the court to award a running royalty going forward.[172] In that case, the court may wish to award a lump-sum royalty to cover the use going forward. But that lump sum should still be assessed on the basis of all the information

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171. *See infra* Section II.H.
172. In principle, a similar argument may be made with respect to the other factors we have considered. So, a lump-sum royalty to cover use of the patented invention going forward might take into account concerns over double marginalization. However, such concerns are likely too fine-grained to be taken into account in practice, given that the damages assessment is inevitably no more than a rough estimate of the true loss.

available at the time of litigation. That is, if the parties' expected sales are 1000 units per year indefinitely, and in fact sales for five years between the first infringement and trial are 10,000 per year, and the evidence indicates that demand is likely to be stable, the court should award a royalty going forward based on 10,000 units per year, not 1000.

We have discussed lump-sum royalties at some length because situations in which the parties would have agreed to a lump sum raise the contrast between the pure and contingent ex ante approaches most sharply. Of course, parties do not always use a lump sum, despite all of the advantages outlined above. Although we are not aware of any current statistics on point, the conventional wisdom is that running royalties (sometimes combined with an initial lump-sum payment) are much more common in practice than purely lump-sum licenses.[173] The reason for this, we suggest, is simple: the parties normally prefer that the royalty reflect the true value of the invention rather than expectations—which are likely to prove erroneous—and there must be some substantial countervailing reason to use a lump sum before the parties will do so. In effect, a running royalty is a way that the parties can use ex post information in a negotiation that takes place ex ante. The contingent ex ante approach adopts the same basic principle while recognizing that the reasons that the parties might use a lump sum in actual negotiations are not normally applicable in the damages context.

## F. *Bargaining Weakness*

In some cases, the relative bargaining power of the parties may change over time. Suppose the patentee was in a weak position at the time of the first infringement, and so would have accepted a 20/80 split of the expected profits, but it would be in a position to demand a 50% share if the negotiation took place at the time of trial. Should information about the patentee's improved bargaining power be used to determine the royalty split?[174]

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173. *See, e.g.*, 3 ROGER M. MILGRIM & ERIC E. BENSEN, MILGRIM ON LICENSING § 18.06 (Matthew Bender rev. ed., 2015) ("Without doubt, the most common form of consideration for licenses of patents, know-how, trade secrets and trademarks is what is known as running royalty."). *But see* FED. TRADE COMM'N, PATENT ASSERTION ENTITY ACTIVITY 1, 85–86 (2016) (reporting that among the patent assertion entities (PAEs), defined as "businesses that acquire patents from third parties and seek to generate revenue by asserting them against alleged infringers," that the FTC recently studied, "[t]he reported licenses were predominantly lump sum;" in part because litigation PAEs (sometimes referred to as patent trolls) prefer not to monitor or enforce licenses).

174. Note that bargaining weakness is not generally a live issue. The split either turns on some rule of thumb—25%, or the Nash 50%, though U.S. law now disfavors both—or on the split in comparable licenses. This kind of adjustment is just too fine-grained for most actual royalty assessments.

In our view, a generic appeal to bargaining weakness cannot answer this question. To determine whether and how a royalty payment should be adjusted to account for changes in bargaining power, it is necessary to identify the particular source of the change in bargaining power.[175] This will normally be straightforward because a party relying on changed circumstances to argue for a different split (or that certain licenses should not be taken as comparable), must be able to specify the particular change. Once the source of the change in bargaining power is identified, it should be dealt with on its own terms, rather than on the basis of the generic bargaining power label.

To illustrate, suppose that the patentee was originally in a weak bargaining position because it was in difficult financial circumstances. A low lump-sum royalty that a licensee could have extracted is equivalent to the licensee providing a loan to a risky borrower in exchange for the expectation of a continuous income stream (here, from using the patent).[176] The infringer should not be rewarded with a similarly low reasonable royalty because it would have provided a loan at the time of the first infringement if it did not actually do so.

As another example, perhaps the patentee was in a weak bargaining position because the infringer had a specialized distribution system necessary for product success.[177] If the infringer in fact used that distribution system to open up the market, and the patentee's bargaining position subsequently improved because the market had been developed as a result of the infringer's efforts, then the infringer should be rewarded for having actually provided the service of opening the market, even though it did so as an infringer. On the other hand, if the product succeeded because the plaintiff incurred substantial costs in developing its own alternative distribution system, then the infringer should not be

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175. *See* Albert Choi & George Triantis, *The Effect of Bargaining Power on Contract Design*, 98 VA. L. REV. 1665, 1674−77 (2012) (providing a general discussion of the meaning of the term "bargaining power"); Sebastian Zimmeck, *A Game-Theoretic Model for Reasonable Royalty Calculation*, 22 ALB. L.J. SCI. & TECH. 357, 375−406 (2012) (considering how the *Georgia-Pacific* factors relate to bargaining power). Since the court rejected the 25% rule of thumb as a basis for assessing a reasonable royalty in *Uniloc USA, Inc. v. Microsoft Corp.*, 632 F.3d 1292, 1315 (Fed. Cir. 2011), some expert witnesses have invoked a Nash Bargaining Solution, which assumes equal bargaining power, so that the parties would split the available surplus 50/50. *See, e.g.*, Virnetx, Inc. v. Cisco Systems, Inc., 767 F.3d 1308, 1331 (Fed. Cir. 2014). The Federal Circuit rejected this approach, however, in *Virnetx, id.* at 1331−34, as insufficiently tied to the facts. This is consistent with our view that "bargaining power" needs to be unpacked before one can usefully apply it in assessing a reasonable royalty.

176. *Cf. Virnetx*, 767 F.3d at 1330 (noting that royalty analysis involves uncertainty).

177. See, for example, *TWM Manufacturing Co. v. Dura Corp.*, 789 F.2d 895, 899 (Fed. Cir. 1986), in which the defendant argued that the patentee "had an unproven product he was desperate to license to a company like Dura with marketing and manufacturing expertise." On these facts, this appears to have been simply a baseless assertion, and nothing in the decision turned on it.

rewarded simply because it would have provided the distribution system if they had negotiated at the time of the first infringement even though it did not actually do so.[178]

In all of these cases, it is necessary to use ex post information to determine the service actually provided by the infringer. This avoids giving the infringer a windfall by rewarding it for a service that it did not actually provide.

## G. *Noninfringing Alternatives*

As noted above, one factor that is always relevant in negotiating patent royalties, real or hypothetical, is the potential licensee's ability to avoid using the patented invention at all by opting for a noninfringing alternative.[179] If, for example, the parties expect that the potential licensee would earn $100 in profits by using the patented invention and $80 from the next-best alternative, the patented invention is worth only $20 to the licensee. On these facts, the licensee's maximum willingness to pay for a license would be less than or equal to $20 plus the cost of acquiring the next-best alternative.[180] More generally, the value of the patented invention to the licensee is capped at the benefit the licensee derives from the patent over and above the benefit it would derive from using the next-best noninfringing alternative. By this same logic, if there are no feasible noninfringing alternatives, the patent owner can extract the entire value of the use (in the above example, $100). But what if a proposed alternative's status as infringing or noninfringing is determined only after the date on which the hypothetical negotiations occur?

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178. Jarosz & Chapman, *supra* note 32, at 790, (arguing that "[a] patent holder does not become *more injured* by unauthorized use if it enjoys a stronger bargaining position, and it does not become *less injured* by such unauthorized use if it enjoys a weaker bargaining position"). If the concept of bargaining weakness is unpacked, we disagree. A patent holder who can extract a higher share of the incremental profit because it has a good alternative distribution system is more injured by infringement than a patentee was not in a position to distribute its own product.

179. *See supra* Section I.A.

180. If the next-best alternative technology is in the public domain, the cost of acquiring it is zero. If the alternative itself is patented, the cost of acquiring it is the cost of obtaining a license. If the two patentees engage in Bertrand competition, this too would be zero, while under other (possibly more common) scenarios it might be positive. Judge Holderman discusses these issues to some extent in *In re Innovatio IP Ventures, LLC Patent Litig.*, MDL No. 2303, No. 11 C 9308, 2013 WL 5593609, at *20 (N.D. Ill. Oct. 3, 2013) (concluding that the court would consider patented alternatives but "that they will not drive down the royalty in the hypothetical negotiation by as much as technology in the public domain").

A recent case on point is *AstraZeneca AB v. Apotex Corp.* [181] AstraZeneca (Astra) owned a patent on the compound omeprazole, which it marketed as a gastrointestinal drug under the brand name Prilosec; this patent expired in 2001.[182] Astra also owned two patents pertaining to a specific formulation of omeprazole; these patents expired in 2007.[183] Between 2001 and 2007, therefore, generic drug companies could market omeprazole only if they avoided using Astra's patented formulation.[184] The first such company to do so, KUDCo, began marketing a noninfringing omeprazole product in 2002 using its own patented formulation.[185] The following year, three other companies (Mylan, Lek, and Apotex) produced generic omeprazole "at risk," that is, before any court had determined whether their formulations infringed.[186] In 2007, a court ruled that Mylan's and Lek's formulations did not infringe but that Apotex's formulation did.[187] The question before the court in 2013, therefore, was the amount of damages that Apotex owed Astra, based on a hypothetical negotiation just prior to the date on which Apotex began infringing in November 2003.[188]

Apotex argued that but for the infringement, it could have launched a competing product by copying the noninfringing formulations employed by Mylan and Lek.[189] The court rejected this argument on the basis that the ex post information available at the time of the hypothetical negotiation is limited to knowledge that the patent at issue is valid and infringed, and does not extend to knowledge of whether alternatives are infringing: "The hypothetical negotiation framework does not treat the parties as having knowledge of all events between the negotiation and the finding of infringement simply because it requires them to assume that the Patents are valid and infringed."[190]

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181. 985 F. Supp. 2d 452 (S.D.N.Y. 2013), *aff'd in relevant part*, 782 F.3d 1324 (Fed. Cir. 2015). A variation on this theme arose in *Innovatio*, 2013 WL 5593609, at *20 (rejecting the argument that the court should consider, as a possible noninfringing alternative, a patent that existed but that the IEEE did not consider at the time of standard adoption). For reasons discussed in the text above, we believe the court should have taken the patent into account.

182. *AstraZeneca*, 985 F. Supp. 2d at 459.

183. *Id.*

184. *See id.*

185. *Id.* at 463.

186. *Id.* at 463–64.

187. *See id.* at 464 n.7.

188. *Id.* at 459.

189. *Id.* at 481.

190. *See id.* at 481, 500 n.36. The facts of the case were more complex and did not present this issue so clearly. The court concluded that, as of November 2003, Apotex lacked the ability to employ the noninfringing alternative formulations used by Mylan and Lek. *See id.* at 481. This would have justified the court's conclusion even on the contingent ex ante approach, albeit for different reasons. Moreover, like KUDCo, Mylan and Lek also owned patents relating to their

Our view is that, on the contrary, courts should assume that parties bargain ex ante with knowledge of all relevant information that is revealed ex post, including the existence of noninfringing alternatives, even though in reality this information remained uncertain until 2007.[191] As noted above, the value of an invention to a licensee *is* its marginal value compared to the noninfringing alternative.[192] If the patent can in fact be invented around relatively easily, then it is not a valuable contribution to the art, even though it may be difficult to know in advance which of the various easily developed alternatives actually infringe. Put another way, patents are intended to reward valuable technical innovations, not to reward the uncertainty inherent in the patent system; excluding ex post information from the hypothetical negotiating parties' information set effectively enables the patent owner to extract rents based precisely on such uncertainty.[193]

Similarly, suppose that the ex post information at issue was that KUDCo's patent was invalid, and the noninfringing product sold by KUDCo would have been the best noninfringing alternative at the unpatented price. On our analysis, Apotex's damages should be calculated on the basis that the parties would have known that KUDCo's patent was invalid at the time of the hypothetical negotiation. If the examination of KUDCo's patent had been more rigorous, the patent would not have issued in the first place, and Apotex's damages should not turn on the vagaries of the examination process. Whether KUDCo's patent examiner was more or less experienced, or was trying to close the file to get away early on a Friday afternoon, should have no bearing on Apotex's liability. Thus, as in our other examples, the use of ex post information better correlates the patent owner's private reward with the invention's social value. Moreover, in such situations, the use of actual facts, as opposed to recreating the hypothetical licensee's expectations, should be administratively much simpler.

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formulations. *See id.* at 481, 500 n.36. How to proceed when the alternative itself is patented is a separate question. *See supra* note 181.

191. *See id.* at 459.

192. *See supra* text accompanying note 51.

193. Note also that if potential infringers are systematically irrationally pessimistic about whether an alternative product infringes, use of the pure ex ante approach inflates the return to weak patents. Conversely, the incentive to create would be undermined if it turns out that infringers are systematically overoptimistic on this issue. In any event, the reward for invention should not turn on the quirks of behavioral psychology any more than on the uncertainty inherent in the legal system.

## H. *Administrability and Evidentiary Considerations*

We have argued that courts generally should use ex post information to determine the reasonable royalty, because doing so enables a more accurate determination of the value of the invention. But the overarching principle is that the royalty should be commensurate with the true value of the invention. Normally this requires using ex post information, but sometimes using ex ante information may provide a better assessment of the true value of the invention. *Hanson v. Alpine Valley Ski Area, Inc.* illustrates this point,[194] as the court (correctly) assessed royalties based only on ex ante information.

The court in *Hanson* made two main points in coming to its conclusion. We will call these the insurance argument and the evidentiary argument.[195] While the insurance argument is intuitively very appealing, ultimately it is wrong, but the evidentiary argument alone provides a complete justification for the holding.

Hanson held a patent for a snow-making machine for use at ski hills.[196] The patented invention was a radically new technology that was much more efficient than the prior art.[197] The royalty assessed by the magistrate and affirmed by the Federal Circuit was one-third of the expected cost saving of using the invention as compared with the older technology.[198] In practice, this meant that the royalty was a fixed rate based on the capacity of the snow-making machine, regardless of the amount the machine was actually used. The infringer, Alpine, argued that the royalty should have been based on its actual use, which Alpine asserted was much lower than the average or expected use.[199]

The Federal Circuit rejected the defendant's arguments, for two reasons. The first is what we will refer to as the insurance argument:

> [A] royalty based upon actual use would have been inconsistent with the function snowmaking equipment serves at a ski resort and the reasonable needs and expectations of both the licensor and the licensee. A resort has snowmaking machinery to enable it to function at times when there is no or insufficient natural snow. As the magistrate stated, the resort hopes that "natural snow will always be sufficient and that artificial snow will never be needed." He noted that the "machines insure the business can function without natural snow" and that Hanson's "expert

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194.  718 F.2d 1075, 1079 (Fed. Cir. 1983).
195.  *See id.* at 1080.
196.  *Id.* at 1076.
197.  *See id.* at 1076.
198.  *Id.* at 1077, 1083.
199.  *See id.* at 1080.

likened the machine to an insurance policy." The magistrate justifiably concluded that in these circumstances "[t]he number of hours a machine is used is irrelevant; the desire is never to use the machine. The machine's utility simply does not depend upon its hours of operation."[200]

While there is some merit to this point, it is an overstatement to say that the actual use of the machine is "irrelevant" to the value of the invention. A ski-hill operator might count on opening earlier or extending the season beyond what normally would be permitted by using the machine. To this extent, the value of the machine resides not in its insurance function but rather in its use. Moreover, even if we ignore this aspect of the machine's value, there is still another substantial use value. Suppose that the operator does not intend to use the machine in this way but solely for insurance (for example to make snow after an unexpected mid-winter thaw). Use is still relevant to the insurance value of the machine because the invention will be worth more to an operator who encounters more such incidents. The invention will be much more valuable in a region with highly variable weather where several mid-winter thaws normally occur, than it will be in an area in which the weather is highly predictable. In the extreme, in an area in which mid-winter thaws never occur, no ski hill would bother buying the machine for insurance purposes. This means that snow-making for insurance purposes really has two components: it reduces the actual loss caused by variable weather, and it also reduces the loss caused by the uncertainty and attendant inability to plan. The first component depends on use, while the second is the pure insurance component.[201] So it is wrong to say that the machine's utility does not depend on its hours of operation.

Accordingly, one can assess the insurance component of the royalty in *Hanson*, as discussed above under "Risk Shifting" above, though there is a twist to that analysis.[202] The court in *Hanson* explicitly addressed the risk-shifting argument, stating that both parties would prefer a lump sum because it reduced risk on both sides:

> A royalty based on actual use would produce unsatisfactory results here for both the licensor and the licensee. If there were extensive snow during the season,

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200.  *Id.*

201.  Put another way, to the extent that the snow-making machine reduces the loss from a mid-winter thaw, its value lies in the amount by which it reduces the loss, which is to say its use. The fact that a reduction in loss reduces uncertainty is a separate benefit. This is true for any device that serves an accident prevention or insurance function; it will always be more valuable to a user who has more accidents. The only product that serves a pure insurance function is monetary insurance itself.

202.  *See supra* Subsection II.E.1.

there would be little use of the machine and the patentee would receive an inadequate return for the value of his invention. On the other hand, if there were little or no snow, the licensee would have to pay exceptionally large royalties.[203]

A first point to note is that a lump sum is normally said to shift risk from the patentee to the user, rather than reducing the risk to both. However, with some caveats, the court's analysis in *Hanson* is correct in suggesting that in this case a lump sum would reduce risk to both parties.[204] The court is wrong to say that the patentee would receive an inadequate return under a running royalty because higher royalties in years of little snow would offset lower royalties in years of extensive snow.[205] Nevertheless, a lump sum does reduce risk to the patentee, as compared with a running royalty, and the patentee might have preferred a lump sum for that reason. What is unusual about *Hanson* is that a lump sum also reduces the risk to the user. Normally, a lump sum increases risk to a user faced with an uncertain demand for the patented product because under a running royalty, the amount owed by the user is higher when demand (and hence profits) are high, and lower when demand (and hence profits) are low.[206] But in *Hanson*, the correlation runs the other way. When there is no snow and profits would otherwise be low, payments under a running royalty will be high; when there is plenty of snow and higher profits, payments will be low.[207]

This unusual relationship between risk and the nature of the royalty does not change our basic analysis discussed above.[208] First, even if the patentee would have preferred a lump sum because it would have reduced the patentee's risk, infringement by the user does not reduce the patentee's risk in the same way. A hypothetical negotiation based only on ex ante information would reward the infringer as if it had borne some of the risk, even though it did not. The fact that the infringer would also have preferred a lump sum from a risk perspective does not change this.

Second, the point remains that using a hypothetical negotiation based only on ex ante information to replicate risk shifting would be the tail wagging the dog. The risk-shifting motivation might have been quite a minor consideration in the actual case. A running royalty on the facts of

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203.  *See Hanson*, 718 F.2d at 1080.

204.  *See id.*

205.  *See id.*

206.  Similarly, where the patent's principal function is to reduce the cost of production, a lump sum would increase the user's risk of cost uncertainty.

207.  Put another way, if use of the snow machine fully compensates for variable snowfall, profits will be constant in all states of the world, but royalty payments will be variable under a running royalty, thus increasing the risk to the user as compared with a lump sum. *See id.*

208.  *See supra* Subsection II.E.1.

*Hanson* would have given rise to a serious monitoring problem, as discussed below, and absent evidence of substantial risk aversion on the part of the parties, we expect that monitoring concerns probably were the main factor leading the parties to prefer a lump sum. Moreover, using ex ante information also would distort the primary goal of ensuring that the patent incentive is preserved. Both of these considerations weigh heavily against replicating a hypothetical lump sum based on ex ante information merely to preserve the risk-shifting effect. The point here is that replicating the risk-shifting arrangement implicit in a lump-sum royalty is not a sufficient reason to assess the royalty using only ex ante information, even in an unusual case like *Hanson* where a lump sum would reduce risk to both parties.

With all that said, we are of the view that *Hanson* was correctly decided. To see why, imagine how the ex post allocation of risk shifting would actually work on the facts in *Hanson*. To assess damages using ex post information, we would first have to assess the amount that the invention was actually used and assess damages for use accordingly. To this use value, the court would then need to add a separate component to reflect the insurance value. In principle this can also be assessed on an ex post basis; the insurance function is more valuable the more the weather fluctuates from seasonal averages at a particular ski hill. Again, to the extent that the parties' ex ante expectations are accurate, the insurance value assessed ex post will be the same as the expected insurance value ex ante.

This approach to assessing damages will no doubt strike the reader as being very impractical, and we agree. In order to determine the appropriate use and risk rates, it would be necessary to deconstruct those rates by looking at the use and risk associated with typical customers, separate out (somehow) the use and risk components, then determine the use and risk faced by the particular infringer and apply the deconstructed rates to the actual usage. This would be impossibly complex, not least because actual customers did not actually negotiate separate use and risk rates. Consequently, this approach should not be used—but because it is impractical, not because it is wrong in principle.

This leads to a second key point. The evidence was that Hanson would only have granted licenses at a uniform rate and that it did not grant—and would not have granted—licenses based on use.[209] Why not? One major reason for this, as the court explained, is that "it would have been extremely difficult to monitor actual use. Apparently no complete or accurate records were kept of the actual use of the Hedco machines at Alpine's resort."[210]

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209.  *Hanson*, 718 F.2d at 1077.

210.  *Id.* at 1080.

There are two important points here. The first is that the patentee did not license on a use basis because of the difficulty of monitoring use.[211] The second is that it would be very difficult for the court to assess damages based on actual use because the evidence of actual use is very unreliable.[212] The patentee itself could not monitor that use, and the infringer had no incentive to do so either, and did not.

In our view, this provides a simple and compelling justification for the result in *Hanson*. Recall that the basic argument in favor of using ex post information is that it provides a simpler and more accurate assessment of the true value of the invention than does the parties' ex ante expectations. While we have argued that this is often true, ultimately that argument turns on practical evidentiary considerations. We acknowledge that if the parties' ex ante expectations are correct on average, then there will be no difference between the two approaches from an incentive perspective. Our argument therefore reduces to the proposition that ex post information is more likely to be accurate than ex ante expectations. But even if this is true about information in the abstract, there is no such thing as information in the abstract. In any particular case the argument will turn on the relative reliability of specific evidence actually available. In a case such as *Hanson*, it is almost certainly true that the ex ante expectations of the parties are better evidence of the actual value of the invention than an attempt to ascertain what the ex post value would be.[213]

As we have emphasized, the fundamental principle is that the damages award should be commensurate with the true value of the invention. We have argued that in many contexts, taking into account ex post information allows for a more accurate assessment of the true value of the invention. But *Hanson* provides an example in which it is almost certainly cheaper and more accurate to assess damages solely on the basis of expected value, rather than to make a determination on the basis of ex post evidence, which is, in the particular context, very unreliable.

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By means of the examples discussed in this Part, we have shown that the contingent ex ante approach provides a better framework for accurately determining the (non-holdup) value of patents in a variety of

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211. *See id.*

212. *See id.*

213. One might speculate that, given the various proposed strategic advantages of using some form of running royalty as discussed in Section II.E, parties are most likely to agree to lump-sum royalties in contexts similar to *Hanson* where it would be disproportionately costly to monitor the amount of the licensee's use. Agreements of this type may be fairly common in reality, even if cases such as *Hanson* in which monitoring costs are high both ex ante and ex post typically generate insufficient stakes to appear frequently among the reported decisions.

settings, by enabling courts to take into account value-relevant ex post developments, such as the inclusion of the patent in a chosen standard, an increase or decrease in demand for goods incorporating the patent, regulatory approval (or not) of the patented product for marketing, and the demonstrable availability of noninfringing alternatives. The approach also allows courts to avoid formalistic inquiries into whether an infringer has committed one act or multiple acts of infringement, and it ensures that the damages judgment properly reflects both services rendered and burdens avoided by the infringer. At the same time, the approach is flexible enough to accommodate the use of ex ante information in the (probably atypical) case in which the cost of acquiring ex post information would be prohibitive. The contingent ex ante approach therefore provides not only a principled explanation for certain otherwise anomalous aspects of current law, as described in Part I, but also an economically sound basis for resolving a host of difficult questions surrounding the measurement of damages in specific cases.

CONCLUSION

Commentators often seem to assume that there are only two theoretical options for calculating a reasonable royalty: what we have referred to above as the "pure" ex ante and ex post approaches. Under the pure ex ante approach, the court attempts to construct the bargain the parties would have negotiated prior to infringement—ex ante—on the basis of information that was available to them at that time.[214] On this view, ex post information is relevant only to the extent it provides circumstantial evidence of what the parties' ex ante expectations might have been. So stated, the pure ex ante approach avoids holdup—basing the royalty in part on the defendant's sunk costs, which do not reflect the value of the invention—but nevertheless must provide for ad hoc exceptions to account for the assumption of validity and infringement and for the use of a royalty base comprising actual, ex post sales. By contrast, under the pure ex post approach, a court would attempt to replicate the bargain the parties might have reached at some point after the defendant began infringing, possibly as late as the date on which judgment is entered. Because it uses more accurate information about the actual value of the invention, the pure ex post approach may seem to better align the patentee's reward with the social value of the invention; but unless an ad hoc exception is made to *this* approach, the holdup problem looms large, particularly (though certainly not exclusively) in cases involving SEPs.

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214. The lesser-used "analytical" approach, *see supra* note 8, does not necessarily involve the construction of a hypothetical bargain, but like the pure ex ante approach, it uses ex ante information—the defendant's projected profits from the use of the invention.

This Article demonstrates that decoupling the *timing* of the hypothetical negotiation from the *information set* available to the hypothetical negotiators enables courts to enjoy the best of both worlds by positing a hypothetical ex ante bargain that occurs with full knowledge of all relevant information that is available ex post. The ex ante timing ensures that sunk costs are excluded from consideration because these costs would not factor in to an ex ante bargain. Even if the parties could foresee the subsequent magnitude of these costs if they were to arise, they would bargain with knowledge that these costs never *will* arise because ex ante the parties either will negotiate to a license or the defendant will choose an alternative technology. At the same time, it allows the negotiation to occur in light of the best available information as to the actual value of the invention as disclosed by subsequent events. And while this might seem to be a highly unrealistic framework—absent time travel or precognition, no one really *can* bargain ex ante using ex post information—it is less artificial than a pure ex ante approach that is, after all, based on a *hypothetical* negotiation. The hypothetical aspect of both the pure and the contingent ex ante approaches is a necessary feature if we are to avoid holdup; unlike the pure ex ante approach, however, the contingent approach does not compound the hypothetical nature of the inquiry by ignoring real-world information that emerges ex post. Using this information should lead to a more accurate estimate of patent value and thus better align the patentee's reward with the purposes of the patent system.

Finally, we have analyzed how the contingent ex ante approach should apply in a variety of settings—including cases involving SEPs (whether FRAND-committed or not), sequential infringement, regulatory uncertainty, and unexpected exogenous events—while recognizing that there may remain certain discrete cases in which reliance upon ex ante information may be necessary because the cost of acquiring ex post information is prohibitive. As a general matter, however, our proposed framework promises greater accuracy at lower cost than do either of the two pure approaches, while at the same time providing a principled and unifying explanation for a variety of features of patent remedies.