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# THE MEANING OF FRAND, PART I: ROYALTIES

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ABSTRACT

What does it mean for a patent holder to commit to a standard-setting organization (SSO) to license its standard-essential patents (SEPs) on fair, reasonable, and nondiscriminatory (FRAND) terms? When is a royalty FRAND? Drawing from both legal theory and economic theory, I propose an interpretation of FRAND that distinguishes and reconciles the conflicting definitions of FRAND and provides courts a practical approach to identifying FRAND royalties. A proper understanding of a FRAND royalty requires recognizing the combinatorial value of standard-essential patents. That recognition reveals the fallacy in attempting to apply the "*ex ante* incremental value" rule to the determination of a FRAND royalty. FRAND royalties divide the aggregate royalties generated by the standard among the holders of patents essential to the standard. Such a division should maximize the surplus resulting from the standard's creation. It must also satisfy an individual-rationality constraint for the patent holder and the licensee, thereby encouraging continued participation in the setting and implementation of open standards, as opposed to greater reliance on proprietary standards.

*JEL*: D21; D23; K11; K12; O31; O34

## I. INTRODUCTION

What does it mean for a patent holder to commit to a standard-setting organization (SSO) to license its standard-essential patents (SEPs) on fair, reasonable, and nondiscriminatory (FRAND) terms? When is a royalty FRAND? Drawing from both legal theory and economic theory, I propose an interpretation of FRAND that would be acceptable—owing to its fairness and efficiency—to someone in the original position, cloaked in a Rawlsian veil of ignorance that prevents him from knowing whether he will ultimately be a net

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infringer or net licensor of SEPs.[1] Courts and other tribunals could feasibly administer this interpretation of FRAND in the many disputes concerning smartphones and other technologically complex products that read upon hundreds or thousands of patents.

In Part II of this article, I explain how an economist measures, in the simplest case, a reasonable royalty for infringement of a patent that is not essential to any standard. This simple case uses a model of bilateral bargaining—the hypothetical negotiation between a willing licensor and a willing licensee at the time of first infringement of the patent in suit. The size of the bargaining range depends in part on the incremental value that the patent in suit creates for the infringer relative to the value created by the next-best noninfringing substitute available to the infringer. Importantly, I clarify that the incremental value of a patent must include the infringer's cost of acquiring the next-best alternative.

In Part III, I explain the FRAND requirements in the intellectual property rights (IPR) policies of the SSOs most involved in setting standards for mobile devices and networks. I next explain why it is erroneous to apply the simple bilateral bargaining model to the complex, multilateral case of FRAND licensing of SEPs. Understanding a FRAND obligation requires understanding the economic significance of the combinatorial value of standard-essential patents. This understanding in turn reveals the fallacy in attempting to apply the "incremental value" rule to determine a FRAND royalty for the infringement of an SEP. If a patent is indeed essential to making downstream products that read on a standard, then it logically follows that the patent does not have a substitute, including the notional noninfringing substitute that courts attempt under existing law to identify for purposes of determining a reasonable royalty for infringement. All standard-essential patents must be used in fixed proportion. By definition, therefore, they are nonsubstitutable. So it makes no sense to engage in an exercise that requires hypothesizing that there exists for a nonsubstitutable patent a noninfringing

Croce, Peter Culham, Nicola Dagg, Richard Dickinson, Maurits Dolmans, Götz Drauz, Michael Engel, Huw Evans, Nicholas Fox, Tim Frazer, Mark Friend, David Gabathuler, Mark Gardner, Thomas Graf, Michael Grenfell, Patrick Gorman, Alejandro Guerrero, Kirti Gupta, Dietmar Harhoff, Oliver Heinisch, Michele Herman, Susan Hinchliffe, Roy Hoffinger, Christophe Humpe, Edward Kling, Michael Knapper, David Leichtman, Mark Lemley, Timothy Lindsay, Guy Lougher, Martin Mandorff, Philip Mansfield, Donald McCombie, Douglas Melamed, James Modrall, Andrew Moir, Soojin Nam, Charles Pommiès, Miguel Rato, Terry Ridout, Paula Riedel, Pat Roach, Juan Rodriguez, David Salant, Jürgen Schindler, Benjamin Schröer, Mark Seidman, Omar Shah, Daniel Spulber, Russell Steinthal, David Swain, Anna Vernet, Justin Watts, David Wilson, Gunnar Wolf, and Tony Woodgate. I have been an expert economic witness to Ericsson and other companies involved in litigation over FRAND royalties. However, the views expressed here are solely my own, and this article has not been commissioned by any company or organization.

[1] *See* JOHN RAWLS, A THEORY OF JUSTICE 12 (Belknap 1971); *see also* KEN BINMORE, NATURAL JUSTICE 15 (Oxford Univ. Press 2005); WILLIAM J. BAUMOL, SUPERFAIRNESS: APPLICATIONS AND THEORY 9 (MIT Press 1986) ("Superfairness analysis . . . . derives from . . . . the games of fair division. Everyone knows the procedure that can be used to assure that two people will divide a cake fairly: one of them cuts the cake into two parts and the other then chooses.").

substitute. It is therefore necessary to confine the incremental value method for calculating damages to infringement of standard-*in*essential patents, known among patent law practitioners as implementation patents.

In Part IV, I explain the problems with applying the incremental value approach to measuring a FRAND royalty for SEPs, which bases the FRAND royalty on the incremental value of the patent above the value of substitute patents, which competed with the patent in suit for adoption into the standard. First, I question whether it is intellectually rigorous or even practical to apply the *Georgia-Pacific* factors[2] to the FRAND context. Second, a main judgment in Judge Robart's April 2013 ruling in *Microsoft v. Motorola*[3] was that the FRAND royalty should not include any value accreting to the patent from its adoption into the standard. Thus, Judge Robart adopts the *ex ante* incremental value approach. I explain why the *ex ante* incremental value approach for calculating FRAND royalties is inconsistent with Judge Robart's other premise, that FRAND royalties should encourage participation into the standard, because it fails to compensate patent holders for additional risk associated with participating in the setting of open standards. Third, I explain how Judge Holderman's October 2013 decision in *Innovatio IP Ventures*[4] addresses some of the flaws of Judge Robart's opinion.

In Part V, I provide an economic framework for calculating FRAND royalties that reconciles the many disparate views on the meaning of FRAND. A FRAND royalty satisfies the *individual-rationality constraint*, under which both the SEP holder and the implementer are better off with the license than without it. A royalty is FRAND if it (1) ensures the SEP holder's continued participation in standard setting, (2) does not deny the implementer access to the standard, (3) is consistent with a reasonable aggregate royalty burden for all SEPs on the implementer's standard-compliant product, and (4) approximates the royalty rates of similarly situated licenses. The SEP holder and the implementer each must expect to profit more by participating in the SSO than by forgoing such participation. The individual-rationality constraint provides a bargaining range for a FRAND royalty. The lower bound is the SEP holder's minimum willingness to accept, equal to the SEP holder's opportunity cost of choosing to monetize its inventions by participating in the setting of an open standard and licensing its SEPs to all comers on FRAND terms. The upper bound is the licensee's maximum willingness to pay for the patents as SEPs. I also explain why setting a FRAND royalty as the *ex ante* incremental value of the SEP is unworkable in practice.

In Part VI, I explain how the FRAND commitment resembles an ancillary restraint in antitrust law, without which joint venturers could not bring a new

[2] Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970).

[3] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

[4] Memorandum Opinion, Findings, Conclusions, and Order, Innovatio IP Ventures, LLC Patent Litigation, No. 11-cv-09308 (N.D. Ill. Oct. 3, 2013) (No. MDL 2303) [hereinafter RAND Opinion in *Innovatio*].

product into being. The challenge lies in dividing the producer surplus among SEP owners. The law of fiduciary duty and the principles of equity can guide courts in preventing opportunistic behavior that would jeopardize the value created by the production of downstream products resulting from the aggregation and exploitation of the SEPs. Put differently, the existence of fiduciary duties and the availability of equitable remedies reduce the likelihood that royalty stacking will occur.

In Part VII, I adapt the FRAND model to the considerably more complex case in which bargaining takes place with respect to portfolios of SEPs, and one must determine the FRAND royalty for a single SEP. I examine five alternative methods for dividing the joint surplus among SEP holders based on (1) heuristic use of the Lorenz curve, a tool that economists have used for measuring the distribution of income inequality of nations, (2) the Shapley value from game theory, (3) bargaining theory and the ultimatum game, (4) patent counting, and (5) patent pools. These methods will require further refinement before they are implementable.

A sequel to this article will examine the meaning of FRAND as it pertains to the patent holder's right to seek an injunction against infringers and to the duty of members of an SSO to negotiate a FRAND royalty in good faith.[5]

## II. THE SIMPLE CASE OF A REASONABLE ROYALTY FOR INFRINGEMENT OF A NON-STANDARD-ESSENTIAL PATENT

In the simplest case, patent infringement is a form of involuntary exchange, whereby the infringer acquires use of the patent without the consent of the patent holder. Reasonable-royalty damages are based on the notion that, had the transaction between the patent holder and the infringer been *voluntary*, the infringer would have paid the patent holder a royalty for the use of the patent. Calculating reasonable-royalty damages entails estimating the royalty that the patent holder would have collected from the infringer, starting at the time of first infringement.[6]

[5] *See* J. Gregory Sidak, *The Meaning of FRAND, Part II: Injunctions* (forthcoming 2014) (on file with author).

[6] One district court judge in the Eastern District of Texas, for example, uses the following jury instruction on reasonable royalties:

> A reasonable royalty is the amount of money a willing patent holder and a willing prospective licensee would have agreed upon at the time of the infringement for a license to make the invention. It is the royalty that would have resulted from an arms-length negotiation between a willing licensor and a willing licensee, assuming that both all parties are presumed to know that the patent is infringed and valid. The reasonable royalty you determine must be a royalty that would have resulted from the hypothetical negotiation, and not simply a royalty either party would have preferred. Evidence of things that happened after the infringement first began may be considered in evaluating the reasonable royalty only to the extent that the evidence aids in assessing what royalty would have resulted from a hypothetical negotiation.

## A. The Bargaining Range in the Hypothetical Negotiation

An economic approach to analyzing the hypothetical negotiation is to determine the bounds of the bargaining range. Those bounds are the minimum royalty that the patent holder would accept (while still being better off than without issuing a license) and the maximum royalty the infringer would be willing to pay (while still being better off than without being issued a license). Because the hypothetical voluntary transaction necessarily makes both parties better off, a negotiated royalty must fall between these upper and lower bounds, which define the bargaining range. Testifying expert economists have widely accepted this approach.[7] Figure 1 depicts the bargaining range.

### 1. *The Upper Bound of the Royalty Range and Clarification of the Patent's Incremental Value*

The maximum lump-sum royalty that the infringer would have been willing to pay equals the incremental profits that it would expect to earn by licensing the infringed patent rather than using the next-best noninfringing substitute over the infringement period. Important considerations are whether there exist any noninfringing substitutes or "design-arounds" and what the costs of implementing and using those design-arounds are in relation to using the patented technology. For example, a design-around may exist, but it could require from the would-be infringer a fixed cost to implement, could require greater ongoing marginal costs of production compared with what the would-be infringer could achieve with the patented technology, and could lead to a lower quality product (and thus lower sales at a lower price) compared with what the would-be infringer could achieve with the patented technology. To license the patent, the would-be infringer would be willing to pay a royalty up to the increase in profits resulting from the cost savings, the increased sales, and the increased price associated with using the licensed patent as opposed to using the next-best noninfringing substitute.

When the expected profits from using the next-best noninfringing substitute are close to the expected profits from using the patented input, the incremental profitability of licensing the patented input over using the next-best noninfringing substitute is small. The infringer's maximum willingness to pay would therefore be low. The maximum royalty would also be low.

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Final Jury Instructions at 24–25, Ericsson Inc. v. D-Link Sys., Inc., No. 6:10-cv-00473 (E.D. Tex. June 12, 2013), ECF No. 504 (Davis, J.). "The framework which you should use in determining a reasonable royalty is a hypothetical negotiation between *normally prudent business people*." *Id.* at 28 (emphasis added).

[7] *See, e.g.*, FED. TRADE COMM'N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 166–67 (Mar. 2011); Jerry A. Hausman, Gregory K. Leonard & J. Gregory Sidak, *Patent Damages and Real Options: How Judicial Characterization of Noninfringing Alternatives Reduces Incentives to Innovate*, 22 BERKELEY TECH. L.J. 825, 831–33 (2007).

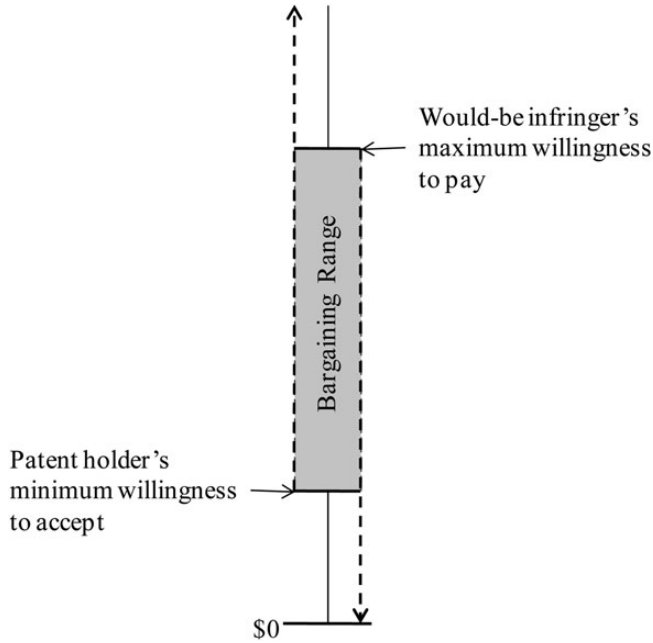


**Figure 1.** Reasonable-royalty bargaining range

The incremental value of a patent (implementation or standard-essential) to a licensee is the increase in the licensee's profits that results from using the patented technology rather than the next most profitable alternative to the patented technology. That is, the incremental value of a patent to the licensee is equal to the increase in profits from licensing, not including the cost of the license. Too often, the focus of incremental value analysis is on revenues, not profits. Calculating incremental value based on revenue does not include the potential licensing costs of the next-best alternative to the patented technology. That oversight can lead to two different mistakes of economic reasoning. First, it can lead to an understatement of the incremental value of the patent. Second, it may identify an incorrect next-best alternative.

The incremental value of patent *A* is equal to the profit generated using patent *A* minus the profit generated using technology *B*. Technology *B* may be a patented technology that the licensee already licenses, one that the licensee does not currently license, or a non-patented technology in the public domain. In any of the three cases, to measure a licensee's willingness to pay for the patent accurately, the profit generated using *A* must be compared with the profit from using *B*, *including the costs of acquiring the rights to technology B*. In some cases, it might be possible for the alleged infringer to acquire the rights to technology *B* at zero additional expense. But one cannot generalize this condition, and it is fallacious economic reasoning simply to assume that the

next-best alternative is free. The cost of acquiring *B* is a fact-specific inquiry that courts must determine on a case-by-case basis.

It is crucial that the costs of licensing the next-best alternative are included in the incremental value analysis to ensure that the next-best alternative is actually a lawful option for the licensee to use. If the next-best alternative is itself a patented technology, then failing to include the cost of licensing implicitly means that the analysis compares using patent *A* to *infringing* patent *B*. However, the set of alternatives must be limited to *lawful* alternatives; otherwise, the next-best alterative may turn out to be infringement or misappropriation in a broad range of situations.

The failure to include the licensee's cost of acquiring the lawful right to use the next-best alternative can lead to misidentification of the next-best alternative. Suppose that, relative to using a non-patented alternative, the use of patent *A* leads to increased revenue of $300, patent *B* leads to increased revenue of $200, and patent *C* leads to increased revenue of $100. If one neglects to include the licensee's costs of acquiring the lawful right to practice patent *B* or patent *C*, then patent *B* is the next-best alternative to patent *A*, because patent *B* results in higher increased revenue than does patent *C*. The licensee will be willing to pay up to $100 to license patent *A* (equal to $300 – $200, the difference between the expected revenue using technology *A* and technology *B*).

However, suppose the licensing cost of patent *B* is $150, whereas the licensing cost of patent *C* is only $25. The licensee would be willing to pay at most the additional revenue generated by the substitute patent—and the cost of licensing the patent. Thus, the actual incremental value of *A* relative to *B* is $250 (equal to $300 – ($200 – $150), the difference between increased revenue from using patent *A* and increased revenue under technology *B minus* the cost of licensing technology *B*). The actual incremental value of patent *A* relative to *C* is $225 (equal to $300 – ($100 – $25), the difference between the increased revenue from using patent *A* and the increased revenue under technology *C minus* the cost of licensing technology *C*).

Patent *C* is thus the next-best alternative to patent *A*, because, *net of its acquisition costs*, patent *C* would offer the licensee higher per-unit profits than patent *B* if the licensee were forced to resort to an alternative to avoid infringing patent *A*. The incremental value of patent *A* determines the maximum amount that a potential licensee will be willing to pay for a license to patent *A*. Including the costs of licensing patents *B* and *C*, a potential licensee will be willing to pay up to $225 for a license to patent *A*. Table 1 shows the numerical example.

Neglecting to consider the acquisition costs of the alternatives (patents *B* and *C*) both understated the incremental value of patent *A* and misidentified the next-best alternative to patent *A*. The incremental value of a patent is an important concept in determining royalties because it will determine the maximum value that a potential licensee is willing to pay for a patent. If one neglects to include the costs of acquiring the lawful rights to use the next-best

**Table 1.** Example of the identification of the next-best alternative and the incremental value of a patent

| | **Patent *A*** | **Patent *B*** | **Patent *C*** |
|---|---|---|---|
| Added revenues | $300 | $200 | $100 |
| Acquisition cost | | $150 | $25 |
| Added profit (added revenues – acquisition cost) | | $50 | $75 |
| Incremental value of *A* relative to alternatives (added revenue from *A* – added profit from the alternative) | | $250 | $225 |

alternative in the calculation of the incremental value, then the analysis could understate or overstate the prospective licensee's actual willingness to pay.

*2. The Lower Bound of the Royalty Range*

The minimum royalty that the patent holder would be willing to accept to grant a license for the patent in suit is a function of the losses (in terms of forgone royalties) that it would sustain by licensing rather than not licensing the patent. In other words, the licensor's willingness to accept depends on its opportunity cost of licensing the patent to the would-be infringer at the time of the hypothetical negotiation. For example, even if the patent owner does not compete with the infringer, and therefore would not lose profits due to lost sales in the downstream market, the patent owner might nonetheless lose other licensing opportunities by licensing to the infringer. In those circumstances, the patent owner would demand a royalty that at least replaced the profits that the lost licensing opportunities would have generated.

*3. The Negative Bargaining Range*

Suppose instead that the patent holder would not have willingly licensed its patented technology because doing so would cause its expected lost profits to exceed the would-be infringer's maximum willingness to pay for the license. This is the case of the negative bargaining range: there is no royalty to which both the patent holder and would-be infringer would have agreed at the time of first infringement. Figure 2 illustrates a negative bargaining range.

The outcome of a voluntary negotiation before infringement would be that no exchange occurs. In this scenario, the court should require the infringer to pay an amount equal to the patent holder's minimum willingness to accept in the hypothetical negotiation. One district court judge in the Eastern District of Texas, for example, gives the following jury instruction:

> An infringer's net profit margin is not the ceiling by which a reasonable royalty is capped. The infringer's selling price can be raised, if necessary, to accommodate a higher royalty rate. Requiring the infringer to do so, may be the only way to adequately compensate the patentee for the use of its technology.[8]

[8] *See supra* note 6. *See also* Memorandum Opinion & Order at 39, Ericsson Inc. v. D-Link Sys., Inc., No. 6:10-CV-473 (E.D. Tex. Aug. 6, 2013) (citing Douglas Dynamics, LLC v. Buyers

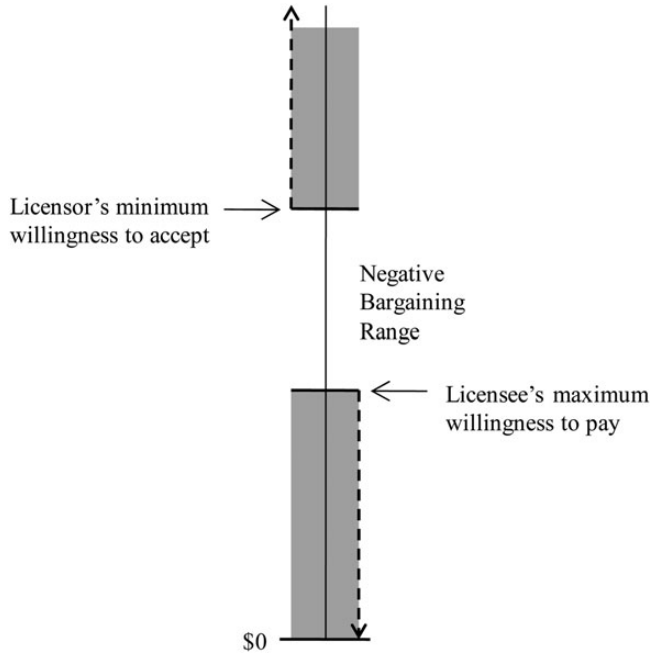


**Figure 2.** Negative bargaining range in a hypothetical, voluntary negotiation

Even though the amount would exceed the infringer's hypothetical maximum willingness to pay, that amount would be necessary to fully compensate the patent holder for its injury from patent infringement, as section 284 of the Patent Act requires.[9]

## B. The Point Royalty Within the Bargaining Range

The precise point royalty within the bargaining range should be informed by the relative bargaining power of the infringer and patent holder. If the patent holder had greater bargaining power in the hypothetical negotiation, it would secure a royalty above the midpoint of the bargaining range. Conversely, if the would-be infringer had more bargaining power, it would secure a royalty below the midpoint. The midpoint of the bargaining range is the natural starting point for one practical reason. One needs to start somewhere within the bargaining range, and the midpoint provides a straightforward reference point for making qualitative adjustments to determine the final point royalty. The

Prods. Co, 2013 WL 2158423, at *7 (Fed. Cir. May 21, 2013); Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1555 (Fed. Cir. 1995) (en banc)) (Davis, J.).

[9] 35 U.S.C. § 284.

justification for using the midpoint in the bargaining range as the starting point for selecting the point estimate of the reasonable royalty is strictly computational tractability. In particular, the use of the midpoint is not based in any way on the Nash bargaining solution, which at least two courts have deemed to be an inadmissible method for an expert witness to use to calculate the reasonable royalty in the hypothetical negotiation.[10]

In *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, the U.S. District Court for the Southern District of New York identified fifteen factors comprising "a comprehensive list of evidentiary facts relevant . . . to the determination of the amount of a reasonable royalty for a patent license."[11] The Federal Circuit has subsequently endorsed the framework, stating: "A reasonable royalty can be calculated from . . . a hypothetical negotiation between the patentee and infringer based on the factors in *Georgia-Pacific*[.]"[12] The fifteen factors are:

(1) The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty.

(2) The rates paid by the licensee for the use of other patents comparable to the patent in suit.

(3) The nature and scope of the license, as exclusive or non-exclusive; or as restricted or non-restricted in terms of territory or with respect to whom the manufactured product may be sold.

(4) The licensor's established policy and marketing program to maintain his patent monopoly by not licensing others to use the invention or by granting licenses under special conditions designed to preserve that monopoly.

(5) The commercial relationship between the licensor and licensee, such as, whether they are competitors in the same territory in the same line of business; or whether they are inventor and promoter.

(6) The effect of selling the patented specialty in promoting sales of other products of the licensee; the existing value of the invention to the licensor as a generator of sales of his non-patented items; and the extent of such derivative or convoyed sales.

(7) The duration of the patent and the term of the license.

(8) The established profitability of the product made under the patent; its commercial success; and its current popularity.

(9) The utility and advantages of the patent property over the old modes or devices, if any, that had been used for working out similar results.

[10] *See* Oracle Am., Inc. v. Google Inc., 798 F. Supp. 2d 1111, 1119 (N.D. Cal. 2011) ("a patent plaintiff would love the Nash bargaining solution because it awards fully half of the surplus to the patent owner, which in most cases will amount to *half* of the infringer's profit, which will be many times the amount of real-world royalty rates") (emphasis in original); Suffolk Tech. LLC v. AOL Inc., No. 1:12-cv-625 (E.D. Va. Apr. 12, 2013) (excluding the testimony of the damages expert for Suffolk, who used the Nash bargaining solution).

[11] Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970), *modified and aff'd*, 446 F.2d 295 (2d Cir. 1971).

[12] Wordtech Sys., Inc. v. Integrated Networks Solutions, Inc., 609 F.3d 1308, 1319 (Fed. Cir. 2010) (citing Lucent Tech., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009); Minks v. Polaris Indus., Inc., 546 F.3d 1364, 1372 (Fed. Cir. 2008)).

(10) The nature of the patented invention; the character of the commercial embodiment of it as owned and produced by the licensor; and the benefits to those who have used the invention.

(11) The extent to which the infringer has made use of the invention; and any evidence probative of the value of that use.

(12) The portion of the profit or of the selling price that may be customary in the particular business or in comparable businesses to allow for the use of the invention or analogous inventions.

(13) The 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.

(14) The opinion testimony of qualified experts.

(15) The amount that a licensor (such as the patentee) and a licensee (such as the infringer) would have agreed upon (at the time the infringement began) if both had been reasonably and voluntarily trying to reach an agreement; that is, the amount which a prudent licensee—who desired, as a business proposition, to obtain a license to manufacture and sell a particular article embodying the patented invention—would have been willing to pay as a royalty and yet be able to make a reasonable profit and which amount would have been acceptable by a prudent patentee who was willing to grant a license.

As applied in patent-infringement cases, the finder of fact first evaluates each relevant *Georgia-Pacific* factor individually and then performs a balancing test.[13] Determination of a reasonable royalty is a question of fact; consequently, evaluation of the patent holder's application of the *Georgia-Pacific* factors is a question for the jury, when there is one.[14]

In *Georgia-Pacific*, the court stated, after enunciating the fifteen factors, that "there is no formula by which these factors can be rated precisely in the order of their relative importance or by which their economic significance can be automatically transduced into their pecuniary equivalent."[15] In the decades since the emergence of the *Georgia-Pacific* factors, the Federal Circuit has not provided guidance on the relative weight of each factor. To the contrary, the Federal Circuit has noted, in a statement less helpful than candid, that "this analysis necessarily involves an element of approximation and uncertainty[.]"[16] Thus, the *Georgia-Pacific* balancing test remains undefined and left to the discretion of the finder of fact, until the Federal Circuit finds a suitable opportunity to disambiguate that test in a manner that eliminates its potential for unpredictable

[13] *See, e.g.*, *Lucent*, 580 F.3d at 1325–36.

[14] *See, e.g.*, Unisplay, S.A. v. Am. Elec. Sign Co., Inc., 69 F.3d 512, 517 (Fed. Cir. 1995).

[15] *Georgia-Pacific*, 318 F. Supp. at 1120–21.

[16] *Unisplay*, 69 F.3d at 517. Jurists have observed in general that multifactor tests that lack weights invite inconsistent outcomes. *See, e.g.*, Menard, Inc. v. Comm'r of Internal Revenue, 560 F.3d 620, 622–23 (7th Cir. 2009) (Posner, J.) ("Multifactor tests with no weight assigned to any factor are bad enough from the standpoint of providing an objective basis for a judicial decision; multifactor tests when none of the facts is concrete are worse." (internal citations omitted)); Antonin G. Scalia, *The Rule of Law as a Law of Rules*, 56 U. CHI. L. REV. 1175, 1179–80 (1989).

and arbitrary results. However, in *Whitserve, LLC v. Computer Packages, Inc.*, the Federal Circuit in 2012 did say that it "do[es] not require that witnesses use any or all of the *Georgia-Pacific* factors when testifying about damages in patent cases."[17] Damage experts should "concentrate on *fully* analyzing the *applicable* factors, not cursorily reciting all fifteen."[18] Thus, damage experts need to consider only the factors that are probative to the determination of the point royalty.

A given *Georgia-Pacific* factor (or any relevant qualitative factor) can shift the point value of the reasonable royalty toward the upper or lower bound, or it can have no effect on the royalty estimate whatsoever. When a factor suggests that the patent holder would have more bargaining power than the would-be infringer in the hypothetical negotiation, the factor supports a royalty above the midpoint. When a factor suggests that the would-be infringer would have more bargaining power, the factor supports a royalty below the midpoint. If a given factor was already implicated in the expert's calculation of the reasonable-royalty range, then that factor does not have any additional effect on the point estimate.

In applying the relevant *Georgia-Pacific* factors to determine the point royalty, it is not sufficient simply to conclude that a factor should shift the point royalty "upward" or "downward" (or not at all). The Federal Circuit stressed in *Whitserve* that, in considering the relevant factors, the damage expert must provide "some explanation of both why and generally to what extent the particular factor impacts the royalty calculation."[19] The determination of how a factor affects the point royalty must be tied to the facts of the case.

Once one determines the incremental effect of each relevant *Georgia-Pacific* factor on the relative bargaining power of the parties, one can determine the net effect of all the factors. It is likely that some factors should receive more weight and some should receive less weight—and some no weight at all. (Unfortunately, as noted above, *Georgia-Pacific* gives no guidance on the relative weighting for the fifteen factors.) It is the responsibility of the damage expert to consider all the relevant facts and apply them rigorously and reliably to the bargaining range to derive a point royalty.

Without further direction from the courts as to the proper weight that qualitative factors should receive in the calculation of the hypothetical reasonable royalty, one could start by identifying the relevant factors and then determine whether each factor supports a point royalty above or below the midpoint of the bargaining range. Assuming (for convenience rather than realism) that each factor should receive equal weight, one could divide the upper and lower bounds of the bargaining range into equal parts or "bands." One could sum the number of factors supporting a royalty above the midpoint and the number of factors supporting a royalty below the midpoint. The difference between

[17] Whitserve, LLC v. Computer Packages, Inc., 694 F.3d 10, 31 (Fed. Cir. 2012).
[18] *Id.* (emphasis in original).
[19] *Id.* at 31.

those two figures would determine how many "bands" above or below the midpoint the point royalty should be.

Suppose, for example, that the bargaining range were $100 and there were five relevant qualitative factors. The upper and lower half of the bargaining range would each be divided into five slices (equal to $10 each). (If all five of the factors support a royalty above (below) the midpoint, then the royalty would equal the upper (lower) bound of the bargaining range. The net effect of the factors cannot cause the royalty to exceed the bargaining range.) Suppose that four of the factors supported a royalty above the midpoint and one factor supported a royalty below the midpoint. Then, the net effect of the factors is to support a royalty above the midpoint by three slices, so the royalty would be $80. The assumption of equal weights is arbitrary but not capricious. It is objective and can serve as a useful starting point until such time that the Federal Circuit gives the damage experts or the jury (or both) explicit instruction on a different weighting to use.

### C. The Assumptions of Validity and Infringement in the Hypothetical Negotiation

The hypothetical negotiation presumes that the patent is valid and infringed.[20] This assumption is understandable in light of the general principle that patents are presumed valid, and overcoming this presumption requires clear and convincing evidence.[21] However, the presumption of validity and infringement contradicts—indeed, rejects—the theoretical argument of Mark Lemley and Carl Shapiro that the value of a patent is merely "probabilistic" in the sense that, until the patent is litigated, neither the licensor nor the licensee knows whether a court would actually find the patent to be both valid and infringed.[22] One may dispute the correctness of assuming, for purposes of determining a reasonable royalty, that the patent in suit is valid and infringed and instead argue, as Lemley and Shapiro do, that parties to a licensing negotiation occurring before litigation would value a patent at its expected value and thus discount the royalty for the probability that a court would not find the patent to be valid and infringed. For the time being, however, the assumptions of validity and infringement are what the Federal Circuit requires when one purports to apply a hypothetical-negotiation analysis to a given dispute.

The difference between the Federal Circuit's assumption of infringement and validity and the Lemley-Shapiro assumption of probabilistic valuation of

[20] *See* Lucent Tech., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324–25 (Fed. Cir. 2009); Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1554 n.13 (Fed. Cir. 1995) (en banc).

[21] *See* Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1354 (Fed. Cir. 2010) (en banc).

[22] *See, e.g.*, Mark A. Lemley & Carl Shapiro, *Probablistic Patents*, 19 J. ECON. PERSP. 75 (2005).

patents significantly affects the calculation of reasonable royalties. Because the hypothetical negotiation assumes that the patent in suit is valid and infringed, the royalty derived from the hypothetical-negotiation analysis (including assessment of the *Georgia-Pacific* factors) *must* exceed the royalty that would have resulted from real-world negotiations outside the context of litigation, where Lemley and Shapiro argue that the bid and ask are discounted for uncertainty.

The assumption of validity and infringement means that, holding all other factors constant, the royalty from the hypothetical negotiation for an asserted patent should exceed the royalty for the same patent in a real-world license negotiated with a third-party licensee similarly situated to the infringer. Consequently, observed royalties for similarly situated licensees should be less than the royalty that emerges from the hypothetical-negotiation analysis. If a court were to interpret the hypothetical negotiation as producing the same (probability-adjusted) royalty level as a real-world, non-hypothetical negotiation, then the court would create a free option for the infringer: Infringe the patent and, if eventually found liable, pay the same royalty as if you had negotiated a license before litigation commenced.[23] Thus, to preserve the patent holder's and the licensee's proper incentives to engage in licensing, the reasonable royalty emerging from the hypothetical negotiation must exceed the real-world royalty.

Judge Holderman emphasized this point in *Innovatio*.[24] He refused to adjust the license rate for SEPs whose essentiality was questionable before the court's adjudication. Judge Holderman recognized that, at the time of the hypothetical negotiation, the parties did not know whether the patents were truly essential. He also acknowledged that such adjustment "may seem reasonable," given that "[t]he hypothetical negotiation tries . . . to recreate the *ex ante* licensing negotiation scenario and to describe the resulting agreement."[25] Judge Holderman nonetheless explained that, at the time a court is evaluating damages in a patent infringement suit, it has determined whether the patent is valid and infringed, "foreclosing the hypothetical negotiator from benefiting from any uncertainty as to future court rulings."[26] The licensee "cannot leave the hypothetical negotiation on the ground that it will contest essentiality in court."[27] Judge Holderman thus concluded that "it would be inappropriate to adjust the RAND rate based upon pre-litigation uncertainty."[28]

[23] For a related argument about how damages for patent infringement can give infringers a free option, see Hausman, Leonard & Sidak, *supra* note 7 (describing how Grain Processing v. Am. Maize-Prods. Co., 185 F.3d 1341 (Fed. Cir. 1999), created a "free option" for infringers to use potentially infringing technology and later claim that it would have used a noninfringing technology had it known that the patent was valid and infringed).

[24] RAND Opinion in *Innovatio*, *supra* note 4.

[25] *Id.* at 12.

[26] *Id.* (citing LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 76 (Fed. Cir. 2012)).

[27] *Id.* at 13.

[28] *Id.*

### D. The Proud List and the Double Hypothetical Implicit in the Royalty Negotiation When Patents Are Instead Typically Licensed by Portfolio

There is an additional layer of unreality to the already hypothetical negotiation of the *Georgia-Pacific* analysis. A fundamental problem of the hypothetical negotiation is that the negotiation generally occurs over a bundle of patents rather than a single patent or a select few individual patents. The parties have no desire to negotiate a license for an individual patent, and therefore they have no need to value a single patent. Yet, when negotiations fail and litigation commences, the practical limitations of a trial require that only a subset of patents be litigated (with respect to claims construction, validity, infringement, defenses, and so forth). A patent holder does not assert every possibly infringed patent that it may have in its portfolio but instead typically limits the litigation to its "proud list"—patents that can best be shown to be infringed and that affect the largest part of the other party's revenue stream.[29] (The patent holder's ability to identify its strongest patents for litigation purposes confirms that, at least to some degree, it is possible to rank one's patents ordinally by value, a point whose significance will become clear later in Part VII). This phenomenon of trial by proud list is not, however, explicitly recognized anywhere in the *Georgia-Pacific* factors.

The hypothetical negotiation is therefore doubly hypothetical. It presumes not only that a hypothetical transaction between two willing parties would occur at a given price at a given point in time, but also that a hypothetical transaction between those same parties at that same point in time would occur *with respect to only a single patent (or only a subset of patents) in the patent holder's portfolio*. Like the courts applying *Georgia Pacific* before him, Judge Robart does not spot this problem when adapting the *Georgia-Pacific* analysis for SEPs in *Microsoft v. Motorola*.[30]

One way of reconciling this analytical leap in the application of *Georgia Pacific* to both patent portfolios and SEPs is to reason that, when the patent holder litigates only his proud list, each of his remaining patents contributes to the portfolio's value at a decreasing marginal rate. Hence, the royalty for the proud list is not much less than the license for the entire portfolio containing the proud list, such that the double hypothetical described here does not necessarily cause the *Georgia-Pacific* factors to produce a dramatically insufficient royalty. Courts could address this analytical leap by first evaluating the license fee that parties would negotiate for the entire patent portfolio and then adjust the value downward to limit the royalty damages to the patents asserted in the litigation. This question is a factual one that will allow different answers in

[29] *See, e.g.*, David J. Teece & Peter C. Grindley, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 CAL. MGMT. REV. 1 (1997), *reprinted in* DAVID J. TEECE, ESSAYS IN TECHNOLOGY MANAGEMENT AND POLICY: SELECTED PAPERS OF DAVID J. TEECE 204, 216–17 (World Scientific 2003).

[30] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

different cases. It may not always be appropriate to assume that the value of the asserted patents is close to the value of the portfolio—for example, when there is only one asserted patent from a portfolio of hundreds of patents.

## III. THE ECONOMIC MEANING OF A PATENT'S ESSENTIALITY

Before the creation of a standard, all patents are implementation patents. However, when a standard is created and a patent holder declares its patents to be essential to the standard, the patent is a standard-essential patent and is subject to the FRAND commitment. This status of essentiality changes the fundamental approach to measuring a royalty for the SEP.

### A. Standard-Essential Patents

In this part, I provide background on standard-setting organizations, focusing on mobile network standards. I summarize the FRAND-related provisions of the IPR policies of two main telecommunications SSOs.

#### *1. Standard-Setting Organizations and Telecommunications Standards*

A standard-setting organization is "an entity that is primarily engaged in activities such as developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise maintaining hundreds of thousands of standards applicable to a wide base of users outside the standards developing organization."[31] SSOs develop "agreements containing technical specifications or other criteria," promote "efficient resource allocation and production by facilitating interoperability among complementary products," and, generally, participate in the advancement of the standard and associated technology within industries.[32] Two important SSOs are the European Telecommunications Standards Institute (ETSI) and the Institute of Electrical and Electronic Engineers (IEEE). ETSI develops globally applicable standards for information and communications technologies, including mobile communications technologies.[33] These standardized technologies include, among others, Adaptive Multi-Rate audio code (AMR), Global Systems for Mobile Communications (GSM), General Packet Radio Service (GPRS), Enhanced Data Rates for Global Evolution (EDGE), Wideband Code Division Multiple Access

[31] *Standard Setting Organization [SSO] Law & Legal Definition*, U.S. LEGAL, http://definitions.uslegal.com/s/standard-setting-organization-sso/. "Standard setting organization" is defined in 42 USCS § 1320d(8) as "a standard setting organization accredited by the American National Standards Institute, including the National Council for Prescription Drug Programs, that develops standards for information transactions, data elements, or any other standard that is necessary to, or will facilitate, the implementation of this part."

[32] U.S. DEP'T OF JUSTICE & U.S. PATENT & TRADEMARK OFFICE, POLICY STATEMENT ON REMEDIES FOR STANDARDS-ESSENTIAL PATENTS SUBJECT TO VOLUNTARY F/RAND COMMITMENTS 2–3 (Jan. 8, 2013).

[33] *About ETSI*, ETSI, http://www.etsi.org/about.

(WCDMA), and Long-Term Evolution (LTE) technologies.[34] ETSI and five other SSOs comprise the 3rd Generation Partnership Project (3GPP),[35] which maintains and develops globally applicable technical specifications for the 2G (second generation), 3G (third generation), and 4G (fourth generation) mobile systems.[36]

GSM was the first 2G standard released, and today it accounts for 80 percent of mobile telecommunications subscribers around the world.[37] GPRS and EDGE, additional 2G standards introduced to the global wireless market after GSM, enabled faster data transfer speeds. GSM uses Time Division Multiple Access (TDMA) technology, whereas other 2G standards use Code Division Multiple Access (CDMA).[38] The 2G standards collectively became ubiquitous and are still the backbone of wireless telecommunications networks in the United States and worldwide. The International Telecommunication Union (ITU) introduced the 3G family of wireless standards in 2000 with the release of the International Mobile Telecommunications-2000 specifications.[39] UMTS, WCDMA, HSPA+, and CDMA2000 are all standards developed under the 3G umbrella.[40] WCDMA was the original standard developed, and it is still the most widespread 3G technology.[41]

As 3G technology was rolled out, handset manufacturers did not drop 2G and introduce 3G-only wireless devices.[42] Because simultaneously upgrading all base station hardware and software across the country from 2G to 3G was

[34] *See, e.g.*, *Mobile Communications*, ETSI, http://www.etsi.org/technologies-clusters/technologies/mobile.

[35] 3GPP, http://www.3gpp.org. The five other members of 3GPP are the Association of Radio Industries and Businesses (ARIB) in Japan, the Alliance for Telecommunications Industry Solutions (ATIS) in the United States, the China Communications Standards Association (CCSA), the Telecommunications Technology Association (TTA) in Korea, and the Telecommunications Technology Committee (TTC) in Japan. *Id.*

[36] *3GPP*, ETSI, http://www.etsi.org/about/our-global-role/3gpp; *Technologies*, 3GPP, http://www.3gpp.org/Technologies.

[37] *About 3GPP*, 3GPP, http://www.3gpp.com/About-3GPP; *2G/3G/4G Mobile Networks*, ORANGE, http://www.orange.com/en/networks/our-network/mobile-network.

[38] *CDMA IS-95 (Code Division Multiple Access)*, MOBILECOMMS-TECHNOLOGY, http://www.mobilecomms-technology.com/projects/cdma_is95/; *LTE*, 3GPP, http://www.3gpp.com/LTE; RYSAVY RESEARCH, HSPA TO LTE-ADVANCED: 3GPP BROADBAND EVOLUTION TO IMT-ADVANCED (4G), at 17 (Sept. 2009), *available at* http://www.3gamericas.org/documents/3G_Americas_RysavyResearch_HSPA-LTE_Advanced_Sept2009.pdf [hereinafter HSPA TO LTE-ADVANCED].

[39] HSPA TO LTE-ADVANCED, *supra* note 38, at 14–15; *IMT-Advanced Standards Announced for Next-Generation Mobile Technology*, INTERNATIONAL TELECOMMUNICATION UNION (ITU), http://www.itu.int/net/pressoffice/press_releases/2012/02.aspx.

[40] *About 3GPP*, 3GPP, http://www.3gpp.com/About-3GPP.

[41] *See, e.g.*, *W-CDMA*, ETSI, http://www.etsi.org/technologies-clusters/technologies/mobile/w-cdma.

[42] Kevin Walsh & Jackie Johnson, *3G/4G Multimode Cellular Front End Challenges: Part 2*, at 2, RFMD (2009), *available at* http://www.rfmd.com/cs/documents/WP%203G-4G%20Multimode%20Handset%20Challenges%20Part%202%20Architecture%20Discussion.pdf.

infeasible, wireless service providers rolled out 3G technology gradually.[43] As a result, telecommunications hardware and software is "multi-mode" or "backwards compatible" to communicate with both 2G and 3G as necessary. As consumers became more connected and the processing capabilities of mobile phones increased, greater bandwidth and speed became necessary.[44] The International Telecommunication Union Radiocommunication Sector specified the requirements for 4G wireless service in 2010.[45] The first publicly available 4G service, an Ericsson system using Release 8 of the 3GPP LTE standard, began in Stockholm on December 14, 2009.[46] As with the introduction of 3G, the 4G rollout has required multi-mode capability with older technologies.

The IEEE is an international organization comprised of technical professionals from electrical, computing, and related fields.[47] In addition to performing other activities, IEEE develops standards for a number of technologies, including the IEEE 802.11 set of standards for wireless local area networks (W-LAN), commonly called "Wi-Fi."[48] The 802.11 standard is a local network communication protocol that is used in wireless home and business data networks. Although the 802.11 standard was originally developed for computer networking, nearly all smartphones include 802.11 connection capabilities, as do many other consumer electronics products, such as televisions and Blu-ray players. The IEEE 802.11n standard is an amendment to IEEE 802.11 family of standards.[49]

### *2. SSO IPR Policies*

An SSO develops standards that meet the technical objectives of a specific sector.[50] Members of ETSI and the IEEE routinely patent technologies related to certain standards promulgated by the SSOs, including the standards discussed above. When a patented technology is implemented in a standard,

[43] Cisco, Evolving to LTE: Cisco's Seamless Migration for UMTS Operators (2013), *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns973/ns1076/white_paper_c11-609205.pdf; Kevin Walsh & Jackie Johnson, *3G/4G Multimode Cellular Front End Challenges: Part 1*, at 2, 5–6, RFMD (2009), *available at* http://www.rfmd.com/CS/Documents/WPSPACE3G-4GSPACEMultimodeSPACEHandsetSPACEChallengesSPACEPartSPACE1SPACESpectrumSPACEandSPACERegulatorySPACEIssues.pdf.

[44] Verizon, LTE: The Future of Mobile Broadband Technology 3 (2010), *available at* http://opennetwork.verizonwireless.com/pdfs/VZW_LTE_White_Paper_12-10.pdf.

[45] 4G Americas, 4G Mobile Broadband Evolution: 3GPP Release 10 and Beyond 9 (Feb. 2011), *available at* http://www.4gamericas.org/documents/4G%20Americas_3GPP_Rel-10_Beyond_2.1.11%20.pdf.

[46] *History*, Ericsson, http://www.ericsson.com/us/thecompany/company_facts/history.

[47] *IEEE at a Glance*, IEEE, http://www.ieee.org/about/today/at_a_glance.html.

[48] *Id.*

[49] *802.11n-2009*, IEEE Standards Association, http://standards.ieee.org/findstds/standard/802.11n-2009.html.

[50] *See, e.g.*, ETSI Rules of Procedure, Annex 6: ETSI IPR Policy § 3.1 (Nov. 30, 2011), *available at* http://www.etsi.org/images/etsi_ipr-policy.pdf [hereinafter ETSI IPR Policy].

the use of the patent becomes essential, such that making a product that complies with a standard without practicing the SEP is technically impossible. Parties who manufacture standard-compliant products may be required to license the patented technologies that are incorporated into the standard. Although a patent holder has the statutory right in the United States to refuse to license its technology, if an SEP holder refused to license its SEP, the standard would be made impracticable, because implementers could not comply with the standard without infringing the SEP. In such circumstances, the SSO would need to redesign the standard to bypass the technology in question. Redesigning standards would cause additional costs and delay. To avoid those costs and delays, SSOs normally require technology owners who wish to contribute their patents to a standard to declare that they will license their SEPs on FRAND terms. To facilitate the licensing process, both ETSI and the IEEE have policies that generally require their members to disclose or declare any patents that they believe are essential to a standard. As part of this declaration process, the declaring parties agree to license their declared-essential patents on fair, reasonable, and nondiscriminatory (FRAND) or reasonable and nondiscriminatory (RAND) terms. I summarize the relevant terms of the ETSI IPR Policy and the IEEE Patent Policy below.

The ETSI IPR Policy is Annex 6 to the ETSI Rules of Procedure, November 2011. Clause 6.1 of the IPR Policy provides as follows:

> 6.1 When an ESSENTIAL IPR relating to a particular STANDARD or TECHNICAL SPECIFICATION is brought to the attention of ETSI, the Director-General of ETSI shall immediately request the owner to give within three months an irrevocable undertaking in writing that it is prepared to grant irrevocable licences on fair, reasonable and non-discriminatory terms and conditions under such IPR to at least the following extent:
>
> - MANUFACTURE, including the right to make or have made customized components and sub-systems to the licensee's own design for use in MANUFACTURE;
> - sell, lease, or otherwise dispose of EQUIPMENT so MANUFACTURED;
> - repair, use, or operate EQUIPMENT; and
> - use METHODS.
>
> The above undertaking may be made subject to the condition that those who seek licences agree to reciprocate.[51]

In turn, ETSI's IPR Policy defines "essential" as follows:

> "ESSENTIAL" as applied to IPR means that it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR. For the avoidance of doubt in exceptional cases where a

[51] *Id.* § 6.1.

> STANDARD can only be implemented by technical solutions, all of which are infringements of IPRs, all such IPRs shall be considered ESSENTIAL.[52]

When a patent holder voluntarily submits an IPR licensing declaration to ETSI, the patent holder becomes obligated, by virtue of this undertaking, to offer licenses to the declared IPR to the extent that the declared IPRs are or become essential on terms and conditions that satisfy Clause 6.1. ETSI's IPR Policy guidelines make clear that "specific licensing terms and negotiations are commercial issues between the companies, and . . . shall not be addressed within ETSI."[53] ETSI members are not obligated to disclose within ETSI's Technical Body the commercial terms for SEP licenses granted under FRAND terms.[54]

The IEEE's Patent Policy is section 6 of the IEEE-SA Standards Board Bylaws.[55] Section 6.2 of the Policy provides in part: "If the IEEE receives notice that a [Proposed] IEEE Standard may require the use of a potential Essential Patent Claim, the IEEE shall request licensing assurance, on the IEEE Standards Board approved Letter of Assurance form, from the patent holder or patent applicant."[56] Section 6.2 further provides that the Letter of Assurance shall be either:

> a) A general disclaimer to the effect that the Submitter without conditions will not enforce any present or future Essential Patent Claims against any person or entity making, using, selling, offering to sell, importing, distributing, or implementing a compliant implementation of the standard; or
> b) A statement that a license for a compliant implementation of the standard will be made available to an unrestricted number of applicants on a worldwide basis without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination. At its sole option, the Submitter may provide with its assurance any of the following: (i) a not-to-exceed license fee or rate commitment, (ii) a sample license agreement, or (iii) one or more material licensing terms.[57]

Pursuant to and to the extent required by its Letters of Assurance, a patent holder is obligated to make licenses available to its Essential Patent Claims on the terms and conditions specified in section 6 of the IEEE Patent Policy.[58]

[52] *Id.* § 15.
[53] *Id.* § 4.1.
[54] It is a current debate among scholars and practitioners whether SSOs should be more active in determining a FRAND royalty for SEPs. *See, e.g.*, Deborah L. Feinstein, Robert Skitol, Dennis Carlton, Gregory Leonard, Christine Meyer & Carl Shapiro, *Economists' Roundtable on Hot Patent-Related Antitrust Issues*, 27 ANTITRUST ABA 10, 16 (2013).
[55] IEEE-SA Standards Board Bylaws § 6 (Dec. 2012), *available at* http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf.
[56] *Id.* § 6.2.
[57] *Id.*
[58] *Id.* § 6.1. The IEEE's definition further provides: "An Essential Patent Claim does not include any Patent Claim that was essential only for Enabling Technology or any claim other than that set forth above even if contained in the same patent as the Essential Patent Claim." *Id.*

The IEEE in turn defines "Essential Patent Claim" as "any Patent Claim the use of which was necessary to create a compliant implementation of either mandatory or optional portions of the normative clauses of the [Proposed] IEEE Standard when, at the time of the [Proposed] IEEE Standard's approval, there was no commercially and technically feasible non-infringing alternative."[59]

Similar to ETSI, the IEEE explicitly disclaims responsibility "for determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory."[60] The IEEE's guidelines emphasize that the IEEE bears no responsibility for identifying essential patent claims for which a license may be required or for investigating the legal validity or scope of essential patent claims.[61]

### 3. *Conceptualizing the SSO as a Joint Venture Having the FRAND Commitment as an Ancillary Restraint*

One can conceptualize a standard-setting organization as a joint venture and the FRAND commitment as an ancillary restraint on joint venturers that is essential to their collective success. In turn, the joint venture's success enables downstream manufacturers to make and sell a new product incorporating the standard to consumers, who value that product more highly than the price they pay.

The doctrine of ancillary restraints originated in the English common law in 1711 in *Mitchel v. Reynolds*[62] and permits two or more firms to restrain competition among themselves if doing so is essential to their creation of a new market, product, or productive efficiency. Such cooperation among firms benefits consumers. In this respect, the doctrine of ancillary restraints embodies a kind of cost-benefit analysis that is compatible with, if not identical to, the view that a court should evaluate a restraint of trade on the basis of whether it benefits or harms consumer welfare.

Congress outlawed *any* contract in restraint of trade when it enacted section 1 of the Sherman Act in 1890.[63] This language sweeps so broadly that, if taken literally, it would outlaw cooperation among firms that manifestly benefits consumers. It is not surprising, therefore, that within only nine years the Supreme Court qualified the literalism of section 1 when, in *United States v. Addyston Pipe & Steel*, it incorporated the doctrine of ancillary restraints into American

[59] *Id.* (bracketed text in original).
[60] *Id.* § 6.2.
[61] *Id.* ("The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, [or] for conducting inquiries into the legal validity or scope of those Patent Claims.").
[62] (1711) 24 Eng. Rep. 347 (Q.B.).
[63] 15 U.S.C. § 1.

antitrust jurisprudence.[64] The Court affirmed the opinion of Judge (later, President and Chief Justice) William Howard Taft for the Sixth Circuit that a covenant "merely ancillary to the main purpose of a lawful contract, and necessary to protect the covenantee in the full enjoyment of the legitimate fruits of the contract" is not unlawful.[65]

In the 1980s, the antitrust titans of the federal judiciary reconciled the doctrine of ancillary restraints with the consumer-welfare approach of modern antitrust law. Judge Robert Bork wrote for the D.C. Circuit in *Rothery Storage & Van Co. v. Atlas Van Lines, Inc.* that "a joint venture made more efficient by ancillary restraints . . . is a fusion of the productive capacities of the members of the venture."[66] A restraint is ancillary if it is "subordinate and collateral" to the purpose of a legitimate transaction.[67] Similarly, Judge Frank Easterbrook wrote for the Seventh Circuit in *Polk Brothers, Inc. v. Forest City Enterprises, Inc.* that "a restraint is ancillary when it may contribute to the success of a cooperative venture that promises greater productivity and output."[68] By 2010, it was thoroughly uncontroversial for the Supreme Court to reiterate in *American Needle, Inc. v. National Football League* that American courts judge ancillary restraints within joint ventures according to their reasonableness rather than according to the *per se* rule of illegality that condemns agreements among competitors to raise prices or reduce output.[69]

In 2010, the Federal Circuit in *Princo Corp. v. International Trade Commission* considered whether a patent licensing agreement between standard-setting parties was anticompetitive and an illegal restraint of trade.[70] Philips and Sony established a patent pool to include licenses for patents, both essential and nonessential, to perform the standards for rewritable compact discs—the Recordable CD Standards, commonly called the Orange Book.[71] Both companies patented solutions to encoding the discs, but they agreed that Philips' patent was superior and less prone to error. Philips' and Sony's patent pool included both parties' patents and licensed them to third parties as a package that contained a field-of-use restriction that limited the patent licenses to the manufacture of compact discs in accordance with the Orange Book standards.[72]

The case arose from Philips' complaint to the International Trade Commission (ITC) when Princo Corporation, which licensed the patent

[64] United States v. Addyston Pipe & Steel, 85 F. 271, 282 (6th Cir. 1898), *aff'd*, 175 U.S. 211 (1899).

[65] *Id.*

[66] 792 F.2d 210, 224 (D.C. Cir. 1986); *see also* Engine Specialties, Inc. v. Bombardier, Ltd., 605 F.2d 1, 11 (1st Cir. 1979) (an agreement between joint venturers not to compete within the joint venture is "not offensive in and of itself").

[67] Rothery Storage & Van Co. v. Atlas Van Lines, Inc., 792 F.2d 210, 224 (D.D.C. 1986).

[68] Polk Bros., Inc. v. Forest City Enterprises, Inc., 776 F.2d 185, 189 (7th Cir. 1985).

[69] Am. Needle, Inc. v. Nat'l Football League, 130 S. Ct. 2201, 2216–17 (2010).

[70] Princo Corp. v. Int'l Trade Comm'n, 616 F.3d 1318 (Fed. Cir. 2010).

[71] *Id.* at 1322.

[72] *Id.* at 1322–23.

package from Philips, ceased paying its license fees on the rationale that Philips was misusing its patents.[73] On appeal, the Federal Circuit found that an agreement to refrain from licensing a patent for use outside a standard is not presumptively anticompetitive. Treating the standard-setting process and patent pool as a joint venture and the Orange Book standard as an ancillary restraint, the panel held that "Philips and Sony acted legitimately in choosing not to compete against their own joint venture."[74] Thus, the Federal Circuit's treatment of a standard-setting agreement as a joint venture in *Princo* establishes the foundation for analyzing FRAND commitments within the context of the ancillary restraints doctrine.[75]

## B. The Combinatorial Value of SEPs

Understanding a FRAND royalty requires understanding the economic difference between standard-essential patents and implementation patents. Standard-essential patents can be viewed only in terms of their *combinatorial* value—not their incremental value. The value associated with a standard is joint and common among the SEPs. Once a patent is essential to the standard, the hypothetical-negotiation framework used to determine the royalties for implementation patents does not apply. This distinction between combinatorial value and incremental value informs the meaning of FRAND. Competition among downstream products that implement the standard occurs only with respect to features that depend on "nonessential" implementation patents.

Owing to the complementarity of SEPs, analysis of the incremental value of a patent is insufficient for SEPs because each SEP holds zero incremental value without all other SEPs. Because of the combinatorial value of SEPs, the value to the consumer of the downstream standard-compliant product is joint and common among the SEPs. FRAND royalty terms are appropriately derived by viewing the SSO as a joint venture among its member firms that has as its objective the maximization of the joint surplus created by the standard. The attainment of this shared objective should define FRAND royalties that are *ex ante* efficient (in terms of promoting widespread participation in and consensus on a commercially valuable standard) and *ex post* efficient (in terms of stimulating demand in the downstream market for products that implement the patents that are essential to that standard). The FRAND commitment is

[73] *Id.* at 1323.

[74] *Id.* at 1334. Chief economists of the U.S. and EU enforcement agencies have observed that "market power . . . achieved through the joint action of entities—the SSO members—that might be in competition with each other outside the SSO . . . is acceptable for society because it trades off possible technology competition among SSO members for production of a standard that can speed innovation and expand output." Kai-Uwe Kuhn, Fiona Scott Morton & Howard Shelanski, *Standard Setting Organizations Can Help Solve the Essential Patents Licensing Problem*, 3 COMPETITION POL'Y INT'L CPI ANTITRUST CHRON. (SPECIAL ISSUE) 3 (2013).

[75] The ETSI IPR policy does not explicitly state that the SSO does not constitute a partnership. ETSI IPR Policy, *supra* note 50.

an ancillary restraint on the individual pricing freedom of joint venturers that is voluntarily accepted by the joint venturers because they understand this commitment to be essential to their collective success.

Some notation will clarify the combinatorial nature of the value of SEPs. In the case of a downstream product (such as a smartphone) that reads on many patents, let there be $N$ patented inputs, consisting of $I$ nonessential patents (known as implementation patents) and $\mathcal{J}$ essential patents, where $I + \mathcal{J} = N$. All $\mathcal{J}$ essential patents must be used in fixed proportion to produce the downstream product, which consumers value at $S$.[76] No substitutability at all is possible among SEPs. To the contrary, SEPs are complements rather than substitutes. Patent law's conventional analysis for valuing a patent examines the patent's incremental contribution to the implementer's profitability over that of the next-best noninfringing substitute. This inquiry exemplifies marginal analysis. Its economic import is to ask what the marginal productivity of the patent in suit is. As a matter of mathematics, marginal analysis in economics requires calculating a derivative (in this case, the partial derivative of the implementer's output with respect to the factor of production represented by the patent in suit and its next-best noninfringing alternative). One can calculate the partial derivative of a smooth, continuously differentiable production function with respect to a given factor of production. But a fixed-proportion production technology is not smooth or continuously differentiable. Consequently, marginal analysis of a fixed-proportion production technology is not possible—as a matter of mathematical computation or economic theory or simple logic.[77]

The removal of any one SEP from the downstream product causes its value to consumers to disappear, such that $S = 0$. An analogy is an automobile having all its essential components except a transmission: the car will not go, and it is therefore worthless to the consumer. Adding a fifth wheel will not compensate for the missing transmission, because no substitutability is possible in the first place between the essential input of a transmission and the essential input of a wheel. In other words, the *decremental* value of any of the $\mathcal{J}$ essential patents is therefore $S$.[78]

[76] In other words, the SEPs implemented in the downstream product as factors of production exhibit the fixed-proportion production technology first described by Nobel laureate Wassily Leontief. Cost-minimizing production can occur only at a single fixed point, rather than at any one of an infinite number of possible combinations of the two substitutable factors of production. *See* WASSILY LEONTIEF, THE STRUCTURE OF THE AMERICAN ECONOMY, 1919–1929: AN EMPIRICAL APPLICATION OF EQUILIBRIUM ANALYSIS (Harvard Univ. Press 1941). For a concise explanation of the Leontief production technology, see HAL R. VARIAN, MICROECONOMIC ANALYSIS 4–5 (Norton 3d ed. 1992).

[77] Leontief observed (as a more general principle of economic theory, of course) that fixed-proportions technology constitutes "no less than a formal rejection of the marginal productivity theory" because "the marginal productivity of any [factor] . . . is zero." LEONTIEF, *supra* note 76, at 38.

[78] Saying that the entire value of a product disappears if one removes any one of the SEPs that the product implements is not the same thing as saying that a given SEP "drives" the product's value. In other words, the recognition that an SEP's decremental value is $S$ is not a restatement of the entire market value rule.

It bears emphasis that the incremental value and decremental value are not symmetric in the case of an SEP. The incremental value of any of the $\mathcal{J}$ standard-essential patents is 0—because the downstream product is valuable to consumers if and only if all $\mathcal{J} - 1$ *other* standard-essential patents are simultaneously supplied. Moreover, the same phenomenon of zero incremental value holds for every possible *combination* of $\mathcal{J} - 1$ standard-essential patents. This combinatorial nature of the value conferred on a downstream product by an aggregation of SEPs resembles Gerald Faulhaber's influential analysis of the combinatorial nature of common costs within a multiproduct firm.[79]

What I will call a "breakthrough" product consists of only $\mathcal{J}$ standard-essential patented features, which (as noted above) are *not* substitutes. Such products are properly characterized as a matter of law as the successful outcome of the standard having been established through the cooperation of many firms functioning collectively as a kind of joint venture. The breakthrough product results from the joint production among actual and potential competitors, as well as firms that have only an actual or potential vertical relationship (suppliers of technological inputs and manufacturers of downstream products) and firms that have only an actual or potential complementary relationship (suppliers of complementary technological inputs). These firms have agreed to share their respective technologies on FRAND terms, rather than less favorably on arms-length terms. Through such cooperation among the SSO's members it becomes possible for implementers to combine all $\mathcal{J}$ essential patents and thereby enable SEP holders collectively to reap royalties based on $S$, the value that consumers ascribe to the downstream product that successfully embodies the minimum combination of all those technologies. Moreover, the total size of the market (the aggregate demand for the breakthrough product) will enable SEP holders to earn royalties over a larger volume of units sold than if they chose instead to monetize their inventions outside the SSO. For the consumer, the value of the breakthrough product is joint and common among the $\mathcal{J}$ essential patents. Put differently, the value of the downstream product, $S$, is (as a first approximation, at least, for reasons I will explain momentarily) indivisible among its $\mathcal{J}$ constituent, standard-essential patents, which the implementer must use in fixed proportions.

Once an SSO adopts a standard, competition can occur only over the differentiating features of downstream products that read on *non*essential implementation patents. Only with respect to implementation patents is substitutability possible, because competition cannot exist without at least the possibility that consumers can substitute one product for another, which they cannot do with respect to SEPs. (In this instance, the implementers are the consumers of

[79] *See* Gerald R. Faulhaber, *Cross-Subsidization: Pricing in Public Enterprises*, 65 AM. ECON. REV. 966 (1975); Gerald R. Faulhaber, *Cross-Subsidy Analysis with More Than Two Services*, 1 J. COMPETITION L. & ECON. 441 (2005). *See also* J. GREGORY SIDAK & DANIEL F. SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT: THE COMPETITIVE TRANSFORMATION OF NETWORK INDUSTRIES IN THE UNITED STATES 23 (Cambridge Univ. Press 1998).

inputs.) As Justice Stephen Breyer has said in an analytically similar context in *AT&T Corp. v. Iowa Utilities Board*, "It is in the *un*-shared, not in the shared, portions of the enterprise that meaningful competition would likely emerge."[80] Only with respect to implementation patents does it therefore make economic sense for a court to identify the incremental benefit that the patented functionality creates over the next-best noninfringing substitute, to use that increment of value to define the bargaining range between the patent holder and the infringer in a hypothetical negotiation occurring at the moment of first infringement, and then to use some point estimate within that bargaining range to set a reasonable royalty to compensate for the infringement of that patent. It is thus a fallacy of economic and legal reasoning to apply the incremental value framework to the valuation of an SEP and the corresponding determination of its FRAND royalty.

Figure 3 depicts the value of a retail product that uses $\mathcal{J} + I$ patented inputs, $\mathcal{J}$ of which are standard-essential, and the remaining $I$ of which are implementation patents that are by definition not standard-essential. The $X$-axis shows the cumulative number of patents, and the $Y$-axis shows the cumulative value of the patents. The "cumulative value curve" runs flat along the horizontal axis until the point $\mathcal{J}$ because the incremental value of each standard-essential patent is zero. At $\mathcal{J}$ standard-essential patents, the cumulative value of the patents jumps from 0 to $S$, which is the combinatorial value of the $\mathcal{J}$ essential patents. To the right of point $\mathcal{J}$, the implementation patents are added in decreasing order of their contribution of value to the downstream product. The value $V - S$ is the incremental value associated with all of the implementation patents. The product's value increases from $S$ along the value curve, but the value curve after $\mathcal{J}$ has a horizontal parabolic shape because of the diminishing marginal returns associated with additional implementation patents having lesser individual economic value for the downstream product.

The value of SEPs and implementation patents will vary depending on the specific downstream products. The implementation patents might be less valuable than SEPs if they protect technologies that have only marginal relevance for the downstream product. On the contrary, implementation patents can be more valuable than SEPs if the features that the implementation patents cover are particularly relevant for the success of the downstream product.

### C. The Difference Between a Patent's Having Been Declared Essential and Its Being Essential in Fact

Judge Davis of the Eastern District of Texas has observed that "[t]here is no way to determine the exact number of standard-essential patents."[81] As

[80] AT&T Corp. v. Iowa Utils. Bd., 525 U.S. 366, 429 (1999) (Breyer, J., concurring in part and dissenting in part) (emphasis in original).

[81] Memorandum Opinion & Order at 49, Ericsson Inc. v. D-Link Sys., Inc., No. 6:10-cv-473 (E. D. Tex. Aug. 6, 2013). "Neither side attempted to determine the exact number of standard-essential patents." *Id.*

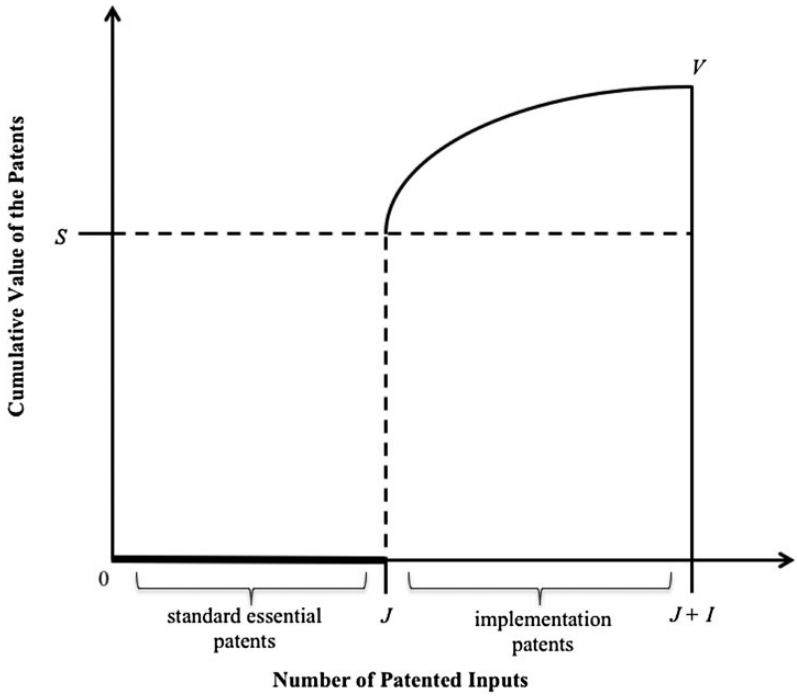


**Figure 3.** The value of the downstream product combining standard-essential and standard-nonessential (implementation) patents

noted earlier, ETSI defines intellectual property rights, including patents, to be "essential" if

> it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR.[82]

Thus, a downstream manufacturer must use all such essential patents to implement the standard at issue. However, declaring a patent to be essential to a standard does not ensure that it is essential in fact—either at the time of the standard's adoption or later, when actual consumer demand for the downstream product implementing the standard has manifested itself.[83] ETSI states in its IPR Database FAQs:

> The information reflected in the ETSI IPR database [regarding the essentiality of a given patent to the ETSI standard] is based on the information received and ETSI has not

[82] ETSI, INTELLECTUAL PROPERTY RIGHTS (IPRs); ESSENTIAL, OR POTENTIALLY ESSENTIAL, IPRs NOTIFIED TO ETSI IN RESPECT OF ETSI STANDARDS, ETSI SR 000 314 V2.13.1, at 6 (2012).

[83] *See, e.g.*, Maurits Dolmans & Daniel Ilan, *European Antitrust and Patent Acquisitions: Trolls in the Patent Thickets*, COMPETITION L. INT'L, Aug. 2012, at 7, 16 n.16.

> checked the validity of the information, nor the relevance of the identified IPRs and *is not in a position to confirm, or deny, that the IPRs are, in fact, essential, or potentially essential*. In other words, the information that appears on the ETSI IPR database reflects the ETSI Members' declarations with regards to IPRs that they have considered essential for a particular ETSI STANDARD.[84]

Generally, SSOs do not verify the essentiality of patents. Consequently, as Judge Holderman observed in *Innovatio*, there is "no guarantee that all [declared] essential patents are in fact essential.[85] It is likely that the number of declared SEPs exceeds the number of patents that are truly essential for practicing the standard. For example, in 2005, D.J. Goodman and R.A. Myers examined the patents and patent applications declared essential for the 3GPP and 3GPP2 standards. They found that only 21 percent of the declared patents were actually essential.[86] Furthermore, essentiality goes to the *claims* in the patent. A given patent could have certain claims that are essential to the standard and other claims that are not.

There are several reasons why a company might overdeclare its number of SEPs. One possibility is that the over-disclosure is unintentional. For instance, the patent or patent application declared as essential may eventually not have been granted, or perhaps it was granted but with significant changes. Second, it is possible that the over-disclosure is intentional and is used as a strategy to signal a strong position in the market. The patent holder may believe that the sheer number of its declared-essential patents will signal to important constituencies the patent holder's technological prowess. This signal may, for example, help the patent holder to attract customers, investors, or skilled workers. At the same time, a company with a large patent portfolio, including a large number of SEPs, is more likely to obtain favorable licensing conditions. A third possible reason to overdeclare one's patents as being standard-essential is to reduce legal risk. The FTC undertook enforcement actions in *Rambus*,[87] *Dell*,[88] and *Unocal*[89] on the theory that the patent holder engaged in an unfair method of competition in violation of section 5 of the Federal Trade Commission Act by misrepresenting or knowingly failing to disclose the essentiality of its patent to the SSO before its adoption of the patented technology into the standard. In at least one famous case, *Broadcom Corp. v. Qualcomm Inc.*, another member of an SSO privately sued the SEP holder for breach of contract, fraud, and antitrust violations.[90] To

[84] *ETSI IPR Database FAQs*, ETSI, http://www.etsi.org/about/570-etsi-ipr-database-faqs (emphasis added).

[85] RAND Opinion in *Innovatio*, *supra* note 4, at 84.

[86] David J. Goodman & Robert A. Myers, *3G Cellular Standards and Patents*, IEEE WIRELESSCOM (June 13, 2005), *available at* http://eeweb.poly.edu/dgoodman/wirelesscom2005.pdf.

[87] *In re* Rambus, Inc., No. 9302 (F.T.C. Aug. 2, 2006), *rev'd sub nom.* Rambus, Inc. v. Fed. Trade Comm'n, 522 F.3d 456 (D.C. Cir. 2008).

[88] *In re* Dell Computer Corp., 121 F.T.C. 616 (May 20, 1996).

[89] *In re* Union Oil Co. of Cal., No. 9305 (F.T.C. July 27, 2005).

[90] Broadcom Corp. v. Qualcomm Inc., 501 F.3d 297 (3d Cir. 2007).

eliminate the risk of such enforcement actions and private lawsuits, the patent holder may prefer to err on the side of declaring its patents to be standard-essential.

In litigation over infringement of a patent declared to be standard-essential, the finder of fact rather than the parties must determine whether the patent is essential in fact. (I am assuming here that a court would consider the determination of a patent's essentiality in fact to be a question of fact to be decided by the finder of fact rather than a question of law, which the court would decide in a jury trial. Needless to say, the case law gives little guidance at this time.)

In his opinion in *Apple v. Motorola* regarding the parties' requests for damages and injunctive relief, Judge Posner distinguished between a patent declared by its owner to be essential and a patent proven by its owner to be essential in fact.[91] In an earlier summary judgment order, Judge Posner had found that Apple had not infringed Motorola's '559 patent, which Motorola had declared to be essential to the Universal Mobile Telecommunications Standard (UMTS).[92] That finding, Judge Posner said, "may seem inconsistent with the proposition that Apple's 3G ('third generation') mobile devices, which are governed by the Universal Mobile Telecommunications Standard (UMTS), must therefore use patents declared essential to that standard, such as the '559."[93] However, Judge Posner explained, "there is no inconsistency," because

> Motorola's standards-essential patents . . . are merely *claimed* to be standards-essential. The European Telecommunications Standards Institute collects declarations by companies that claim to own patents essential to compliance with the UMTS standard, but the Institute does not determine whether they really are essential.[94]

Judge Posner reasoned that, although Apple's handsets "generate the preamble sequences (the subject of the Motorola's '559 patent) required by the 3G UMTS standard, they do not do so in the manner claimed by '559, and so the '559 isn't essential."[95] Thus, as Judge Posner's opinion illustrates, it is possible for a manufacturer to implement a standard in a downstream product without infringing patents that have been declared essential to the standard. Essentiality depends on technical and economic facts external to the contractual operation of the SSO. Essentiality does not spring into creation through the unilateral expression of the patent holder.

For the reason that Judge Posner observed, one must qualify the combinatorial-value framework for evaluating SEPs, recognizing that not all patents that have been declared to be standard-essential are in fact essential to either the creation of the standard or the production of a downstream product implementing that

[91] Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901, 912 (N.D. Ill. 2012).
[92] *Id.*
[93] *Id.*
[94] *Id.* (emphasis in original) (citing *ETSI IPR Database FAQs*, ETSI, http://www.etsi.org/about/570-etsi-ipr-database-faqs).
[95] *Id.*

standard. In contrast to patents that are truly standard-essential, a patent declared to be standard-essential but subsequently found not to be standard-essential does *not* have a decremental value of $S$, the entire consumer value of the downstream product implementing the standard. The consequence of a patent's being determined *ex post* not to be standard-essential in fact is to evaluate claims for its infringement in the same manner that implementation patents are treated—by assessing the marginal contribution of the patent in suit relative to the next-best noninfringing substitute at the time of first infringement. That incremental value may be small. Consequently, it is entirely conceivable that a patent erroneously declared by its owner to be standard-essential may justify only a trivial royalty for infringement.

Over time, implementers may find that some of the declared SEPs are in fact not essential to the standard. Figure 4 shows how the value to consumers of the retail product shifts when implementers deem $K$ of the $\mathcal{J}$ essential patents to be commercially *non*essential. The cumulative value curve shifts left from the point $\mathcal{J}$ to $\mathcal{J} - K$. The combinatorial value $S$ of a product that incorporates all genuinely standard-essential patents occurs at the point $\mathcal{J} - K$. The $K$ patents join the $I$ implementation patents, and each such implementation patent adds positive but diminishing incremental value. There are now $K + I$ nonessential patents. Although Figure 4 shows the $K$ nonessential patents immediately following the $\mathcal{J}$ essential patents in their contribution to the downstream product's cumulative value to consumers, the true incremental value of those $K$ patents may be smaller, such that they would be ordinally ranked farther to the right among the other implementation patents. For example, if the $K$ patents are found to be nonessential and they are not actually practiced, they would move toward the right-most end of the implementation patents, such that their incremental value corresponds to the flatter part of the value curve, where each additional nonessential patent contributes value at a diminishing marginal rate. One could question in such a case whether, as a matter of contract law or promissory estoppel, the FRAND declaration continues to encumber the patent despite its subsequently being deemed not to be standard-essential in fact.

Finally, the royalty on a patent that a court has found to be invalid—regardless of whether it is a standard-essential patent or an implementation patent—should be zero.

### D. The Aggregate FRAND Royalties Based on the Combinatorial Value of SEPs

Figures 3 and 4 represent the entire value to consumers of a downstream product generated by the patents practiced in the product. However, the patent holders do not keep the entire value of the downstream product. They and the downstream implementers divide this value with consumers. Otherwise, demand for the product would collapse, and this new technological

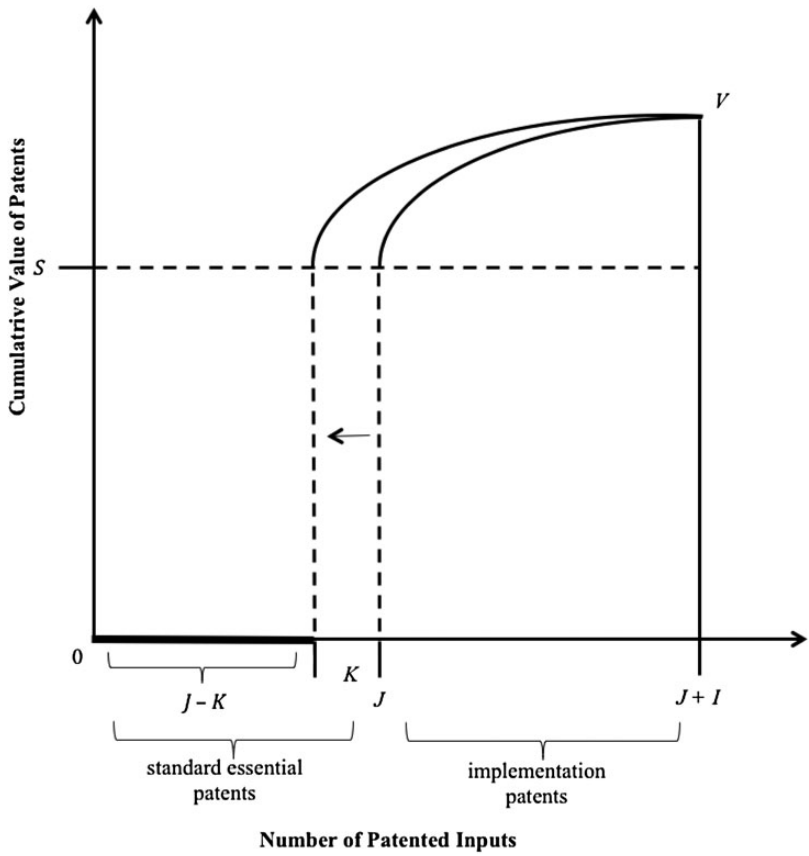


**Figure 4.** The value of the downstream product combining standard-essential and standard-nonessential (implementation) patents after $K$ declared patents are found to be nonessential in fact

marvel would create no consumer surplus whatsoever. Consequently, the aggregate royalties that patent holders earn from the downstream product necessarily will be less than the total value of the downstream product.

*1. The Aggregate Royalty Burden of All SEPs in a Standard*

Figure 5 shows the value of aggregate royalties for standard-essential and implementation patents. The aggregate royalty burden on the downstream product is $\beta S$, where β is the percentage of the downstream product's revenue that is the aggregate royalty burden. Values for β will range between 0 and 1 because SEP holders do not keep the entire value created by the combination of all SEPs. (Although the FRAND royalties will not exceed the value of the downstream product, in practice the aggregate FRAND royalties can exceed the net sales price of the product—for example, if the product is sold at an artificially low price.) The value from $\beta S$ to $S$ is the surplus on SEPs flowing to the

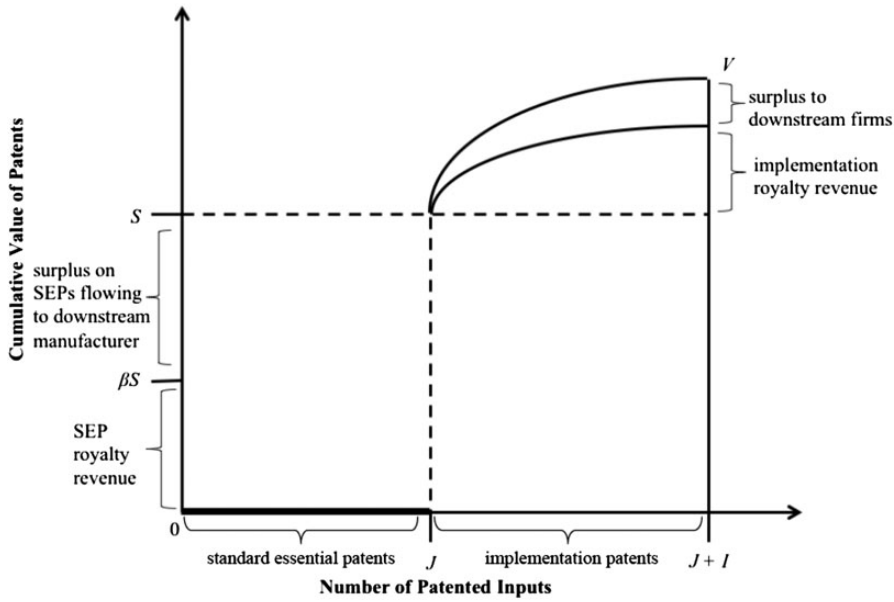


**Figure 5.** Aggregate royalties for standard-essential and implementation patents

downstream manufacturers (some fraction of which those manufacturers will share with consumers). Determination of the royalties for implementation patents proceeds from a traditional hypothetical-negotiation analysis. Like the economic value of SEPs, the value of all *I* implementation patents is split between patent holders and downstream firms.

The actual royalty rates on implementation patents may exceed royalty rates on SEPs in a given downstream product despite the fact that the latter might seem inherently more valuable because of their essentiality to the standard. There are at least two possible explanations for this relationship. First, the actual royalty rates for SEPs may appear lower because they are part of cross-licensing agreements. The predominant consideration flowing to the SEP holder in a cross-licensing agreement will be the reciprocal right to use the licensee's valuable patents (both standard-essential and implementation). The payment of a royalty to the SEP holder may be a small component of the total consideration that the SEP holder receives. Second, the royalties may function as a two-part tariff if the same parties engaged in the FRAND negotiation are likely to make complements. The FRAND rate is the low, fixed component of the two-part tariff, and the implementation-patent royalty subsidizes the low FRAND rates.

The aggregate royalty burden of the SEPs may exceed the aggregate royalty burden of the implementation patents, particularly during the early life of a standard. However, as the standard ages and alternative standards or more advanced implementation patents are developed, the aggregate royalty burden

of implementation patents may surpass the aggregate royalty burden of SEPs. The increase in the value generated by the implementation patents does not mean that the value of the standard itself falls over time. Implementation patents are complements to the standard, such that the development of implementation patents increases the value of the standard.

### 2. *Who Decides the Size of the Aggregate Royalty Burden That SEPs Impose on the Downstream Product?*

Point $\beta S$ in Figure 5 is a stylized depiction of the aggregate royalty burden that SEPs impose on the downstream product, such as a smartphone. However, identifying in principle the existence of the aggregate royalty burden does not begin to answer three practical but challenging questions relevant to the calculation of reasonable royalties on individual SEPs.

First, how large should the aggregate royalty burden be? How large should the pie that SEP holders will divide among themselves be? Here it is useful to invoke the terminology of old-fashioned cost-of-service regulation for public utilities—although in doing so I do not imply that the owner of a patent, even a standard-essential patent, is analogous on either economic or legal grounds to a public utility. In effect, the public utilities commission represents consumers in repeated negotiations with the regulated firm to supply service over the course of many years. The first step in setting the regulated rates of a public utility under cost-of-service regulation is to determine its "revenue requirement" for the period of time that the rate order will be in effect. The revenue requirement for a utility is a kind of break-even constraint: the firm will need revenue to cover its operating expenses and a risk-adjusted competitive return on the capital that it has dedicated to a public purpose. Operating expenses include depreciation, so it is commonly said that a regulated utility is entitled to receive, in addition to its operating costs, a reasonable opportunity to earn a return *of and on* its invested capital. The typical public utilities statute in the United States provides for "just and reasonable" rates (with a requirement of nondiscrimination lurking in the background, if not already inferred from the common law principle of common carriage). The nomenclature of public utility rate regulation (just, reasonable, and nondiscriminatory) thus sounds remarkably close to the fair, reasonable, and nondiscriminatory attributes of royalties for SEPs. It is well established in the American takings jurisprudence on regulated ratemaking that a "just and reasonable" rate may not be set so low as to deny the utility the ability to attract capital from willing investors in the future.[96] In other words, considerations of dynamic efficiency motivate the constitutional interpretation of "just and reasonable." This insight about the connection between dynamic efficiency and the fairness of pricing should apply with even greater force to royalties on patents since they, far more than

[96] Fed. Power Comm'n v. Hope Natural Gas Co., 320 U.S. 591, 605 (1944). *See also* Duquesne Light Co. v. Barasch, 488 U.S. 299, 310 (1989); SIDAK & SPULBER, *supra* note 79, at 381.

the business of regulated utilities, are generally considered the engine of economic growth and consumer betterment.

The public-utility analogy is helpful for underscoring that rates should not be too low, but the analogy quickly loses its salience. The negotiation over the revenue requirement is a bilateral one, between a monopoly provider of regulated services and a single, public representative of all ratepayers. In contrast, many more parties are affected by the determination of the optimal size of the aggregate royalty burden for SEPs embodied in the downstream product that consumers highly prize.

A second and closely related question is, assuming that the necessary information is feasible to collect and analyze, who may lawfully determine how large the aggregate royalty burden shall be? Should the SEP holders or the downstream implementers of a standard determine the size of the aggregate royalty burden for SEPs? Collaboration among SEP holders to determine the aggregate royalties, or a cap on the aggregate SEP royalties, should not raise antitrust concern, because SEPs are complements, not substitutes. In contrast, collaboration among downstream implementers to cap the aggregate royalties for SEPs may produce buyer collusion, because downstream implementers are competitors.[97] The matter is more complicated because many SEP holders are vertically integrated into the implementation of standards in downstream products. Consequently, antitrust authorities (mainly outside the United States after the Supreme Court's 2009 decision in *linkLine*[98]) may be concerned that vertically integrated SEP holders would try to increase the aggregate royalty burden to "squeeze" the margins of downstream competitors that are not vertically integrated into SEP ownership. However, the nondiscrimination requirement of the FRAND commitment attenuates the incentive for downstream implementers to collude over aggregate SEP royalties, as implementers would need only to ensure that the first (similarly situated) licensee pays a low aggregate royalty for SEPs. (However, given the nascent state of the case law, it is far from clear as a matter of legal interpretation, under either contract law or public law, that the nondiscrimination component of the FRAND commitment by itself creates for a given implementer a legally enforceable right to cap its *aggregate* royalties for SEPs.)

Contrary to the suggestion that SEP holders are indifferent or oblivious to the size of their aggregate royalty burden, SEP holders have collectively attempted to cap aggregate royalties for 3G and 4G standards. In November 2002, Nokia, NTT DoCoMo, Siemens, and Ericsson announced that they reached a "mutual understanding" to license their patents essential to the

[97] *See* J. Gregory Sidak, *Patent Holdup and Oligopsonistic Collusion in Standard-Setting Organizations*, 5 J. COMPETITION L. & ECON. 123 (2009).

[98] Pacific Bell Telephone Co. v. linkLine Commc'ns, Inc., 555 U.S. 438 (2009). *See also* J. Gregory Sidak, *Abolishing the Price Squeeze as a Theory of Antitrust Liability*, 4 J. COMPETITION L. & ECON. 279 (2008).

WCDMA standard such that the cumulative royalty rate for WCDMA technology would be, in Nokia's words, "at a modest single digit level."[99] Nokia petitioned the industry to adopt a 5-percent cumulative royalty for WCDMA.[100] Again in April 2008, Ericsson, Alcatel-Lucent, NEC, NextWave Wireless, Nokia, Nokia Siemens Networks, and Sony Ericsson announced their "support that a reasonable maximum aggregate royalty level for LTE essential IPR in handsets is a single-digit percentage of the sales price."[101] Those efforts, to cap aggregate SEP royalties at 5 and 9.9 percent, confirm that SEP holders well understand the Cournot complementarity argument—at least as a matter of business intuition, if not in a formally analytical manner. Possessing that understanding, SEP holders have individually acted in their enlightened self interest to try to prevent the problem from occurring to their own detriment and to the detriment of implementers and ultimate consumers.

These attempts to create a focal point for the aggregate royalty burden for SEPs may not have succeeded in achieving a cap as low as originally proposed.[102] However, neither have these attempts ultimately failed in their overriding purpose, for the aggregate royalty burden of SEPs clearly has not taken so large a share of implementers' operating margins as to prevent them from profitably exploiting the standard to manufacture smartphones. In short, though confronted with a daunting pricing question requiring collective action to answer, SEP holders and implementers have nonetheless muddled on with considerable success—to the great benefit of consumers, notwithstanding the dire predictions of the economists and lawyers who espouse the conjecture that royalty stacking leads to market failure. Consequently, it is hardly clear that (necessarily imperfect) government intervention limiting the legal and equitable remedies of SEP holders would produce a superior outcome for

[99] Press Release, Nokia, Industry Leaders NTT DoCoMo, Ericsson, Nokia and Siemens, and Japanese Manufacturers Reach a Mutual Understanding to Support Modest Royalty Rates for the W-CDMA Technology Worldwide (Nov. 6, 2002), http://press.nokia.com/2002/11/06/industry-leaders-ntt-docomo-ericsson-nokia-and-siemens-and-japanese-manufacturers-reach-a-mutual-understanding-to-support-modest-royalty-rates-for-the-w-cdma-technology-worldwide/.

[100] Press Release, Nokia, Nokia Advocates Industry-wide Commitment to 5% Cumulative IPR Royalty for WCDMA 17 (May 8, 2002), http://press.nokia.com/2002/05/08/nokia-advocates-industry-wide-commitment-to-5-cumulative-ipr-royalty-for-wcdma/.

[101] Press Release, Ericsson, Wireless Industry Leaders Commit to Framework for LTE Technology IPR Licensing (Apr. 14, 2008), http://www.ericsson.com/thecompany/press/releases/2008/04/1209031.

[102] *See, e.g.*, Keith Mallinson, *A Compendium of Industry and Market Analysis Articles on Intellectual Property in Mobile Communications Standards: Response to FTC Request for Comments on the Practical and Legal Issues Arising from Incorporation of Patented Technologies in Collaborative Standards* (June 12, 2011); Philip Solis & Stuart Carlaw, *Mobile Device Royalties* (ABI Research 2011); Rudi Bekkers, René Bongard & Alessandro Nuvolari, *Essential Patents in Industry Standards: The Case of UMTS*, Proceedings of the 6th International Conference on Standardization & Innovation in Information Technology (2009).

consumers than what (necessarily imperfect) market forces have actually delivered.

The third difficult question concerning the aggregate royalty burden for SEPs is how to slice the pie. If no one SEP has incremental value unless an implementer uses it in conjunction with all other SEPs, how shall the many owners of SEPs divide among themselves the aggregate royalty burden for standard-essential patents? I return to this question in Part VII.

### E. The Proper Scope of the Entire Market Value Rule in the Context of SEPs

Economists and courts have largely rejected the entire market value rule as a rigorous method for calculating reasonable-royalty damages in cases of infringement of implementation patents. A reasonable royalty must be based on the disaggregated value of the patent in suit. The Federal Circuit and the district courts have excluded damages testimony when an expert witness has used the entire market value but failed to prove that the patented technology at issue was the basis for customer demand for the product implementing the patent.[103] Consumer electronics products often contain hundreds of patented and non-patented components, and consumers may value those downstream products due to features not covered by the patent in suit. Consequently, the entire market value of the downstream product does not necessarily represent the value of the patent in suit. The Federal Circuit therefore held in *LaserDynamics* in 2012, that, "in any case involving multi-component products, patentees may not calculate damages based on sales of the entire product, as opposed to the *smallest salable patent-practicing unit*, without showing that the demand for the entire product is attributable to the patented feature."[104]

Some would argue that as a practical matter any approach that allocates some aggregate value to an individual patent in suit would suffer from "focal point bias"—the overvaluation of the contribution of the patent in suit relative to the collective contribution of all other patented and unpatented components, occurring particularly in a trial that focuses almost entirely on the patent in suit.[105] A judge exacerbates this cognitive bias among the jury when he allows only a few days for the trial and thus precludes any serious inquiry into

[103] *See, e.g.*, LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 68 (Fed. Cir. 2012); Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir. 2011) (citing Garretson v. Clark, 111 U.S. 120, 121 (1884)); Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1336 (Fed. Cir. 2009); Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1549 (Fed. Cir. 1995); IP Innovation, LLC v. Red Hat, Inc., 705 F. Supp. 2d 687, 690 (E.D. Tex 2010); Cornell University v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 286–87 (N.D.N.Y. 2009).

[104] *LaserDynamics*, 694 F.3d at 67–68 (emphasis added).

[105] *See generally* Amos Tversky & Daniel Kahneman, *Judgment Under Uncertainty: Heuristics and Biases*, 185 SCIENCE 1124 (1974).

the other value-creating inputs. To the extent that one has confidence that the phenomenon of focal point bias is factually present in patent litigation, this bias supports the use of the "smallest salable unit" as the rate base. That is, using the smallest salable unit would increase the ratio of the value of the patent in suit to the value of all other inputs and ideally would reduce the magnitude of the jury's error in estimating damages owing to focal point bias.

Does the Federal Circuit's reasoning disfavoring use of the entire market value rule apply with equal force to SEPs? At least one company involved in smartphone patent litigation, Nokia, argues that it should not. Nokia advocates reversal in the Federal Circuit of any rule that would require patent damages for SEPs to be based on the smallest salable component of the product embodying the patent.[106] Nokia correctly argues that "royalty rates for such patents are typically based on, and applied against, the price of the end product," such as a smartphone.[107] The company therefore defends the use of the entire market value rule to measure damages for infringement of SEPs. However, courts have not always followed this suggestion. Judge Holderman ruled in *Innovatio* that the court must calculate the FRAND royalty "on the smallest salable patent-practicing unit."[108]

In the context of FRAND royalties for SEPs, which royalty base should apply—the entire market value of the downstream product or the smallest salable component of the downstream product that implements the SEP in suit? In a sense, the answer is both. The answer turns on whether or not the declared-essential patent is indeed standard-essential in fact. For an SEP, the smallest salable component must be the entire product embodying the standard. Suppose to the contrary that there exists a salable component that implements only part of the standard. By construction, there must therefore be parts of the standard that this component does *not* implement. If so, then the component itself is not fully standard-compliant, and the essentiality of the patent in suit to the standard is illusory and nonexistent. Characterizing a patent as being standard-essential only has meaning when the standard is actually implemented in the downstream product. For patents that are not SEPs in fact, FRAND has no meaning. This category includes patents that read on a part of the standard that implementers never use because it solves an engineering problem to offer a functionality for which no commercial demand materializes. As a result, for patents that are genuinely standard-essential, the smallest salable component in the FRAND context must be the product that implements the standard.

Using as the royalty base the market value of the downstream product implementing the standard satisfies both the entire market value rule and the

[106] Brief for Nokia Corp. and Nokia Inc. as *Amici Curiae* in Support of Reversal and in Support of Neither Party at 8, Apple Inc. v. Motorola Inc., No. 11-cv-8540 (filed Fed. Cir. May 6, 2013) [hereinafter Amici Curiae Brief for Nokia in *Apple v. Motorola*].

[107] *Id.* at 8.

[108] RAND Opinion in *Innovatio*, *supra* note 4, at 23.

Federal Circuit's "smallest salable component" requirement. In contrast, for implementation patents, the value of the smallest salable component is almost always smaller than the value of the downstream product because implementation patents have substitutes. The same is true of patents declared to be standard-essential but which subsequently prove not to be standard-essential in fact. For a genuinely standard-essential patent, the entire market value rule and the smallest salable component rule converge and produce the same answer.

## IV. PROBLEMS WITH THE *EX ANTE* INCREMENTAL VALUE METHOD—IN GENERAL AND WITH RESPECT TO SEPs SPECIFICALLY

In April 2013, Judge James Robart determined the RAND rates that Microsoft must pay Motorola to use certain of Motorola's SEPs.[109] He modified the *Georgia-Pacific* framework (which a court uses to set a reasonable royalty in the simplest of patent-infringement cases concerning non-SEPs). To set a RAND royalty, Judge Robart engrafted onto *Georgia-Pacific* the *ex ante* incremental value approach advocated by the proponents of the patent-holdup and royalty-stacking conjectures. Consequently, he equated the RAND royalty to the increment by which the value created by the patent in suit exceeded the value created the next-best substitute, *as hypothetically evaluated by the SSO when it decided to adopt into its standard, to the exclusion of alternative technologies not chosen, the technology covered by the patent in suit.*[110]

Judge Robart's analysis is wrong. Its implicit economic assumptions consistently bias the estimate of the FRAND royalty in favor of the infringer. *Microsoft v. Motorola* exposes not only the legal and economic deficiencies of *Georgia-Pacific* in general, but also the problems inherent in converting that already deficient framework into an *ex ante* incremental value methodology for setting FRAND royalties. After identifying Judge Robart's errors of commission and omission, I identify the necessary corrections to his approach so that it would be less biased should other courts choose to use it. I also explain how Judge Holderman's decision implements some of the suggested corrections.

### A. Why General Deficiencies of *Georgia-Pacific* Make Its Framework Inadquate to Identify a FRAND Royalty

When it invokes the *Georgia-Pacific* framework, a district court dumps into the jury's lap the chore of evaluating fifteen factors that are neither mutually exclusive nor exhaustive to determine a reasonable royalty, all with no guidance as

[109] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013) (Robart, J.). For purposes of discussion in this article, I follow the usual convention of making no legal or economic distinction between FRAND and RAND royalties. By making this assumption for present purposes, I do not exclude the possibility that someone may eventually make a compelling argument for why "fair" is not a throwaway word.

[110] *Id.* at *16–20 (citing *Georgia-Pacific*, 318 F. Supp. at 1119–20).

to the relative importance or weight to assign to any particular factor.[111] Multi-factor tests without weights are difficult to implement rigorously and may permit arbitrary determinations to support any claim. Faced with a large number of factors, a judge or jury could simply choose to weight a given factor more heavily to support virtually any royalty. The application of a modified *Georgia-Pacific* framework to the determination of a FRAND royalty does more than simply replace a poorly structured multi-factor test with another. This particular application of *Georgia-Pacific* takes a poor solution to one type of dispute and extends it to an entirely new class of disputes. Although courts have embraced the *Georgia-Pacific* test, the Federal Circuit, as noted earlier, did rule in *Whitserve* in 2012 that an expert witness (and presumably therefore also the finder of fact) need not use the *Georgia-Pacific* factors.[112]

In addition to manifesting the generic problems of multi-factor legal tests that lack relative weights, the *Georgia-Pacific* factors are poorly suited to representing a hypothetical negotiation for FRAND royalties. First, SEPs do not fit within the *Georgia-Pacific* framework unless they are not genuinely essential to the standard (either because the patent holder exaggerated when declaring the SEPs to be essential, or because some subsequent technology has become a technologically and commercially feasible substitute for the (formerly) standard-essential patent). In these two instances, the patent's incremental value will likely be small.

Second, one can view the FRAND commitment as a form of private contracting around a default rule supplied by either statute or case law. In effect, patent holders participating in the SSO opt out of their right to receive a reasonable royalty calculated according to the case law applying the *Georgia-Pacific* method. Other interpretations of the FRAND commitment have portrayed it as the patent holder's (qualified) waiver of its statutory right to an injunction under the Patent Act (and, by extension, the patent holder's (qualified) waiver of its right to an exclusion order from the International Trade Commission under section 337 of the Tariff Act). That alternative interpretation is not persuasive because it would treat many words in the FRAND commitment in an SSO's contractual documentation as inconsequential verbiage. If the FRAND commitment truly consisted only of the SEP holder's forbearance from enjoining an infringer, the SSO could have expressed the nub of that idea much more simply as a blanket prohibition on injunctions, without addressing how the FRAND commitment contractually modifies and circumscribes a patent holder's statutory right to receive a reasonable royalty from the

[111] *See, e.g.*, Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901, 910–11 (N.D. Ill. 2012) (Posner, J.); Daralyn J. Durie & Mark A. Lemley, *A Structured Approach to Calculating Reasonable Royalties*, 14 LEWIS & CLARK L. REV. 627, 628, 632 (2010). I assume that the patent holder typically will demand a jury trial. However, my criticisms of *Georgia-Pacific* do not materially change if instead a judge is applying the framework in a bench trial or in a ruling on a post-trial motion to set aside the jury's verdict or reduce the size of its damage award.

[112] Whitserve, LLC v. Computer Packages, Inc., 694 F.3d 10, 31 (Fed. Cir. 2012).

infringer. Instead, what SSO actually have done is to specify as well the attributes of a permissible royalty within the standard-setting context (namely, the FRAND commitment). One can view those required elements of an acceptable royalty as an election by members of the SSO (and, derivatively at a higher level of legal abstraction, by the third-party beneficiaries who receive only as many rights as the SSO's members collectively choose to assign to them) to opt out of public law's default framework for setting patent royalties. Within the United States, therefore, far from viewing the adoption of a FRAND commitment as inviting or instructing the finder of fact to use the public law framework of *Georgia-Pacific* and its progeny to calculate the royalty for an SEP, a court could, with greater intellectual defensibility, interpret the FRAND commitment as the agreement of SEP holders and implementers to opt out of the *Georgia-Pacific* framework because of its unsuitability for identifying whether a given royalty for a given SEP in a given dispute is FRAND. A court embracing that interpretation of FRAND's relationship to *Georgia-Pacific* would then resort to first principles of law, economics, and equity to define the proper framework for the finder of fact to decide whether a given rate for an SEP is fair, reasonable, and nondiscriminatory.

Third, it is useful to consider analogies to tort and contract, and to recognize the legal and economic significance of the differences between the two analogies. The typical royalty dispute in which a court applies the *Georgia-Pacific* factors resembles a tort (such as trespass or conversion).[113] In a hypothetically voluntary negotiation between the tortfeasor and his victim, the price is struck a split second before the infliction of harm. The *Georgia-Pacific* approach mirrors tort theory in this respect, because the moment of first infringement is when noninfringing substitutes are evaluated for purposes of calculating the royalty in a hypothetically voluntary licensing negotiation. In the stereotypical tort action, the parties do not necessarily know one another. They do not have expectations of repeat transactions. So there is no reason for the patent holder, who is analogous to the tort victim, to forbear from seeking the highest possible compensation for what has been taken from him. The equilibrium that emerges from the hypothetical negotiation is one of mutual opportunism. In the language of economics, the patent holder's objective function for the hypothetical license negotiation is one of unconstrained optimization. The negotiation (and the potential litigation) over a reasonable royalty is not the beginning of a repeated game in this scenario. More likely, the parties hope never to see one another again. The *Georgia-Pacific* approach rests on these same implicit assumptions about the nature of the hypothetical royalty negotiation between the patent holder and the infringer.

[113] *See, e.g.*, Vincent v. Lake Erie Transp. Co., 109 Minn. 456, 124 N.W. 221 (1910) (awarding damages for trespass notwithstanding the defense of private necessity). *See also* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 204–09 (Aspen 7th ed. 2007) (discussing damages for intentional torts).

In contrast, a legal dispute requiring a court to confirm or establish a FRAND royalty rate may expressly arise from a breach-of-contract suit concerning the FRAND obligation. Unlike the parties to the stereotypical tort dispute, the parties to a FRAND dispute are probably members of an SSO who have long known one another, are already contracting with one another, and expect to do so again, repeatedly, into the foreseeable future. Theirs is a repeated-play game *across an infinite sequence of innovations*. In their repeat contracting, these SSO members will form their mutual expectations (and hence their framework for measuring harm in the event of a breach of the licensing promises made by a member of the SSO to the SSO as a whole) far before *Georgia-Pacific*'s moment of first infringement. The current fashion circa 2013 in legal and economic scholarship and in early court decisions interpreting FRAND is to peg this critical meeting of the minds to the moment that the SSO adopts the standard in question. Judge Robart did so in *Microsoft v. Motorola*, and so did Judge Holderman in *Innovatio*. This view seems manifestly incorrect. As I will explain momentarily, the more persuasive moment for recognizing this critical meeting of the minds is earlier, when the inventor belonging to the SSO chooses to monetize his inventions through participation in the SSO rather than by some alternative business strategy. This dichotomy between hypothetical negotiations in tort versus hypothetical negotiations in repeat-play contracting sheds light on the doubtful suitability of a court's use of the *Georgia-Pacific* approach for determining or confirming that a royalty offered for a given SEP is FRAND.

In a common law system, it is the essence of judging to extend an existing legal principle or framework to a novel dispute. To his credit, Judge Robart recognized the need to adjust the *Georgia-Pacific* factors before one can begin to apply them to a RAND royalty determination. However, the decision to retrofit *Georgia-Pacific* for FRAND disputes was an error on Judge Robart's part. Given the opportunity to create the first legal authority on RAND, Judge Robart chose to apply an already deficient framework to a new type of dispute which that framework was never intended to address. It is equally if not more plausible to interpret the FRAND commitment as rejecting the *Georgia-Pacific* approach as the starting point for setting FRAND royalties. Judge Robart, however, interpreted the contract between an SEP holder and other members of the SSO as doing just the opposite.

### B. Arguments for the *Ex Ante* Incremental Value Method

A patent's incremental value is the difference between the patent's value and the value of the next-best noninfringing substitute patent. A patent's *ex ante* incremental value is the difference between the patent's value and the value of the next-best noninfringing substitute patent before the first patent has been adopted into the standard. As noted earlier, SEPs have incremental value only *before* they are adopted into the standard, when there is still competition among substitute technologies for adoption into the standard.

Critics of my argument that the incremental value of a patent is an insufficient means to calculate the royalty for an SEP (because each SEP holds zero incremental value without all other SEPs) may argue in rebuttal that I elide the critical distinction between *ex ante* and *ex post* valuation. I do not agree, but it is useful to walk through the rebuttal argument to see where the divergence of views occurs.[114]

Critics will argue that the invalidity of setting a FRAND royalty on the basis of the incremental value of the patent in suit for use in the standard only applies *after* the SSO has set the standard and all the other SEPs have by definition become essential. Before that point, the SSO usually has options. The SSO might be able to include patent *A* (which I use as a shorthand for "the technology claimed by patent *A*" and which I assume the SSO will actually select) or patent *B* in what would otherwise be the same standard. Or the SSO might be able to use patent *C* in a very different standard intended to serve the same purpose.

In choosing between *A* and *B*, the SSO will assess the incremental value of *A* over *B*. In hypothetical negotiations occurring before the standard's adoption, the potential implementers would not necessarily be able to agree to pay only that increment of value to be licensed for *A*. After all, a car buyer cannot buy a Lincoln for only its incremental value compared with the next-best alternative, which might be a Ford, because the Ford is not free. So the proper measure of the maximum *ex ante* value of a patent that could become standard-essential is not the patent's *ex ante* incremental value *per se*, but rather the sum of the price that the buyer (in this stylized case, the SSO is acting in some collective sense for all the future implementers of the standard) would need to pay for the next-best alternative (*B*) and the incremental value of *A* over *B*.

Here is where the implicit economic assumptions of the proponents and opponents of the *ex ante* incremental value method become critical to distinguish. Proponents of the *ex ante* incremental value approach implicitly assume that competition with *A* would drive the royalty for *B* down to its owner's reservation price, such that implementers would need to pay for only the *B* patent holder's minimum willingness to accept. Proponents believe that the holder of patent *B* will usually have a minimum willingness to accept that approaches zero (in part because, unlike the Lincoln, patent *B* is intellectual property and thus has an incremental cost of essentially zero). In that case, the SSO's maximum willingness to pay will be the incremental value of *A* relative to *B,* since the acquisition cost of *B* will drop out. If so, then the minimum willingness to accept of the holder of patent *A* will approach zero, and the hypothetical *ex ante* bargain at the time of standard adoption might result in a price below the implementers' maximum willingness to pay.

[114] I base the following discussion on my actual correpsondence with the general counsel of a major technology company who is active in the debate over the meaning of FRAND. He prefers to remain anonymous but has allowed me to paraphrase his argument here.

Proponents of the *ex ante* incremental value approach acknowledge that the holder of patent *A* will have a minimum willingness to accept that exceeds zero if the patent holder would incur an opportunity cost by allowing patent *A* to be used in the standard rather than outside the standard. *Rambus v. Infineon* might have been such a case because of the patent holder's belief that it could create a *de facto* RDRAM standard.[115] One can imagine a similar situation if multiple SSOs are establishing competing standards. If so, then the holder of patent *A* might, in determining its minimum willingness to accept for submitting to a FRAND commitment with respect to standard *X*, take into account the diminished value to it of competing standard *Y* if its superior technology is used in standard *X*. Proponents of the *ex ante* incremental value rule implicitly assume that this scenario is rare or nonexistent.

The choice between patented technology *A* and patented technology *C* is more difficult. In the choice of *A* versus *B*, everything else was assumed to remain constant. In the choice of *A* versus *C*, more facts need to change. Proponents of the *ex ante* incremental value approach would concede that the SSO's evaluation of *A* versus *C* would require a more complex calculation of the incremental contribution of the patented technology to the value of the standard. However, they would regard the exercise as conceptually identical to the calculation in the choice of *A* versus *B*.

In other words, proponents of the *ex ante* incremental value rule believe that no patent holder will share in the combinatorial value that is created by the standard except to the extent that the value is captured in the incremental value of the patent (for example, if patent *A* increases the value of the standard by *M*, *M* is the patent's incremental value). Instead, the patent holder is more like a paper clip seller that can engage in price discrimination but winds up selling at its minimum willingness to accept because it faces meaningful competition in each buyer's auction.

In this discussion, the SSO is treated as the hypothetical buyer or licensee (or, more precisely, the agent that determines the terms on which the inputs will be combined). That treatment is consistent with my premise that the SSO can be analogized to a joint venture. The critics' view would, however, suggest that the analogy does not result in the outcome I propose, for two reasons. First, the ordinary joint venture engages in commercial conduct—it buys or sells something. It thus makes sense to think of maximizing the joint surplus through the terms on which the joint venture buys or sells. In contrast, a standard is usable by anyone, and the surplus that the standard creates is realized by users in their implementations of the standard—for example, by selling a standard-compliant product. Second, one could argue that an SSO is not like an existing partnership that tries to serve the partners by creating and distributing surplus to them. Instead, one could frame the SSO as a would-be partnership whose role is to facilitate surplus creation by standard implementers and

[115] Rambus Inc. v. Infineon Techs. AG, 318 F.3d 1081 (Fed. Cir. 2003).

that uses competition to select partners—that is, contributors to any particular standard—with an eye toward minimizing the quality-adjusted cost of technology inputs for the benefit of standard implementers.

One can consider the second point as another way of framing the *ex ante* versus *ex post* point; and it seems essential to the forgiving antitrust treatment of SSOs, compared with the treatment likely afforded a more ordinary joint venture of thousands of industry firms. The second point might also reflect a different but related foundational difference between my way of viewing the framework for a FRAND royalty and the critics' view. I view the SSO as an ordinary, market-based joint venture whose purpose is to further the interests of the joint venture partners as sellers of technology inputs into the joint venture's product (SEP holders) and as implementers of the joint venture's output (licensees). An alternative view would have the SSO serving a quasi-governmental, transactions-cost-reducing function to enable implementers (including but not limited to SSO members and vertically integrated SEP holders) to maximize profits and surplus in the downstream markets in which they implement the standard.

Membership in SSOs is voluntary, so if participants in SSOs (not merely implementers of standards) are not permitted to be market-surplus maximizers, market players will underinvest in standard setting. Critics would provide two responses to this principle. First, as I say of SEPs, there is a difference between a patent being declared essential and its being essential in fact. As a practical matter, if a firm wants to influence industry standards, it needs to participate in the SSO. The would-be SEP holder knows that it is trading the ability to set a higher per-unit price on its technology in return for a higher volume of sales (future licensees created by the standard). Second, my framework could be construed as not being a true member-maximizing model but rather an SEP holder-maximizing model. However, if one expects SSO investment to be driven by the rewards to SSO members, and if those rewards are paid to SEP holders, then underinvestment in SSOs may result by those unlikely to own many SEPs. Consequently, SSOs would become more like Moving Picture Experts Group (MPEG) patent pools.

Critics would argue that my analogy of the SSO to a joint venture implies that SSOs must reward SEP holders entirely by the royalty. Critics would respond that, until recently, most SSO members and patent holders expected to be compensated mostly by product sales in the downstream market, which is presumably what drove them to join the SSO and participate in setting the standard in the first place. One can dispute the plausibility of this argument on the grounds that it means that the SSO is not a robust mechanism for standard setting as the business models of its members move from homogeneity to heterogeneity. But, if that characterization is correct, then one implication might be that the occasional patent holder that does not make products can decide (1) to avoid the SSO and hope the resulting standard incorporates its patented technology (which would ordinarily be a risky strategy) or (2) to bargain with

the SSO by saying that it will agree to license its technology on FRAND terms. In other words, FRAND can be reserved for those who have a more complicated reward structure, and others are free to bargain *ex ante* (if they want to increase the likelihood of volume) or *ex post* (if they want to preserve pricing discretion).

### C. The Unsupported *Ceteris Paribus* Assumption Underlying the *Ex Ante* Incremental Value Rule

The *ex ante* incremental value approach contains a strong implicit assumption which, when recognized explicitly, is manifestly absurd. Because SEPs are *complements*—not substitutes, like implementation patents—one cannot examine the next-best noninfringing alternative to an SEP unless one backdates the hypothetical negotiation between the patent holder and the implementer to the moment of standard adoption. The *ex ante* incremental value method does so and then implicitly makes the economist's *ceteris paribus* assumption—all other factors remain the same. But do all other factors really remain the same in the real world? Certainly not. The need to undertake a hypothetical bargaining analysis is not license to include dispositive assumptions, either explicit or implicit, that are manifestly unworldly.

In the case of the *ex ante* incremental value rule, the rule's absurdity is apparent if one goes even farther into the past to ask the more probative hypothetical question. Rather than begin at the time of standard adoption by members of the SSO, begin at the moment that the inventive firms are deciding how to monetize their inventions. These firms are, or will be, the holders of patents likely to be valuable—perhaps even essential—to the next standard to be adopted. Each one of these inventive firms is deciding whether to participate in the SSO, which would require its declaration of the patents it believes to be standard-essential and its acceptance of the commitment to license those patents to anyone at a price no higher than what is fair, reasonable, and nondiscriminatory.

Suppose that this inventive firm were informed at the moment that it is deciding whether to participate in the SSO that, if the SSO selects its technology for the standard, the firm will receive FRAND royalties calculated according to the *ex ante* incremental value rule. The reward for the inventive firm's participation in the SSO will be limited to the incremental value that its SEP confers on implementers *relative to the best losing technology* considered by the SSO at the moment of standard adoption. Suppose further that the SSO tells the inventive firm, "We know you want to monetize your patents related to the next generation of mobile communications devices that hundreds of millions of consumers will use, but don't worry about the low royalty you will receive on your portfolio of standard-essential patents—you'll make it up on volume!"

Reasonable minds can differ over whether a rational, profit-maximizing firm engaged in inventive activity would find this offer too attractive to refuse.

The important point is that the hypothetical negotiation at the time of standard adoption assumes the enthusiastic participation of at least *two* competing inventors. If the two inventors were equally likely to have their technology chosen (because members of the SSO consider the technologies to be close substitutes *ex ante*), then those two inventors would each have a 50-percent chance of winning the tournament and receiving the payoff of FRAND royalties. What assurance is there that an amount equal to 0.5 multiplied by the incremental profits of all implementers using this particular contribution to the standard would exceed the costs to the winning inventor of developing its patented technology and participating in the standard-setting process?

Put differently, the *ex ante* incremental value method makes a categorical assumption—essentially a conclusion of law—that rests on a highly debatable factual proposition that will surely vary from patent to patent and case to case. There is no basis in fact or economic theory to assume that in all cases the *ex ante* incremental value interpretation of FRAND would suffice to give an inventor a sufficiently large payoff in expected value terms to cause that inventor to decide to monetize his patents through participation in the open standard of an SSO rather than through some other business strategy. In effect, the *ex ante* incremental value method assumes that the inventor has no outside option for monetizing his patent. In other words, the SSO is implicitly assumed to be a monopsony over technology over the relevant time horizon. One needs only to notice that Apple has prospered with a proprietary standard for the iPhone to realize that the real world does not match the hypothetical world that is a necessary (but not sufficient) condition for the *ex ante* incremental value approach to be a plausible interpretation of what constitutes a FRAND royalty.

### D. Economic Rent, Quasi Rent, and the Incentive to Invest in the Uncertain Creation of Patentable Inventions

A proper understanding of FRAND royalties requires understanding the relationship that economic rent and quasi rent have to the incentive to invest in the creation of patentable inventions. Suppose that, to undertake a line of research and development intended to produce a patentable invention, a firm must invest $k$ dollars.[116] This investment is not a direct investment in a particular innovation *ex ante*. Rather, firms invest in research and development (R&D) in search of new innovations. Among a set of $N$ projects, $K$ total R&D dollars may be spent. However, the cost of any given project is not merely the quotient $K/N$. Rather, many of the funded projects will be unsuccessful. That is not to say, however, that failed investments have no value in terms of advancing knowledge. The sunk cost of successful projects must include expenditures on

[116] This discussion draws from SIDAK & SPULBER, *supra* note 79, at 423–25.

unsuccessful projects. *Ex ante,* no one can know the likelihood of any given project's success, or even the overall success rate among proposed projects. As an entrepreneurial activity, R&D is uncertain. The existence of this uncertainty is why the rewards for successful innovations include the right to a temporary monopoly, or patent. Encouraging economic agents to pursue uncertain successes requires large rewards. The cost of a successful project, $k$, is then $(K/N)(1/u)$, where $u$ is the entrepreneur's estimation of the success rate among funded projects, where $0 < u < 1$.

Suppose that the investment $k$ is irreversible, so that $k$ represents a sunk cost. Assume that the firm intends to monetize its invention by licensing its patent to third parties rather than manufacturing its own downstream product employing the patent. The firm has operating costs $c$, which are low because they consist solely of the cost of licensing its patent to implementers. The firm expects to earn revenues $R$.

The firm's economic rent is defined as revenues net of operating costs and investment costs, $R - c - k$. Economic rent provides the incentive for entry. In contrast, the firm's quasi rent is defined as net revenue, $R - c$. The quasi rent provides a firm the incentive to stay in the industry after it has incurred the sunk costs of entry. Having sunk $k$, the firm decides whether or not to license its patent on the basis of its comparison of $R$ and $c$ only. In a static sense, it would manifest the fallacy of sunk costs for the firm to base its decision to license its patent on the magnitude of $k$. Thus, after $k$ is sunk, only quasi rents—not economic rents—affect the firm's decision whether or not to license the patent.

That condition does not mean that pricing should ignore the sunk costs $k$. It is an economic fallacy to ignore the firm's expectations when it is deciding whether to invest $k$. It would be fallacious for the firm to base its investment decision on quasi rents alone, ignoring the magnitude of $k$. *Before* the firm has sunk $k$, it is economic rents that count, not quasi rents.

The FRAND commitment is an enforceable contract between a patent holder and an implementer (including any third-party beneficiary, regardless of its participation in the SSO). That the patent holder willingly chooses to enter into this contract implies that its expected economic rents from contracting are positive: $R - c - k > 0$, which is equivalent to the condition $R - c > k$. In other words, the firm must expect that its net revenue will exceed its sunk investment. If instead the firm expects that its FRAND royalty payment will only recoup its quasi rents, then any incentive for the firm to undertake transaction-specific investment evaporates. Critics of this argument assume away the problem. They simply assert that no transaction-specific investments accompany the FRAND commitment (except perhaps for the costs associated with participation in the SSO), as the SEP holder's research expenses are sunk by the time of standard setting. This rejoinder is unpersuasive because it oversimplifies the standard-setting process. Standards are dynamic. They evolve over years. A firm constantly invests in research and will rationally anticipate that

some of its innovations may become standard-essential over time. The firm's investment decision will directly reflect its expectations about the value of these innovations. As the expected revenues from a FRAND royalty fall, investment will fall for any SSO participant that expects to be a net licensor of SEPs *ceteris paribus*.

The firm's reaction to falling FRAND rates can be offset by an increase in demand for the firm's technology. As SSO participants cooperate to lower the costs of production of standard-compliant end-user products, the quantity demanded of those end-user products will increase. This end-user demand increases the number of products implementing the firm's technology, and thereby the firm's total royalty revenue. For a running royalty, the revenue that the firm collects from patent royalties is the royalty rate, $r$, times the price of the good, $p$, times the number of implementing units of the downstream product, $q$. The innovator can maximize its revenue by remaining outside the SSO, and charging a monopoly rate for its technology, which implies limiting the number of products that can profitably implement that technology. Alternatively, the innovator can, if he is able to cooperate with other SEP holders, charge a sufficiently low royalty rate such that the number of implementing products increases. Total revenue can increase by lowering price and increasing quantity if the increase in quantity demanded for end-user products is sufficiently large and demand is sufficiently price-elastic. An innovator will be motivated to participate in any arrangement that increases its overall profits. The SSO relies on the FRAND commitment to establish an institutional constraint that successfully achieves this alternative business model, increases revenues for all firms (innovators and implementers alike), and lowers prices faced by consumers of the end-user product. The FRAND commitment simply ensures that all firms will license their technology at rates low enough to maintain the greater net gains to all.

In the standard-setting context, a patent holder's expected revenue happens to be based on sunk research costs because, under a FRAND commitment, the patent holder necessarily uses its research and development costs to calculate its revenue requirements before contract formation. That calculation does not mean that R&D costs are part of the firm's economic cost of licensing its SEP. Nevertheless, because the firm's expected revenues reflect those sunk costs, the expected revenues should be used to compensate the firm. The fact that the firm's patented technology has a lower (or higher) incremental value in comparison with other competing patents is not relevant to the compensation decision. To ensure that contract formation occurs between the patent holder and the SSO, the patent holder's expectation of cost recovery must include its past research cost. If FRAND royalties cover only quasi rents and not economic rents, then the level of investment by net licensors will fall. If the patent holder who is a net licensor expects revenue from FRAND royalties to fall far enough, contract formation will not occur.

## E. The Economic Errors in Judge Robart's Use of the *Ex Ante* Incremental Value Method for Determining FRAND Royalties in *Microsoft v. Motorola*

Judge Robart's adjustments and interpretations of the *Georgia-Pacific* factors set the patent's *ex ante* incremental value as a basis for the FRAND royalty. In modifying the *Georgia-Pacific* factors, Judge Robart said that

> a reasonable royalty would not take into account the value to the licensee created by the existence of the standard itself, but would instead consider the contribution of the patent to the technical capabilities of the standard and also the contribution of those relevant technological capabilities to the implementer and the implementer's products.[117]

Judge Robart reasoned that "there is substantial value in the agreed standard itself apart from any contribution of the patented technology to the standard, and the RAND commitment exists so that SEP patent holders cannot demand more than they contribute."[118] He considered it improper for the patent holder to receive any portion of the standard's value: "Rewarding the SEP owner with any of the value of the standard itself would constitute hold-up value and be contrary to the purpose behind the RAND commitment."[119] This assertion is incorrect, as I shall explain.

In addition, Judge Robart found that *Georgia-Pacific* factor 9, which considers the advantages of a patent over existing alternatives, provides the pathway to incorporate Microsoft's *ex ante* incremental value approach into the determination of a FRAND royalty.[120] Thus, Judge Robart ruled that "*an incremental value approach . . . is required* in the court's hypothetical negotiation paradigm."[121] By moving the time of the hypothetical negotiation from the moment of first infringement to the moment of standard adoption, Judge Robart embraced the *ex ante* incremental value framework for measuring FRAND royalties.

The nascent case law on FRAND royalties offers little guidance on whether or how to use the *ex ante* incremental value approach. In *Apple v. Motorola*, Judge Posner briefly addressed what a FRAND commitment implies. Calculation of a FRAND royalty "starts with what the cost to the licensee would have been of obtaining, just before the patented invention was declared essential to compliance with the industry standard, a license for the function performed by the patent."[122] Judge Posner understood his interpretation of a FRAND royalty to ensure that the patent holder would not be rewarded for the holdup value of the SEP.[123] It was not necessary for Judge Posner to

[117] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *18 (W.D. Wash. Apr. 25, 2013) (Robart, J.).
[118] *Id.*
[119] *Id.* at *19.
[120] *Id.*
[121] *Id.* at *80 (emphasis added).
[122] Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901, 913 (N.D. Ill. 2012) (Posner, J.)
[123] *Id.*

determine a FRAND rate in his opinion, and his comments on FRAND were therefore understandably brief. Judge Posner did use the patent's *ex ante* value as the starting point, but he did not say where the analysis should go next. He also did not expressly endorse the incremental value approach. The word "incremental" never appears in his opinion.

It is therefore important not to leap to the unsubstantiated conclusion that Judge Posner's use of an *ex ante* price as the starting point of the FRAND royalty determination implies that he would use *ex ante* incremental value for determining the FRAND royalty rate for an SEP in the same manner that Judge Robart did. Judge Posner is silent on the use of incremental value as an indicator of a FRAND royalty rate, and Judge Posner's understanding of *ex ante* value need not be equivalent to Judge Robart's understanding of *ex ante* incremental value. In particular, one can and should read special significance into Judge Posner's phrase "what the cost to the licensee would have been of *obtaining* . . . a license for the function performed by the patent,"[124] for this choice of wording is consistent with a recognition by Judge Posner of the need to avoid the common error of failing to include in a hypothetically negotiated patent royalty the cost to the licensee of lawfully acquiring the right to use the next-best noninfringing substitute.

Judge Robart's depiction of a patent's *ex ante* incremental value does not contain this same caveat. To the contrary, it manifests at least five errors of economic reasoning that materially understate the magnitude of a FRAND royalty.

### 1. *The Invention's Marginal Contribution to the Standard versus the Invention's Incremental Value over the Next-Best Substitute*

The first error of economic reasoning by Judge Robart is one that permeates his opinion: the incremental value of a specific patent does not reflect its marginal contribution to the standard. For example, railroad transportation was standardized during the nineteenth century. Suppose that various steam engine designs existed, and the incremental value of the best design over the second-best might have been slight. (Diesel and electric locomotives were not feasible alternatives until later.) However, the steam engine likely had a high marginal contribution to the standard, relative to other technologies in the standard, such as the precise gauge of the track (1,434 milimeters, or 4 feet, 8-½ inches), which initially was subject to considerable variation.[125]

[124] *Id.* (emphasis added).

[125] *See, e.g.*, DOUGLAS J. PUFFERT, TRACKS ACROSS CONTINENTS, PATHS THROUGH HISTORY: THE ECONOMIC DYNAMICS OF STANDARDIZATION IN RAILWAY GAUGE (Univ. of Chicago Press 2009); FRANCIS WHISHAW, THE RAILWAYS OF GREAT BRITAIN AND IRELAND: PRACTICALLY DESCRIBED AND ILLUSTRATED (John Weale 1842) (repub. David & Charles 1969); Warton W. Evans, *The Narrow Gauge Question*, THE ARGUS (MELBOURNE, VICTORIA), Oct. 2, 1872, at 15, *available at* http://trove.nla.gov.au/ndp/del/article/5839798.

The critical distinction is that *ex ante* incremental value compares the patent to other *substitute* patents that existed before the technology's adoption into the standard (various steam engine designs), whereas the marginal contribution to the standard compares a given patent's contribution to the standard with the contributions made by other *complementary* patents adopted in the standard (the chosen steam engine design versus the chosen track gauge).

### 2. *The Potential for the Legal Definition of Essentiality to Create an Economic Tautology in the Hypothetical Negotiation*

Second, Judge Robart's assessment of essentiality contradicts the IEEE definition of essentiality. This error is legal as well as economic. According to the IEEE, a patent claim is essential if "there was no commercially and technically feasible non-infringing alternative" for the patent at issue "at the time of the [proposed] IEEE Standard's approval."[126] Judge Holderman recognized the significance of the IEEE's definition of essentiality in *Innovatio*, holding that, to prove that a patent is essential to an IEEE standard, one must establish that "'no commercially or technically feasible non-infringing alternative' by which to implement the standard" was available "at the time of the standard's approval."[127] "If [a] later technological development creates another, non-infringing means to comply with the standard," he said, "a patent claim is *still* standard-essential"[128] because essentiality is defined at the time of standard adoption.

Thus, by definition, one cannot apply the *ex ante* incremental value rule to determine the value of or FRAND royalties for patents essential to IEEE standards because there are, at the relevant moment, no non-infringing substitutes for the patents over which to calculate incremental value. Judge Robart, however, assumed that there *are* substitutes at the time of standard adoption, indeed so many compelling substitutes that the chosen technology makes only a small incremental contribution to the value of the standard over the contribution that the runnerup technology would have made if it had been chosen instead. But, as defined by the IEEE, an SEP *would* in fact have significant incremental value under the *ex ante* incremental value test because a patent must have "*no* commercially and technically feasible non-infringing alternative"[129] at the time of standard approval to be deemed "essential" in the first place. Based on this definition of essentiality supplied by the SSO itself, it is inappropriate—as a matter of economic logic or as a matter of contractual interpretation—to apply Judge Robart's version of the *ex ante* incremental value approach to *any* IEEE standard-essential patent.

[126] IEEE-SA Standards Board Bylaws, *supra* note 55, § 6.1.
[127] RAND Opinion in *Innovatio*, *supra* note 4, at 16 (quoting IEEE-SA Standards Board Bylaws, *supra* note 55, § 6).
[128] *Id.* (emphasis added).
[129] *Id.* (emphasis added).

### 3. *The False* Ceteris Paribus *Assumption and the Biased Characterization of the Investor's Outside Options at the Chosen Moment of the Hypothetical Negotiation*

Judge Robart's third economic error was making the false *ceteris paribus* assumption described earlier and thus ignoring the need to ensure the continued participation of inventors in the current standard and in future standards. He said that "[a] RAND royalty should be set at a level consistent with the SSOs' goal of promoting widespread adoption of their standards."[130] Yet he also asserted that the SEP holder should not be compensated for its invention being adopted into a standard. That assertion is inconsistent with the former premise. Firms invest not only in developing patents, but also in competing to be adopted into a standard.[131] This form of rivalry exemplifies dynamic competition, in which firms compete not *within* the market but *for* the market.[132] As the D.C. Circuit observed in its *Microsoft* antitrust decision, "[r]apid technological change leads to markets in which 'firms compete through innovation for temporary market dominance, from which they may be displaced by the next wave of product advancements.'"[133] This kind of "Schumpeterian competition . . . proceeds 'sequentially over time rather than simultaneously across a market.'"[134] If the winner of that tournament—whose patented technology the SSO adopts into the standard—is not compensated for that additional investment, how can one expect patent holders to invest in participation in standard setting? Investment in innovation would flow instead into proprietary standards—of precisely the sort which, if they proved to be commercially successful, fuel titanic disputes over monopolization or abuse of dominance.

The "winner-take-all" nature of standard setting increases the risk to inventors and their investors. Using the *ex ante* incremental value method and other rent-shifting proposals that view low prices as the sole objective of standard setting fails to compensate inventors and their investors for their risk bearing. A royalty that excludes all value associated with the patent's essentiality for the standard is inconsistent with what Judge Robart called "the SSOs' goal of promoting widespread adoption of their standards," because it will deter investments in contributions to the standard.

[130] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *12 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

[131] *See, e.g.*, Troy J. Scott, *Standards and the Incentives for Innovation*, presented at the Research Roundtable on Innovation and Technology Standards (2013) (explaining that the net effects of standards for intellectual property protection are positive, increasing innovative investments and increasing their private and social value).

[132] *See* Harold Demsetz, *Why Regulate Utilities?*, 11 J.L. & ECON. 55, 57 & n.7 (1968); *see also* J. Gregory Sidak & David J. Teece, *Dynamic Competition in Antitrust Law*, 5 J. COMPETITION L. & ECON. 581 (2009).

[133] United States v. Microsoft Corp., 253 F.3d 34, 49 (D.C. Cir. 2001) (per curiam) (quoting Howard A. Shelanski & J. Gregory Sidak, *Antitrust Divestitures in Network Industries*, 68 U. CHI. L. REV. 1, 11–12 (2001)).

[134] *Id.* at 50 (quoting Shelanski & Sidak, *supra* note 133, at 11–12).

The easiest way to understand the significance of the false *ceteris paribus* assumption in Judge Robart's approach is to recognize that his approach is "not *ex ante* enough." The chosen moment of the hypothetical negotiation between the willing licensor and the willing licensee should be pushed back in time not merely from *Georgia-Pacific*'s moment of first infringement to Judge Robart's moment of standard adoption, but rather all the way back to the moment when the inventor decides whether or not to monetize his invention within the open standard of an SSO rather than outside the SSO through a proprietary standard or some other business strategy predicated on exclusion rather than open access. At that earlier moment, both the inventor (the future patent holder) and the implementer still have outside options to the hypothetical negotiation. Both the seller and the buyer of innovative inputs intended for the downstream product still have substitution opportunities. *Neither* party at that anterior moment is subject to lock in or holdup.

That moment, far more than Judge Robart's later moment for conducting supposedly *ex ante* analysis, more closely achieves the Rawlsian ideal of the original position, in which the inventor and implementer are both still veiled in some considerable degree of ignorance concerning the commercial potential of the technology before them. In contrast, Judge Robart's approach is selective, asymmetric, and therefore inherently biased: it sets a FRAND rate so as to restore the implementer—but not the inventor—to the original position. The buyer in the hypothetical negotiation would still have substitution opportunities, but the inventor would not.

### *4. The Neglected Cost of Acquiring the Next-Best Noninfringing Alternative*

The fourth error of economic reasoning committed by Judge Robart was, as noted above, to ignore the implementer's acquisition cost of the next-best noninfringing substitute. His version of *ex ante* incremental value analysis mischaracterizes what a FRAND royalty commitment represents.

Consider the following. First, if a patent is essential to a standard, then it will have positive value as an implementation patent in a counterfactual world in which the standard does not exist and inventors instead choose to monetize their inventions through other business strategies. Second, more than one firm will receive positive value in licensing the rights to practice the patent in this counterfactual world. Those assumptions are not strong ones. However, based on those assumptions alone, licensees would be willing to pay more than Judge Robart's measure of the patent's *ex ante* incremental value. So long as the *ex ante* incremental value exceeds the difference in the licensing price for two competing patented technologies, the licensees will purchase the rights to the higher-valued technology at a price up to the incremental value of that patent *plus* the price of lawfully acquiring the right to use the less valuable patent. So, even under these relatively weak assumptions, the price for the patent must exceed Judge Robart's interpretation of the *ex ante* incremental value.

To return to the earlier example, if a Lincoln is worth $4,000 more to me than a Ford, I still must pay, say, $40.000 for the Lincoln—not $4,000—because other buyers have their own private valuations of the Lincoln and have bid up its price. The price I must pay for the Lincoln is still $40,000, and not only the $4000 of incremental value that the Lincoln gives me over the Ford.

Consider another example that more closely resembles a tournament between two inventors to supply an implementer. Airbus and Boeing manufacture large passenger aircraft. The newest generation of Airbus aircraft is the double-deck A380. The newest generation of Boeing aircraft is the 787 Dreamliner. Suppose that Lufthansa intends to make a fleet purchase of only one of the two kinds of jetliners and therefore requests bids, with prices, from Airbus and Boeing. Suppose that the price of the 787 is $250 million, and the price of the larger A380 is $300 million. Suppose that Lufthansa estimates that it would earn $300 million of profit from the 787 over its useful life or $330 million of profit from the A380 over its useful life. Because the A380 will generate greater profit for Lufthansa than the 787, Lufthansa chooses the A380.

Under the logic of Judge Robart's version of *ex ante* incremental value analysis, the A380 would confer an incremental benefit on Lufthansa of $30 million (= $330 million in incremental profit from using the Airbus A380 – $300 million in incremental profit from using the Boeing 787). Of course, if Lufthansa paid only $30 million for the A380, it would be paying only a fraction of what Airbus (and other airlines) thought was a competitive price for the airliner. Airbus has the outside option of selling its A380s to Air France and others airlines instead. More generally, there is no assurance under Judge Robart's approach to defining *ex ante* incremental value that Lufthansa's incremental profit will be a large enough payment to Airbus for it to recover the quasi rents (on a per plane basis) of designing and manufacturing an A380.

Judge Robart's approach provides no assurance that the licensee's incremental profit from using the patent in suit rather than the next-best noninfringing substitute will translate into a high enough royalty to enable the patent holder to recover the sunk costs of developing the patented technology. Consequently, his approach provides no assurance that the hypothetical transaction between a willing licensor and a willing licensee would ever occur. Put differently, Judge Robart assumes the answer to his hypothetical question.

### 5. *The Failure to Disaggregate the Increment of the Implementer's Bargaining Power Attributable to the Implicit But Erroneous Assumption That Implementers Collectively Negotiate as a Monopsonist*

A fifth, and particularly serious, error of economic reasoning that Judge Robart implicitly committed was to fail to disaggregate the degree of bargaining power that an individual implementer would wield vis-à-vis an SEP holder from the degree of bargaining power that all implementers would collectively wield vis-à-vis the same SEP holder if they were coordinating their purchases

as a monopsonist. The hypothetical negotiation at the time of standard adoption is properly cast as *a series of simultaneous, bilateral negotiations* between the SEP holder and each of the implementers. It is incorrect to treat that hypothetical negotiation in the FRAND context as a single transaction occurring between one SEP holder and a solitary representative of all implementers. The difference between the two versions of the hypothetical negotiation is the increment in bargaining power that implementers gain when they act collectively. It is well understood in economic theory that a monopsonist pays a lower price for an input (and consumes a lower volume of the input) than do competing buyers acting individually.[135] It is similarly incorrect to assume implicitly in the hypothetical negotiation that implementers (who are horizontal competitors in the various markets for downstream products) may lawfully exchange information with one another about the prices that they are bilaterally negotiating with the SEP holder, so that implementers may simulate monopsony power.

Judge Robart makes no adjustment for the difference between competitive and monopsonistic negotiation over the FRAND royalty for an SEP. For him to equate, without any such adjustment, the *ex ante* incremental value of a given SEP to its FRAND price is to assume tacitly that implementers may lawfully acquire and exploit monopsony power to reduce the SEP's price. Such an interpretation of FRAND demands that the SSO must play the role of a buyer's cartel in the innovation market. However, the law does not permit implementers to do so. Section 1 of the Sherman Act forbids horizontal price fixing among buyers as well as sellers. Clearly, the monopsonistic suppression of the competitive price for an SEP would exceed the legitimate purpose of the FRAND commitment as an ancillary restraint that increases economic efficiency. At a minimum, this erroneous interpretation of FRAND would make the contract void at common law for being contrary to the public interest.

To advance economic efficiency and increase consumer surplus, the ancillary restraint needs only to ensure that the selection of the standard does not empower the patent holder to charge implementers a monopoly price after the SSO has selected the patent holder's technology and made the patent covering that technology essential to the standard. To interpret the FRAND price as being the monopsony price goes too far—as a matter of legal analysis, as a matter of economic analysis, and as a matter of common sense. No plausible interpretation of the FRAND commitment should conclude that the inventor consented to receiving a royalty suppressed to the monopsony level. Furthermore, the output-suppressing effect of monopsony would violate what Judge Robart called "the SSOs' goal of promoting widespread adoption of their standards."[136] Wider adoption of a standard would occur if the FRAND royalty were set in a manner

[135] *See* Sidak, *Patent Holdup and Oligopsonistic Collusion in Standard-Setting Organizations*, *supra* note 97.

[136] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *12 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

than attempts to simulate the outcome of a competitive equilibrium rather than Judge Robart's monopsonistic equilibrium.

### 6. *Summary: The Implications of Judge Robart's Opinion for Understating a FRAND Royalty*

The FRAND commitment is a contract that, like all other contracts, should be interpreted and applied in accordance with the intent of the parties (that is, the SSO and the SEP holder). According to Judge Robart, the purpose of FRAND is to ensure the standard's success. Yet his decision places, through the *ex ante* incremental value cap, all of the burden for the standard's success on patent holders. It is a cap to which no other member of the community supported by the standard is held as a matter of law or fact. Placing the burden entirely on a single party is not the delicate balance of interests and obligations that many claim that the FRAND commitment embodies.

Judge Robart's *ex ante* incremental value approach limits the compensation for inventors to marginal returns, while permitting implementers to hold the residual claim to the value created by the standard, regardless of the relative contribution that each class of stakeholder makes. This asymmetric burden is paradoxical in view of the fact that the only parties for whom the adequacy of compensation is an objective of FRAND policies are the inventors whose technology propels the standard.

Finally, the *ex ante* incremental value method is unworkable. As Judge Robart himself pointed out, the approach "lack[s] . . . real-world applicability."[137] It would require the court to measure the value of every SEP in a portfolio or at issue, identify the alternatives available at the time of the discussion of the standard, and their respective value. This task would be fact-intensive, time-consuming, and extremely difficult—if not impossible—to perform in practice.[138] It is therefore not surprising that, to my knowledge, courts and SSO members do not actually use the *ex ante* incremental value method in the real world. SSO members and patent holders never measure the exact monetary value of individual patents. It would be impossible to ask parties and courts to do so.

## F. Judge Holderman's Revised *Ex Ante* Incremental Value Approach

In *Innovatio*, in September 2013, Judge Holderman of the Northern District of Illinois set a RAND royalty of $0.956 per unit for a portfolio of nineteen SEPs

[137] *Id.* at *13.

[138] *See, e.g.*, David J. Teece, Peter C. Grindley & Edward F. Sherry, *SDO IP Policies in Dynamic Industries*, Submission to the ITU Patent Roundatble (Oct. 10, 2012) ("One obvious difficulty with making this [*ex ante*] approach realistic is that, in practice, most licensing negotiations for standards-essential patent licenses . . . take place *ex post*, after the standard has been set and after the parties have some basis for determining which patents are standards-essential and which are not.").

concerning the 802.11 standard for Wi-Fi.[139] The case concerned a dispute between Innovatio, the owner of patents essential for the 802.11 standard, and several manufacturers of electronic devices produced in compliance with the standard.[140] Before the hearing on validity, the parties agreed to evaluate the potential damages available to Innovatio if the manufacturers were subsequently found to have infringed the SEPs at issue.[141] Given that the SEPs were subject to a RAND commitment, the court determined the damages by assessing the appropriate RAND royalty for Innovatio's portfolio.[142]

Judge Holderman's determination of the RAND rate bears several parallels to Judge Robart's decision in *Microsoft v. Motorola*, decided earlier in 2013. As Judge Robart did, Judge Holderman used a variant of the *Georgia-Pacific* factors to determine the RAND royalty.[143] To a greater extent than Judge Robart, however, Judge Holderman emphasized the need to set a RAND rate high enough to maintain the innovator's incentives to invest in future R&D and to contribute its inventions to SSOs.[144] Although Judge Holderman did not implement the *ex ante* incremental value method, he placed the hypothetical negotiation at the time of the adoption of the standard,[145] as Judge Robart did. Judge Holderman concluded that a RAND commitment aims to avert patent holdup and royalty stacking, and consequently he believed that courts should take into account those risks when determining the RAND royalty.[146] Furthermore, Judge Holderman maintained that the RAND rate must, to the extent possible, reflect only the value of the underlying technology and not the holdup value.[147] He suggested that the SEP holder should not capture any portion of the standard's value.[148]

For the reasons I have explained, the *ex ante* incremental value approach is inappropriate for the determination of a (F)RAND royalty. Judge Holderman's approach amends the *ex ante* approach and thereby corrects some of the flaws in Judge Robart's RAND opinion that I delineated above.

Judge Holderman's approach differs from Judge Robart's in several important respects. First, Judge Holderman did not determine a RAND range, but rather a specific RAND rate.[149] Second, Judge Holderman considered that the SEPs in question were valid and infringed, and refused to discount the RAND royalty because of pre-litigation uncertainty about the validity and essentiality

[139] RAND Opinion in *Innovatio*, *supra* note 4. Judge Holderman did not release a redacted version of his opinion until October 2013.
[140] *Id.* at 1, 2.
[141] *Id.* at 2.
[142] *Id.*
[143] *Id.* at 36.
[144] *Id.* at 19.
[145] *Id.* at 14.
[146] *Id.* at 14, 17.
[147] *Id.* at 16.
[148] *Id.* at 79.
[149] *Id.* at 11.

of the SEPs in suit.[150] Third, and most important, Judge Holderman rejected the argument that when two equally effective alternatives compete for incorporation into the standard, the RAND royalty could be driven to zero. Accepting the testimony of Professor David Teece, who served as the patent holder's expert economic witness, Judge Holderman found that "it is implausible that in the real world, patent holders would accept effectively nothing to license their technology."[151] He noted that "such a low return . . . would discourage future innovators from investing in new technology and from contributing their technology to future standards."[152] Judge Holderman thus correctly recognized that, in using the *ex ante* incremental value method, the determination of the value that the SEPs contribute to the standard requires not only the identification of the noninfringing alternative technologies that competed for adoption into the standard, but also the cost of lawfully acquiring the use of those alternatives.

Judge Holderman again emphasized the need to consider the acquisition cost of the best noninfringing substitute when rejecting the "bottom up" approach proposed by Dr. Gregory Leonard, the expert economic witness for the alleged infringers. Leonard used the incremental value rule and argued that a hypothetical licensee at the time of standard adoption would not pay more for Innovatio's patents than the amount necessary to adopt an alternative, noninfringing technology.[153] His "bottom up" approach to calculating a RAND royalty would "determin[e] the cost of implementing reasonable alternatives to the Innovatio patents that could have been adopted into the standard, and dividing that cost by the total number of infringing units to determine the maximum per unit royalty Innovatio's patents would have merited in the . . . hypothetical negotiation."[154] Judge Holderman rejected this methodology. He observed that "Dr. Leonard did not account for the royalty that the alternatives to Innovatio's patent might be able to charge."[155] In other words, like Judge Robart, Leonard neglected the acquisition cost of the next-best noninfringing alternative.

## V. AN ECONOMIC FRAMEWORK FOR IDENTIFYING FRAND ROYALTIES

The scholarly literature on "fair" and "reasonable" royalties for SEPs does not consistently define these terms.[156] Some scholars oppose trying to set precise definitions applicable to all cases.[157] Some who do favor a precise definition

[150] *Id.* at 13.
[151] *Id.* at 37.
[152] *Id.*
[153] *Id.* at 72.
[154] *Id.*
[155] *Id.* at 73.
[156] *See, e.g.*, Damien Geradin, *Ten Years of DG Competition Effort to Provide Guidance on the Application of Competition Rules to the Licensing of Standard-Essential Patents: Where Do We Stand?*, 9 J. COMPETITION L. & ECON. 1125 (2013).
[157] *See, e.g.*, Roger G. Brooks & Damien Geradin, *Interpreting and Enforcing the Voluntary FRAND Commitment*, 9 INT'L J. IT STANDARDS & STANDARDIZATION RES. 1, 11 (2011).

argue that a FRAND royalty cannot exceed the SEP's incremental value over the next-best noninfringing alternative.[158] Others would define a FRAND royalty as a royalty (1) based on the proportion of all SEPs incorporated into the standard[159] or (2) calculated in light of the alternative patented technologies available when the SSO adopted the standard[160] or (3) based on the Shapley value from cooperative game theory.[161]

I provide here a framework for determining a FRAND royalty that clarifies the differences between these perspectives and reconciles those differences to the extent possible. From a practical perspective, comparable FRAND licenses for the SEPs at issue are the most reliable starting point for determining FRAND royalties.

## A. Maximizing the Joint Producer Surplus Created by the Standard Subject to the Individual-Rationality Constraint

A FRAND commitment has both a ceiling and a floor. A FRAND royalty may not be less than reasonable for the SEP holder or more than reasonable for the licensee.The creation of the standard will generate joint producer surplus, as discussed in Part III.B. The underlying principle that will determine which royalties are FRAND is that fair and reasonable royalties for SEPs will maximize the surplus resulting from the standard's creation. Under this rule, each SEP holder will have an incentive to cooperate in the *next* generation of breakthrough technology for which the SSO will undertake to establish its *next* open standard.[162]

This maximization of surplus will have two essential elements. The first concerns the constraint the individual rationality imposes on the surplus-maximizing FRAND royalty. The second relates to maximizing the standard's joint surplus given that the downstream products of vertically integrated SEP holders will bear FRAND royalties as marginal costs.

### *1. Individual Rationality as a Constraint on the FRAND Royalty*

The first essential element of the maximization of the joint producer surplus associated with the standard is that, for the SEP holder and licensee voluntarily

[158] *See, e.g.*, Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2039 (2007).

[159] *See, e.g.*, Philippe Chappatte, *Frand Commitments—The Case for Antitrust Intervention*, 5 EUR. COMPETITION J. 319 (2009).

[160] *See* Daniel G. Swanson & William J. Baumol, *Reasonable and Nondiscriminatory (RAND) Royalties, Standard Selection, and Control of Market Power*, 72 ANTITRUST L.J. 1, 21 (2005).

[161] Anne Layne-Farrar, A. Jorge Padilla & Richard Schmalensee, *Pricing Patents for Licensing in Standard Setting Organizations: Making Sense of FRAND Commitments*, 74 ANTITRUST L.J. 671, 693 (2007); David J. Salant, *Formulas for Fair, Reasonable and Non-Discriminatory Royalty Determination*, 7 J. IT STANDARDS & STANDARDIZATION RES. 67 (2009).

[162] Annalisa Biagi and Vicenzo Denicolò propose that the optimal policy rewards early inventors more generously than late inventors to speed the innovation process. Annalisa Biagi & Vicenzo Denicolò, *Timing of Discovery and the Division of Profit with Complementary Innovations*, presented at the Research Roundtable on Innovation and Technology Standards (2013).

to agree on a FRAND royalty and participate in the SSO, each participant must satisfy its own *individual-rationality constraint*.[163] The individual-rationality constraint is a fundamental principle in the economics of contracts. Also called the "participation constraint," the individual-rationality constraint requires that each party to the FRAND licensing transaction prefer participating in the SSO and implementing its open standard to not participating in the SSO.[164] Under the individual-rationality constraint, the holders and licensees of SEPs (including implementers that are not members of the SSO) must be better off implementing the standards than not. Each member must expect to receive enough compensation to ensure its participation in the SSO's open standard.

The individual-rationality constraint provides a bargaining range. The lower bound is the SEP holder's minimum willingness to accept, equal to the SEP holder's opportunity cost of licensing its patents—as SEPs—under FRAND terms. The upper bound is the licensee's maximum willingness to pay to license the SEPs. The bargaining range for a FRAND royalty should be tighter, and the convergence from the opening bid-ask spread to a mutually agreeable price should occur more quickly, than in the stereotypical *Georgia-Pacific* negotiation that hypothetically occurs *at arm's length* between a willing licensor and a willing licensee of a non-standard-essential patent at the time of first infringement. One can view the licensee's commitment to expeditious negotiation of the SEP royalty as the *quid pro quo* of being entitled as an SSO member (or as the SSO's third-party beneficiary) to avail oneself of the FRAND obligations that the SEP holder willingly accepted. To date, courts and commentators have oddly overlooked how the speed at which the bid-ask spread converges might shed light on the legal question of whether a party is negotiating a FRAND royalty in good faith.

For the SEP holder, the minimum willingness to accept will include the opportunity cost of licensing *plus* the fixed costs of participation in the SSO, and possibly also the expected direct costs of reaching a licensing agreement. Because the minimum willingness to accept for an implementation patent holder is only the opportunity cost of licensing, the minimum willingness to accept for an SEP holder will exceed the minimum willingness to accept for the implementation patent holder. Additional costs may arise from participation in an SSO. For example, failure to disclose a potentially essential patent may subject a firm to antitrust scrutiny, and the costs of defending a potential suit.

Likewise, for an implementation patent, the licensee's maximum willingness to pay is the profit it expects to gain from using the licensed patent, relative to the profit it would gain by not licensing the patent. For reasons

[163] *See, e.g.*, PATRICK BOLTON & MATHIAS DEWATRIPONT, CONTRACT THEORY 245 (MIT Press 2005).

[164] *See, e.g.*, JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 154–55 (MIT Press 1988); LUIS M.B. CABRAL, INTRODUCTION TO INDUSTRIAL ORGANIZATION 175 (MIT Press 2000).

examined above, the incremental value of an SEP is not necessarily defined. At the time of standard setting, every patent is in effect an implementation patent having some incremental value. Even with an observable incremental value, the licensee's maximum willingness to pay for a patent as an SEP will fall below the maximum willingness to pay for the same patent as an implementation patent just before the standard selection. This difference represents the implementer's direct and indirect costs of participating in the standard-setting process. Note that this comparison is for patents that exist at the time of standard setting. There may be patents that have no value at all unless they are incorporated into the standard because they cover inventions created for the sole purpose of solving a problem that exists only within the standard. In that case, the licensee's maximum willingness to pay for a patent as an SEP would be higher than if the patent were an implementation patent with zero value.

To ensure the licensee's participation in the SSO, the maximum willingness to pay cannot exceed the incremental value of the patent (including the value of acquiring the lawful right to use the next-best alternative) minus the transactions costs of participating in the SSO and the direct costs of licensing. The timing of this hypothetical bargaining would be before the creation of the standard (since the negotiation by definition requires a willing licensor who has already found the prospect of monetizing his invention through an open standard superior to monetizing it through an alternative business would). The range of royalties for an SEP that can result from a number of bilateral negotiations must satisfy the individual-rationality constraint to ensure participation in the standard.

The individual-rationality constraint incorporates insights from other economic approaches to determining FRAND royalties. The Swanson-Baumol approach considers the royalty rate upon which the parties would have agreed when setting the standard.[165] This royalty rate will indirectly affect the patent holder's individual-rationality constraint. Assuming an *ad valorem* running royalty, to ensure a patent holder's participation in the SSO, the FRAND royalty rate (multiplied by the size of the royalty base multiplied by the number of units sold under the open standard) must equal or exceed the (higher) *ex ante* royalty rate (multiplied by the size of the royalty base multiplied by the (smaller) number of units sold under the proprietary standard). Otherwise, the patent holder would expect to reap a higher profit through *non-FRAND* licensing occurring before the patent's adoption into the standard. The *ex ante* royalty rate is therefore a lower bound to the fair and reasonable rate that satisfies the individual-rationality constraint.

The approach of Anne Layne-Farrar, Jorge Padilla, and Richard Schmalensee considers the marginal contribution of the patent to the standard.[166] Again, the individual-rationality constraint will incorporate that

[165] Swanson & Baumol, *supra* note 160, at 29.
[166] Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 698.

information. An SEP with a more significant marginal contribution will have fewer close substitutes and a higher expected licensing value if it is not incorporated into the standard. Therefore, to satisfy individual rationality for the patent holder, the FRAND royalty must exceed the royalties that the patent holder could gain from not committing to FRAND rates. These royalties represent the patent holder's outside option and would not be bound by a FRAND commitment. So, the royalty rate could exceed the FRAND rate. However, without the adoption of the patent's technology into the standard, fewer manufacturers would choose to license the patent. Nonetheless, as the marginal contribution of the patent increases, both the expected royalty rate and the expected number of licensees will increase. Therefore, to ensure participation in the SSO, the FRAND royalty rate must be higher for patents with higher marginal contributions.

*2. Maximizing the Standard's Joint Producer Surplus Given the FRAND Royalties that Vertically Integrated SEP Holders Will Bear in the Marginal Costs of Their Downstream Products*

As members of a joint venture, the members of an SSO seek to maximize the joint producer surplus created by the standard, or SSO. FRAND royalties should thus maximize the joint producer surplus of the SSO. The objective function that the SSO must collectively maximize may incorporate royalties as a marginal cost of the production of the breakthrough good. As royalties per unit increase, the marginal cost of producing a unit of the downstream good will increase, the profit-maximizing price of that good will rise, the quantity demanded will fall, and the producer surplus from sales of that good will also fall. If royalties always took the form of a marginal cost for the licensee (as in the standard case of an *ad valorem* royalty on the product's price), then the solution to the surplus-maximization problem would be for each SEP holder to charge as low a royalty as possible while still satisfying the individual-rationality constraint for the SEP holder and the licensee (which I explain below).

One complicating factor deserves attention: some firms that participate in the SSO both produce retail goods (for which they must pay royalties) and own SEPs (from which they receive royalties). In the joint maximization problem, the intra-SSO royalty payments would be included as both a cost and revenue and would cancel each other out. Put simply, aggregate *net* royalties for SEPs would be zero among members of the SSO, as in a royalty-free cross license. Thus, transfers of payments among members of the SSO—just as among members of a joint venture—do not increase the joint surplus created by the SSO. For that reason, the surplus-maximizing royalty will be based on the optimal royalty charged to implementers who are not members of the SSO, or who have zero patents to cross-license to members of the SSO.

Even if firms within the SSO have different marginal costs for and different marginal revenues from their retail products, the differences result from firm-specific product differentiation that occurs *after* the standard's creation.

Let the standard itself represent an intermediate product. Manufacturers purchase that intermediate product first by licensing the SEPs in the standard. Then, as manufacturers implement the standard in their retail products, they differentiate their products with implementation patents and other non-patented product attributes. Thus, before implementers have incurred the costs of licensing, and before they have differentiated the intermediate product, that product is still homogeneous. It has the same costs of production for all implementers. Thus, the royalty rates charged by one member of the SSO to an implementer will not affect the joint surplus created by the standard. Therefore, the determination of the optimal royalty rate will be based on the optimal royalty rate charged to implementers who are not members of the SSO.

There are likely to be some firms that are not part of the constructive joint venture but still produce the breakthrough good. There are also likely to be some firms that specialize in producing technology that are a part of the constructive joint venture but which do not produce the breakthrough good. Thus, there will also be royalty payments made from firms outside the SSO to SSO members.

Focusing purely on the royalties paid by non-SSO members, the SSO faces a standard pricing problem. As the SEP holder increases the royalty rate, the royalty base will decrease. At some point, the marginal benefit to the SEP holder from raising its royalty rate will fall to zero. This point defines the royalty rate that maximizes the joint surplus of the SSO members from the setting of the standard. If this rate also satisfies individual rationality (meaning that all parties are better off for having participated in the SSO), then the rate will satisfy the requirement of being fair and reasonable. If individual rationality is not satisfied, then the fair and reasonable royalty would be that which makes the individual-rationality constraint bind. That is, the fair and reasonable royalty would be the lowest royalty that ensures the patent holder's participation in the SSO.

### B. Elements of a FRAND Royalty

A FRAND royalty ensures participation in the SSO by requiring that both the patent holder and the implementer satisfy the individual-rationality constraint, such that both are better off implementing the standard than not. Based on the analysis below and the concept of the combinatorial value of SEPs that I explained earlier, I argue here that a royalty is FRAND if the royalty:

(1) ensures the patent holder's continued participation in standard setting;
(2) does not deny the implementer access to the standard;
(3) is consistent with a sustainable aggregate royalty burden for all SEPs on the implementer's product practicing the SEPs in suit; and
(4) approximates the royalty rates (as a function of an implementer's sales of its product practicing the SEP in suit) of similarly situated licensees.

The first three factors define a "fair and reasonable" royalty. The fourth factor defines a "nondiscriminatory" royalty. I explain now the economic reasoning for this interpretation of FRAND.

### *1. A Robust Definition of "Fair and Reasonable"*

A fair and reasonable royalty promotes participation in the standard by both SEP holders and implementers. Such a royalty adequately rewards the SEP holder for its investment in standard setting and does not deny the implementer access to the standard.

#### *a. Ensuring the SEP Holder's Continued Participation in Standard Setting*

Research and development does not occur once and for all. It is a continuous process. Inventors produce patentable innovations on a recurring basis. Similarly, a standard evolves over time. Patents that are essential to the standard are revealed over time. As technology changes, the marginal contributions of different patents to the value of the downstream product also change. A fair and reasonable royalty must be high enough to ensure the patent holder's continued participation in standard setting.[167]

In Part IV, I explained the problems with setting a FRAND royalty as the *ex ante* incremental value of SEPs. In addition, a FRAND royalty equal only to the difference between the value of the SEP and the value of the best runner-up technology would fail to reward the SEP holder adequately. Particularly, the FRAND royalty must incorporate the *ex ante* incremental value of the SEPs *and* the price of the next-best noninfringing alternative. That amount approximates the value of the SEP. By rewarding the patent holder based on the value that the SEP contributes to the standard and to the downstream product implementing the standard, patent holders will have the incentive to invest in valuable inventions for the next generation of standards.

#### *b. Neither Denying the Implementer Access to the Standard Nor Contributing to an Unsustainable Aggregate Royalty Burden*

Two conditions define a fair and reasonable royalty from the implementer's perspective. First, a FRAND royalty must not be so high as to deny the implementer access to the standard. Second, an individual FRAND royalty must not contribute to an unsustainable aggregate royalty burden. Thus, a FRAND royalty should not be excessive—either individually or in combination with the

[167] *See, e.g.*, RAND Opinion in *Innovatio*, *supra* note 4, at 19 ("a RAND rate must be set high enough to ensure that innovators in the future have an appropriate incentive to invest in future developments and to contribute their inventions to the standard-setting process"); Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *12 (W.D. Wash. Apr. 25, 2013) (Robart, J.) ("[t]o induce the creation of valuable standards, the RAND commitment must guarantee that holders of valuable intellectual property will receive reasonable royalties on that property").

other royalties required to implement the standard without infringing any SEPs. These parameters determine the upper bound of a FRAND royalty for a licensee.

The FRAND commitment ensures *access* to the standard. SSOs' IPR policies do not say how to divide economic rents between the SEP holder and the licensees. A common claim is that preventing patent holdup is a goal (in the eyes of some, *the* goal) of a FRAND commitment, and that the FRAND royalty should be deemed to be what would have resulted in competitive bidding among inventors for adoption of their respective technologies into the standard (what Swanson and Baumol call the "*ex ante* competitive" level[168]). As noted earlier, this claim lacks factual support, as SSO IPR policies do not mention patent holdup. In contrast, it would flout the explicit obligation to license one's SEPs on FRAND terms if the SEP holder demanded prices, terms, or conditions so extreme that their practical effect was to render the offer to license nugatory and thus deny the implementer the ability to make a standard-compliant product. But there is no reason to expect that the *ex ante* competitive level that Swanson and Baumol define is the point above which the royalty for an SEP would be so high as to constitute a *de facto* denial of access and thus a violation of the licensor's FRAND obligation.

A royalty would not be FRAND if it denied the implementer access to the standard and contributed to an unsustainable aggregate royalty burden. Such a royalty, which I call the "shutdown royalty," would cause the licensee to refrain from producing a standard-compliant product. A firm will stop making its products (that is, shut down) when the price of the product falls below the average variable cost of producing the product.[169] Thus, a firm will shut down if its operating profit is at or below zero. Therefore, the royalty that lowers the licensee's operating margin to zero is the upper bound for the sum of all *ad valorem* royalties that the implementer can afford to pay before ceasing to produce its product. It bears emphasis that I do not advocate that, if an aggregate royalty for an SEP were one penny below the implementer's entire profit margin, that aggregate royalty would necessarily be FRAND. Rather, the usefulness of the shutdown royalty is that it provides a reality check. It is a measurable threshold that would cause the implementer not to produce its standard-compliant product. One can conclude that a royalty is excessive or an aggregate royalty is stacked too high for an implementer if it exceeds the implementer's profit margin. Real-world litigation over FRAND royalties is likely to concern offers from the SEP holder that are far below the implementer's shutdown royalty. In such cases, an implementer's claims of patent holdup and royalty stacking will lack plausibility.

The implementer's operating margin includes all the royalties that the implementer is already paying on the patents practiced in the implementer's product.

[168] *See, e.g.*, Swanson & Baumol, *supra* note 160, at 10–15.

[169] *See, e.g.*, DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 59–60 (Addison-Wesley 4th ed. 2005).

The operating margin does not include royalties on the infringed patents in suit or other patents for which the implementer is currently negotiating a license. Therefore, the operating margin is the highest aggregate royalty the implementer would pay on the patents in suit (standard-essential or implementation), plus other outstanding royalties (standard-essential and implementation) for patents.

*2. A Robust Definition of "Nondiscriminatory"*

Price discrimination in economics is "selling two units of the same physical good at different prices."[170] However, that definition is not applicable in all situations.[171] Even units of a homogeneous good may sell at different prices when the producer's cost of selling to one purchaser differs from his cost of selling to another.[172] Conversely, uniform pricing is actually price discrimination if the cost of providing the good varies from purchaser to purchaser.[173] An SEP holder's opportunity costs of licensing to two different licensees may not be equal. If so, it is not price discrimination for the SEP holder to charge different royalty rates to the different licensees. In considering whether royalties are nondiscriminatory, one must assess whether the licensees are similarly situated in terms of the licensor's opportunity costs of licensing its patent portfolio to the licensees.

The parties to a negotiation are free to define "nondiscriminatory" licensing in their contract however they like. In the absence of a contractually specified definition, there is no consensus among economists yet as to whether "nondiscriminatory" has a connotation in the FRAND context that differs from how economists define discriminatory pricing generally. Dennis Carlton and Allan Shampine define "nondiscriminatory" in the FRAND context as requiring that all licensees seeking to implement a standard receive licenses to SEPs reading on the standard, and that all "similarly situated" licensees pay the same royalty rate for a given SEP holder's portfolio.[174] Roger Brooks and Damien Geradin distinguish nondiscriminatory pricing from most-favored-nations (MFN) clauses, which would require royalties to a particular firm to be no greater than those charged to other firms.[175] Instead, they find latitude in "nondiscriminatory" that allows for adjustment according to the particular situations of any firms in a licensing negotiation. Swanson and Baumol define a nondiscriminatory rate using the efficient component-pricing rule (ECPR), which Baumol

[170] TIROLE, *supra* note 164, at 133.

[171] *Id.*

[172] *See* GEORGE J. STIGLER, THE THEORY OF PRICE 209 (Macmillan Co. 3d ed. 1966) ("Price differences do not necessarily indicate discrimination."); TIROLE, *supra* note 170, at 133–34 ("Hence, we will say there is no price discrimination if differences in prices between consumers exactly reflect differences in the costs of serving these consumers.").

[173] STIGLER, *supra* note 173, at 209–10 ("If a college charges the same tuition for a large elementary class taught by an instructor, and a small advanced class taught by an expensive professor, it is clearly discriminating.").

[174] Dennis W. Carlton & Allan L. Shampine, *An Economic Interpretation of FRAND*, 9 J. COMPETITION L. & ECON. 531, 546 (2013).

[175] Brooks & Geradin, *supra* note 157, at 15.

developed for pricing competitor access to bottleneck facilities in network industries.[176] The Swanson-Baumol ECPR solution amounts to the requirement that the royalty rate that a vertically integrated patent holder charges its retail competitors be the same as the implicit royalty that it would charge its own downstream retail arm. Swanson and Baumol argue that the royalty rate should compensate the patent holder for the transactions costs of licensing plus the opportunity cost, leaving the patent holder indifferent between licensing and not licensing the patent. However, Layne-Farrar, Padilla, and Schmalensee argue that one cannot apply this method when licensing multiple complementary patents, as one typically does not observe the incremental value of an individual patent to the standard.[177]

### *a. Narrow and Broad Definitions*

There are at least two options for defining "nondiscriminatory" in FRAND cases. Under the narrower definition, nondiscriminatory licensing would require an equal per-unit royalty across licensees. The problem with this definition is that, in the presence of frequent cross licenses, even determining the per-unit royalties contained within a single cross license can be difficult. In addition, this definition would not maximize the surplus generated by the standard's creation. As I explain below, a multipart tariff, such as a two-part tariff, would generate more licensing revenue for the SSO in terms of the royalties paid by implementers that are not members of the SSOs, compared with licensing revenues from requiring all implementers to pay the same rate.

Under a broader definition, nondiscriminatory licensing would require that royalties be approximately the same across licensees with similar output levels. This definition requires only that the SEP holder offer similarly situated licensees the same approximate royalty rate as a function of output.[178] That is, if an SEP holder offers one implementer a royalty rate that falls as output increases, then the SEP holder should offer a similar declining royalty rate to a second, similarly situated implementer. Terms can vary with the risk preferences of licensees and changes in the perceived value of patents. However, as long as the SEP holder offers terms to two similarly situated licensees that are not grossly disproportionate, the SEP holder should be deemed to have satisfied the "nondiscriminatory" component of the FRAND commitment.

[176] Swanson & Baumol, *supra* note 160, at 29. For further explanation of the ECPR, see WILLIAM J. BAUMOL & J. GREGORY SIDAK, TOWARD COMPETITION IN LOCAL TELEPHONY 105 (MIT Press 1994).

[177] Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 698.

[178] Dennis Carlton proposes determining whether firms are similarly situated by examining their cost savings. If one firm gets a large cost saving from using the SEP and another firm does not, then the firms are not similarly situated, and the SEP holder therefore would not necessarily violate the nondiscriminatory component of the FRAND commitment by charging the two licensees different royalty rates. *See* Feinstein, Skitol, Carlton, Leonard, Meyer & Shapiro, *supra* note 54, at 14.

*b. Two-Part Tariffs and Optional Tariffs*

This broader definition of "nondiscriminatory" would permit nonlinear pricing of SEPs, including two-part tariffs and optional tariffs. A two-part tariff is a price that includes an access fee and a usage price. For example, a licensing agreement could include both a flat fee and a running royalty based on unit sales or revenues.[179] An optional tariff is different: the licensee chooses between paying an established rate and negotiating an alternative rate.[180] An example of an optional tariff would be the SEP holder announcing a price of *X* percent of net sales as the running royalty for a portfolio of SEPs while also allowing licensees to enter into agreements on different terms. A potential licensee could either accept the SEP holder's standard fee structure or negotiate its own royalty structure. (In effect, an SEP holder offers an optional tariff when it opens any licensing negotiation with standard "reference rates.") Under this broader definition of "nondiscriminatory," the average per-unit or *ad valorem* running royalties may differ across licensees of the same portfolio of SEPs, but the royalty terms would still be nondiscriminatory, since any licensee would have the same choice of two alternative ways to structure its payment of royalties.

The understanding that the SSO functions as a joint venture supports the broader definition of "nondiscriminatory." That definition is consistent with joint profit maximization within the joint venture and thus encourages participation in the SSO by both patent holders and implementers. To consider why the SSO would define "nondiscriminatory" to require that all licensees face the same nonlinear pricing schedule and *not* the same per-unit or same *ad valorem* running royalty, I examine how the selection of a nonlinear tariff affects the surplus generated by the standard.

The magnitude of the royalties exchanged between SSO members will not change the surplus that the standard generates, because the net royalties exchanged between SSO members will always sum to zero. However, a two-part tariff, an optional tariff, or some other nonlinear pricing strategy will permit greater capture of surplus from non-SSO members without necessarily distorting their pricing decisions in the retail market.

For example, if a license includes a two-part tariff composed of an upfront lump-sum payment and a running royalty rate on sales of licensed products, the running royalty could be the optimal running royalty for the SSO. The lump-sum payment could include some portion of the surplus that the licensee will receive from licensing the technology at the running royalty rate. The existence of the lump-sum payment will not affect the output decision of the

[179] *See* CARLTON & PERLOFF, *supra* note 169, at 314.

[180] For a nontechnical summary of the economic literature on optimal tariffs, see John C. Panzar & J. Gregory Sidak, *When Does an Optional Tariff Not Lead to a Pareto Improvement? The Ambiguous Case of Self-Selecting Nonlinear Pricing When Demand Is Interdependent or Firms Do Not Maximize Profit*, 2 J. COMPETITION L. & ECON. 285 (2006).

licensee, because it will not change the marginal cost of producing a licensed product. In addition, the running royalty will be the same as the running royalty rate that is optimal without the lump-sum payment. As a result, the running royalty also will not change the marginal cost of producing a licensed product. So long as the lump sum does not exceed the surplus to the licensee from implementing the standard under the license, the licensee will still license the product and produce the same output as with the optimal running royalty rate and no lump-sum payment. Therefore, there will be no inefficient distortion in the product market resulting from the use of a two-part tariff instead of only a running royalty. This two-part tariff will allow SSO members and implementers to capture greater surplus from the standard than simple linear pricing would allow.

Even if an identical lump-sum payment and running royalty rate are offered to multiple licensees, these licensees may have varying per-unit licensing costs. As output by a licensee increases, the per-unit cost of the fixed fee will fall. Consequently, licensees with higher levels of output will pay a lower average royalty than licensees with lower levels of output.

Using nonlinear tariffs will maximize the surplus generated by the standard and will not cause inefficiencies in the product market. Consequently, the view of the SSO as a joint venture indicates that "nondiscriminatory" pricing should mean that each licensee is offered the same menu of licensing options. However, it does not require that all licensees pay the same royalty rate. The same terms offered thus allow that different licensees ultimately pay different average per-unit royalties.

Thus, nondiscriminatory licensing requires only that similarly situated licensees be offered the same approximate royalty rate as a function of output. That is, if a patent holder offers a license where the royalty rate falls as output increases to one licensee, a similar declining royalty rate should be offered to a similarly situated licensee. Terms may vary depending on the risk preferences of various licensees and changes in the perceived value of patents. However, as long as the terms offered to two similarly situated licensees are not grossly disproportionate, the "nondiscriminatory" aspect of the SEP holder's FRAND commitment should be satisfied. The same terms offered thus allow different licensees to pay different average per-unit royalties. In addition, under the "nondiscriminatory" requirement of FRAND, licensees that are members of the SSO should not receive preferential terms relative to licensees that are not members of the SSO.

### *c. Royalties for Implementers That Are Not SSO Members*

Finally, as I explained above, the surplus-maximizing royalty rate for SEPs is defined by the royalty that the SEP holder would charge to non-SSO members, because payments transferred among members of the SSO will not affect the joint surplus created by the SSO. Because the nondiscrimination requirement in the FRAND commitment prevents an SEP holder from giving

SSO members discounts compared with non-SSO members, that requirement imposes the surplus-maximizing rate on implementers that are SSO members as well. Put differently, SSO members should not get preferential treatment as licensees compared with licensees that are not SSO members. Nondiscrimination is a less controversial element of FRAND pricing, but its precise meaning is still subject to conflicting opinions.[181]

## C. Applying the FRAND Framework to Determine FRAND Royalties

The above framework for determining the economic meaning of FRAND royalties presents a specific value only in the abstract. In practice, the framework will reveal a range of values depending on the interpretation of the profit-maximization problem and the individual-rationality constraint. Through the presentation of this framework, I have identified different elements one should consider in determining what constitutes a FRAND licensing rate for a specific patent or a specific portfolio of patents. These elements include the incremental value of the patent, the cumulative royalty for the patents within the standard, the stand-alone cost of developing the patent, the royalty rate charged for the patent in other licenses, and the strength of the patent or patent portfolio. One weights those inputs based on the facts of the case to determine the range of royalty rates that would satisfy a FRAND commitment. Voluntarily negotiated royalty rates for comparable FRAND licenses typically should be the most heavily weighted element of this analysis and therefore should serve as the starting point for determining a FRAND royalty.

### *1. Using Comparable, Voluntarily Negotiated Licenses as the Most Reasonable Starting Point in the FRAND Analysis*

Because of the dynamic nature of standard setting, the analysis of FRAND royalties should focus on continuously promoting incentives to invest in the creation and implementation of valuable standards.[182] Research and development does not occur as a discrete process. It is a continuous process, and inventors produce patentable innovations on a recurring basis. Likewise, a standard evolves over time. Patents that are essential to the standard are revealed over time. As technology changes, the marginal contributions of different patents to the value of the downstream product also change. For example, the development of complementary products may make a touch screen more important to the commercial value of a smartphone than members of the SSO might have expected when they adopted the standard.

[181] *See, e.g.*, Anne Layne-Farrar, *Nondiscriminatory Pricing: Is Standard Setting Different?*, 6 J. COMPETITION L. & ECON. 811 (2010).

[182] *See, e.g.*, Daniel F. Spulber, *Innovation Economics: The Interplay Among Technology Standards, Competitive Conduct, and Economic Performance*, 9 J. COMPETITION L. & ECON. 777 (2013); Daniel F. Spulber, *Should Business Method Inventions Be Patentable?*, 3 J. LEGAL ANALYSIS 265, 297–304 (2011).

Because factors such as the marginal contribution of a patent to a standard, the *ex ante* value of a patent, or even the number of patents in a standard constantly change, these factors typically cannot be given substantial weight in a determination of FRAND royalty rates. The *ex ante* value of a patent depends upon the presence and value of complementary patents. As these patents are discovered or change in value, the "*ex ante*" value of the patent itself will change.[183] Other information, such as an industry consensus about the *ex ante* value of a patent or its marginal contribution to the standard, may clarify the importance of these factors affecting the value of a patent. Only then should one give these factors significant weight in determining FRAND royalty rates.

Because of the difficulties in identifying the value of specific inputs in the FRAND determination, the observed royalty rates from existing licenses are the most probative data at the economist's disposal. "An established royalty," the Federal Circuit has observed in patent-infringement litigation generally, "is usually the best measure of a 'reasonable' royalty for a given use of an invention because it removes the need to guess at the terms to which parties would hypothetically agree."[184] Direct observation of a comparable, voluntarily negotiated royalty obviates more conjectural lines of economic analysis. Simply put, a royalty was "fair" and "reasonable" if both parties voluntarily agreed to it. That is what it means to be a "willing" buyer and a "willing" seller. License negotiations generally take place between sophisticated industry members, who can observe the relative strength of the licensed portfolios with respect to the strength of other members' portfolios. License negotiations also typically involve technical discussions wherein the parties evaluate the technical contributions of the licensed portfolios. Consequently, it is unlikely that licensing parties would agree to pay significantly above the true value of the licensed technologies. Moreover, if a licensor expects to negotiate licenses in the future and expects its future technical contributions to be up for vote by its licensees, then the licensor is unlikely to demand royalties exceeding the true value of its patents.

The agreed-upon royalty necessarily ensured that both parties expected to be better situated as a result of the license than in its absence. Otherwise, the parties never would have agreed to the license. In addition, one can determine whether a license is nondiscriminatory only by comparing it to other licenses. Consequently, the most probative starting point for determining FRAND royalty rates is to analyze previous royalty rates established in comparable licensing agreements over FRAND terms.

[183] *See, e.g.*, Gastón Llanes & Joaquín Poblete, *Ex-Ante Agreements in Standard Setting and Patent Pool Formation*, Research Roundtable on Innovation and Technology Standards (2013).

[184] Monsanto Co. v. McFarling, 488 F.3d 973, 978–79 (Fed. Cir. 2007). *See also* LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 79–80 (Fed. Cir. 2012) ("Actual licenses to the patented technology are highly probative as to what constitutes a reasonable royalty for those patent rights because such actual licenses most clearly reflect the economic value of the patented technology in the marketplace.").

*a. Six Factors Influencing the Comparability of a Prior FRAND License*

At least six factors influence how closely a comparable FRAND license informs the negotiated license terms at issue and how much weight one should give that comparable license in determining the appropriate FRAND royalty rate:

(1) the patents included in the license agreement,
(2) the date of the license,
(3) the use of the licensed technology,
(4) the inclusion of other consideration in the agreement,
(5) whether the license was part of a settlement of litigation or arbitration, and
(6) whether the royalty was a lump sum or a running royalty rate.

These factors inform the relative bargaining power of the parties in the benchmark license.

First, the patents in benchmark licenses affect the relative value of a license agreement in determining a FRAND royalty for the patent(s) in suit. Whether the benchmark agreements license individual patents or portfolios of patents for standards that contain the patent holder's SEPs in suit helps determine which benchmark agreements should receive the most weight. The more a benchmark agreement resembles the license negotiation at issue, the more weight it should receive as a benchmark.

Second, the date of a benchmark license affects its comparability to the FRAND negotiation at issue. The closer an agreement is in time to the FRAND negotiation at issue, the more weight it should receive in determining the reasonable royalty rate. Many factors that influence the relative bargaining power of the parties to a licensing agreement are unobservable. The more time that passes between two agreements, the less informative one agreement will be in predicting the outcome of a different, hypothetical royalty negotiation.

Third, the parties' uses of the licensed technology may affect the comparability of a benchmark license to the FRAND negotiation at issue. For example, if the licensee will use the technology in question to produce a horizontal substitute for a good that the licensor produces, the licensor will risk losing sales to the competing, licensed product. These lost sales are an opportunity cost of licensing the patent in suit. Consequently, the licensor may require a higher FRAND royalty to satisfy its individual-rationality constraint, and therefore the final royalty may be higher than if the licensee intended to use the licensed technology to produce a non-competing good or a vertical complement to the licensor's products. In short, for a benchmark license to receive more weight, the licensee's use of the patented technology should be the same as the infringer's intended use in the FRAND negotiation at issue. If licenses having this degree of comparability are unavailable, one must make appropriate adjustments when comparing the terms of benchmark

licenses that are available. Because the licensees that practice a standard typically compete within the same industry, this factor is often not a significant part of the analysis.

Fourth, when a benchmark agreement includes consideration beyond a license for the patents at issue (such as copyright licenses, licensing of trade secrets, or consideration unrelated to IP), then that benchmark agreement should receive less weight in determining the FRAND royalty. This weight should be even less when the terms for licensing the patent at issue comprise a small part of the entire benchmark agreement. The more unrelated the terms that the benchmark agreement contains, the more likely it is that the license terms do not accurately reflect the specific value of the patent at issue. Depending on the possibility of future agreements, either party may have an incentive to use other terms of the agreement to cross-subsidize the licensing terms to create royalty rates that are higher or lower than the true value of the license. A licensee who anticipates future licensing for similarly situated patents could overpay for other elements of the agreement to establish a low royalty rate. Conversely, a savvy licensor could permit the licensee to underpay for other terms to establish a high royalty rate. Even when a patent license is not part of a larger agreement, caution is necessary to identify any ancillary agreements between the parties to determine whether the royalty rate is only part of a more complex package of consideration. For example, Judge Posner found (in a non-FRAND case) that a plaintiff's expert economic witness misconstrued the royalty rates she calculated because she excluded from her calculation such ancillary agreements present in the settlement of litigation with the licensee.[185]

This factor is particularly important given that participants in SSOs often manufacture goods that practice the SEPs. As a result, there is a high probability that any benchmark agreement will include cross licenses. Cross licenses may have royalty rates that obscure the FRAND royalty for a particular patent. For the net payment in a cross license to serve as a meaningful benchmark, the net balancing payment in the cross license must be based on identifiable one-way royalties for each parties' SEP portfolio.[186] Alternatively, if the

[185] Order of January 18, 2013 at 11–12, Brandeis Univ. v. East Side Ovens Inc., Nos. 1:12-cv-01508, 1:12-cv-01509, 1:12-cv-01511, 1:12-cv-01513 (N.D. Ill. Jan. 18, 2013) (Posner, J.) ("The stated payment for this license is a $[#] one-time payment to GFA [the licensor], but the payment appears to have been returned to [Company C] as 'consulting fees' over the next few months. The settlement also provides, however, for changing a strategic partnership between [Company C] and a GFA subsidiary. . . . But [the patent holder's damages expert] has made no attempt to value any individual component of the complex settlement agreement, and so [the expert] cannot responsibly value the patent license itself.").

[186] *See, e.g.*, Teece, Grindley & Sherry, *supra* note 138, at 9 (explaining that in cross licenses, "[r]oyalties are typically determined based on the relative value of each company's technology portfolio" and that "[t]he parties will calculate a balancing payment based on the relative values of the portfolios and each party's expected volume of sales of licensed products"). Establishing a net balancing payment without first establishing the FRAND one-way royalties for each party's SEPs would enable the parties to avoid charging other parties consistent

negotiation at issue is for a cross license, then cross licenses will be useful benchmarks, provided that the bundle of patents at issue is similar to the bundle of patents in the benchmark. The patents granted back in the benchmark cross license also need to be similar to the patents granted back in the negotiation at issue. In short, cross licenses may contain helpful information, but they should receive heavy weighting in the determination of the FRAND royalty only when they resemble the negotiation at issue.

In particular, care is necessary when using cross-licensing agreements as benchmarks for one-way licensing agreements. The vast economic literature on termination rates (access pricing) in telecommunications networks is informative.[187] When calls go in both directions among two independently owned networks and are relatively symmetric in their volumes, the termination rates tend to offset one another. In that case, a price of zero might be most efficient, since it would obviate pricing, metering, and collecting payment for a large number of individual calls. But, roughly speaking, if the flow of traffic is asymmetric (such that the first network on balance consumes substantially more termination services of the second network than the second network consumes of the first), then a termination rate that the parties have set on the expectation of reciprocal use of one another's network assets will be disproportionately generous to the first network and disproportionately disadvantageous to the second network. By the same reasoning, the terms of a cross license (which is predicated on the mutual expectation of the parties that the first patent holder will use the patents of the second patent holder about as much as the second will use the patents of the first) will not reflect the willing terms of trade for a one-way license to use an individual patent (or portfolio of patents).

Fifth, if a benchmark license was negotiated as part of a settlement to a lawsuit, then the royalty rate agreed upon may include some part of the expected (and avoidable) costs of litigation and the uncertainty surrounding the litigation's outcome. For a prospective licensee who is also a defendant in a patent infringement case, the settlement of the suit will include value above and beyond the value of the license—namely, the avoidance of litigation costs or the elimination of uncertainty related to the outcome of the litigation. If the settlement is limited to the license terms with no additional transfer of money or other consideration, then the settlement could overstate the true economic value of the patent in suit. Conversely, for a prospective licensor who is also the plaintiff in a patent-infringement case against the prospective licensee, the settlement of the suit could include value above and beyond the value of the license—namely, the avoidance of litigation costs or the elimination of

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royalties, which would reduce the transparency of pricing and thus confound the nondiscrimination requirement of the FRAND commitment.

[187] *See, e.g.*, JEAN-JACQUES LAFFONT & JEAN TIROLE, COMPETITION IN TELECOMMUNICATIONS (MIT Press 2001); SIDAK & SPULBER, *supra* note 79.

uncertainty related to the outcome of the litigation. If the settlement is limited to the license terms with no additional transfer of money or other consideration, then the settlement could understate the true economic value of the patent in suit. Judge Holderman, for example, refused to consider licensing agreements "that were adopted under the duress of litigation."[188]

Essentially, when a benchmark license results from the settlement of litigation, that license loses some of its probative value as a comparable benchmark for the negotiation at issue. Unobserved factors could bias the royalty rate upward or downward. Without additional evidence, it may be impossible to determine reliably which outcome will be more likely. Indeed, it may even be impossible to determine whether the net flow of consideration is to the licensor or the licensee. That latter could be the case if the licensee is the first of multiple defendants to settle and is being offered ancillary inducements from the licensor to negotiate a high royalty rate, which the licensor then intends to cite as evidence relevant to the FRAND royalty rate that the remaining defendants should be ordered to pay. For example, Judge Posner found (in a non-FRAND case) that this licensing strategy motivated the benchmark royalty proposed by the patent holder's expert economic witness on damages.[189]

Sixth, whether a past license was negotiated as a fixed, lump-sum payment or a payment that is a function of the use of the licensed technology (for example, a running royalty rate or a fee per unit sold) affects how comparable the benchmark license is to the FRAND negotiation at issue. Fixed and variable license terms allocate the economic risk regarding uncertainty over the true value of the licensed technology differently between the parties. With a fixed lump-sum payment, the licensee bears more of the risk that the license will become less valuable over its term, and the patent holder bears more risk that the license will become *more* valuable over its time—which would result in the patent holder being under-compensated. With a variable payment, the licensor bears the risk that the license will become less valuable over time. Because the different forms of payment allocate risk differently, royalty rates should include some payment for the allocation of risk. As a result, if a benchmark license has a different payment structure than that in the FRAND

[188] RAND Opinion in *Innovatio*, *supra* note 4, at 64.

[189] Order of January 18, 2013 at 12, *Brandeis*, Nos. 1:12-cv-01508, 1:12-cv-01509, 1:12-cv-01511, 1:12-cv-01513 (Posner, J.) ("[The patent holder's damages expert] notes as bearing on the possible cost of the license to [Company C] a statement in the settlement agreement that the settlement's value 'equals or exceeds $[#]' and a claim by the CEO of GFA [the licensor] that it may be as much as $[#]. Neither of these self-serving statements, apparently made for litigation purposes, can be the basis of a reliable calculation by an economist. . . . She has not used a reasonable methodology to calculate the plaintiffs' damages by reference to the . . . license[s], or profits at risk, or to assess the cost of noninfringing alternatives.").

license, it will be less relevant to the determination of the FRAND royalty at issue. If a party is offering as the benchmark a license having a different payment structure, that party's expert witness on damages must adjust for the allocation of risk before converting one type of payment to the other.

The preceding paragraph implicitly assumes that the licensor and the licensee are equally informed about the economic risk regarding uncertainty over the true (revealed) value of the licensed technology. In other words, there is not asymmetric information about the economic significance of the licensed technology. In that case, the preference for a lump-sum royalty rather than a running royalty will reflect each party's risk preferences or need for liquidity—as opposed to its possession of any asymmetric information about the economic value of the licensed technology. There is, however, a compelling economic rationale for lifting the assumption of symmetric information: the licensee has a comparative advantage in predicting its own future sales. In the presence of asymmetric information, a licensee who seeks a lump-sum royalty may do so because the licensee expects that the lump sum will undercompensate the licensor. This information advantage also suggests that, in converting a lump-sum payment to a running royalty, one should adjust the running royalty to incorporate the reassignment of the risk to the licensor and to account for information asymmetry.

One way to account for the difference in risk perceptions and differences in the accuracy of projections is to base any conversion of a lump sum to a running royalty rate on sales of the licensed product that occurred in the period immediately preceding the license agreement. These sales would be observable to both parties and are a more accurate indication of the parties' intended royalty rate than are sales that occurred after the licensing period has commenced. Another way to account for the difference in risk perceptions and differences in the accuracy of projections is to have a subsequent true-up mechanism. This kind of device is common to long-term commercial contracts generally, as well as to rate orders for regulated utilities that extend for a number of years.

If enough time has passed that one can verify the accuracy of the sales projection upon which the parties based the lump-sum royalty, then the lump-sum license can serve as a reliable benchmark for comparison only insofar as the original projections were accurate. If the initial projections proved particularly inaccurate, not only does that inaccuracy limit the value of the past license as a benchmark, it also suggests that satisfying the FRAND commitment may require a running royalty to ensure that the licensor is properly compensated. In the abstract, FRAND commitments do not necessarily require running royalties or lump-sum payments. But in industries where the projections of sales of downstream products using the patent in suit might be less accurate, it is reasonable that either party can demand a running royalty to ensure that it is properly compensated for risk arising from uncertainty over the future demand for the licensed product.

In summary, these six factors are not necessarily mutually exclusive or exhaustive. Nonetheless, these factors are necessary for determining the comparability of benchmark licensing agreements when calculating FRAND royalties. The FRAND calculation will result in a range of royalty rates that would satisfy the FRAND commitment. Using the best available information, one then determines where within that range the rate for a specific SEP or portfolio of SEPs should fall. Because many factors that determine FRAND rates may be unobservable, the actual outcomes of comparable negotiations provide valuable information in estimating FRAND royalties. The factors described above help the finder of fact to determine how much weight the different benchmark licenses should receive in determining the FRAND royalty.

*b. Do All Prior Licenses Lack Comparability for Identifying a FRAND License on the Rationale That They Were Negotiated Against the Threat of Hold Up?*

Some economists might argue that past licenses cannot serve as comparable benchmarks because they were all negotiated subject to the SEP holder's ability to "hold up" the licensee and extract excessive royalties. Under that conjecture, the royalties in past licenses cannot inform a FRAND royalty at issue—or, alternatively, one must quantify and adjust for the share of the agreed-upon royalties that is attributable to patent holdup, which would of course require laborious computations and would be a contentious matter for fact finding.

Fortunately, courts need not worry about this conjecture, as it is not credible that royalties negotiated under the FRAND obligation (and to which parties voluntarily agreed) were inflated by holdup. In *Ericsson v. D-Link*, the infringer argued that past licenses were not comparable because they "include value derived from Ericsson's 'overall patent leverage[.]'"[190] The U.S. District Court for the Eastern District of Texas rejected that argument when ruling on post-trial motions:

> Ericsson's RAND obligations are public knowledge. Ericsson's letters of assurance to the IEEE are publically available, so any potential licensee would be able to determine whether Ericsson had RAND obligations. The previous licensees were sophisticated parties, making it likely they would have been aware of Ericsson's RAND obligations during the negotiations. Taken together, there was substantial evidence that the prior licenses were negotiated within the framework of Ericsson's RAND obligations.[191]

By the court's reasoning, the royalties in an SEP holder's past licenses with third parties would generally *not* be inflated due to holdup.

The effect of the SEP holder's ability to seek an exclusion order or an injunction on the magnitude of previously negotiated royalties is limited. The European

[190] Memorandum Opinion & Order at 33, Ericsson Inc. v. D-Link Sys., Inc., No. 6:10-cv-473 (E.D. Tex. Aug. 6, 2013) (quoting ECF No. 529 at 8).

[191] *Id.* at 35.

Commission, for example, has expressed such concern in its investigation of Samsung: "seeking an injunction could allow Samsung to impose royalty rates . . . a licensee would not agree to, absent the threat."[192] However, both the SEP holder and the prospective licensee know during negotiations that, if negotiations fail, the SEP holder can commence patent-infringement suits seeking an injunction, an exclusion order, or both. The mere filing of a section 337 patent-infringement suit at the ITC, for example, would certainly not guarantee that (1) the ITC will issue the exclusion order, (2) the President will not veto the exclusion order, and (3) the Federal Circuit will uphold the exclusion order provided that the President did not exercise his veto and the licensee appealed the ITC's issuance of the exclusion order. President Obama's veto in August 2013 of the ITC's exclusion order against Apple's infringing products in Investigation 337-TA-794[193] lowered the expected value of an SEP holder's threat to attempt patent holdup, thereby reducing the probability that any royalties negotiated in bilateral, voluntary agreements are subject to holdup. The Northern District of California's issuance of a preliminary injunction preventing the enforcement of an ITC exclusion order in *Realtek Semiconductor Corp. v. LSI Corp.*[194] similarly reduces the likelihood that an SEP holder can credibly threaten patent holdup *ex ante*.

Furthermore, even if the SEP holder is able to obtain an injunction against the infringer, there is no reason to assume that the licensing rates negotiated under such a threat are not FRAND. FTC Commissioner Joshua Wright has observed that, "[a]lthough the rate negotiated with the injunction threat is likely greater than the rate negotiated without the threat of injunction, it does not follow that the former is above F/RAND."[195] An SEP holder that uses the threat of an injunction might still demand the infringer to pay only a FRAND royalty. The use of the injunction, in other words, might have a thoroughly legitimate purpose. For example, the SEP holder might use the injunction as a tool to "encourage an infringing implementer to come to the negotiation table" and negotiate FRAND royalties.[196] There is consequently no valid justification to assume that royalties negotiated under the threat of an injunction necessarily violate FRAND.

[192] Press Release, European Commission, Antitrust: Commission Consults on Commitments Offered by Samsung Electronics Regarding Use of Standard Essential Patents (Oct. 17, 2013), http://europa.eu/rapid/press-release_IP-13-971_en.htm.

[193] Letter from Michael B.G. Froman, Executive Office of the President, to The Honorable Irving A. Williamson, Chairman, U.S. ITC (Aug. 3, 2013).

[194] Order Granting Plaintiff Realtek Semiconductor Corporation's Motion for Partial Summary Judgment and Denying Defendants LSI Corporation and Agere System LLC's Motion to Stay at 12, Realtek Semiconductor Corp. v. LSI Corp., No. C-12-03451-RMW (N.D. Cal. May 20, 2013).

[195] Joshua D. Wright, Commissioner, Fed. Trade Comm'n, Remarks at The Inaugural Academic Conference: The Commercial Function of Patents in Today's Innovation Economy, George Mason University School of Law, at 29–30 (Sept. 12, 2013).

[196] *Id.* at 31.

Moreover, past licenses are probative comparisons *even if* they were negotiated subject to the SEP holder's ability to engage in patent holdup. It is irrelevant whether the SEP holder was able to engage in holdup during the negotiations of past licenses used in comparisons. The reason for using past licenses is to compare the royalties at issue with other FRAND royalties for the SEP portfolios at issue. Even if one accepts for sake of argument the possibility of holdup occurring in past negotiations, one does not need to find royalties that have zero "holdup value" for the purposes of conducting the relevant comparison. In the past licenses that one uses, the fact that both parties agreed to the royalties in those licenses indicates that those royalties are FRAND, regardless of whether they include any "holdup value." ETSI and the IEEE oblige an SEP holder to license its SEPs on FRAND terms; ETSI and the IEEE do not oblige an SEP holder to license its SEPs at a price that contains no "holdup value." Equating FRAND with "no holdup value" is a construct of critics of SEP holders that was introduced after the fact. If an SEP holder and a licensee voluntarily agree to a license for the patent holder's SEPs, then the rate is necessarily FRAND.

Finally, to exclude any past license between an SEP holder and an implementer from serving as a benchmark because it could have been negotiated subject to the risk of holdup would present a practical problem for determining FRAND royalties. If past license agreements cannot serve as reliable benchmarks for a FRAND royalty rate, then what can? Without past licenses where the SEP holder and licensee agreed upon FRAND royalties, the finder of fact would be left with considerably less empirical evidence on what constitutes FRAND terms. FRAND royalty determinations would become inherently more conjectural and hypothetical. Past bilateral licenses voluntary agreed upon, without litigation, thus represent the best available benchmark for the determination of FRAND royalties.

### *2. Comparing the Proportional Contribution and "Top-Down" Approaches*

In the limited number of FRAND cases decided to date, courts have considered two methodologies for the calculation of FRAND royalties. One is what I call the "Proportional Contribution" methodology, which the SEP holder used in *Innovatio*. The second methodology, offered in the same case is the "Top-Down" methodology that Dr. Gregory Leonard used (and Judge Holderman applied). I examine the advantages and limitations of each methodology. I also examine the extent to which these methodologies are equivalent, and how likely it is that they will yield FRAND results.

The Proportional Contribution methodology calculates the FRAND royalty as the product of (1) the market-determined price of the downstream product, (2) the proportional share of the value of the product that derives from the standard, and (3) the proportional share of the value of the standard

that derives from the patent:

$$FRAND\ Royalty = Price\ of\ End\ User\ Product \times \frac{Contribution\ of\ Standard}{Value\ of\ Product} \times \frac{Contribution\ of\ Patent}{Value\ of\ Standard}.$$

In the Proportional Contribution methodology, the marginal contribution that an SEP makes to a standard is the SEP's share of the value of the standard. The total value of a standard is in turn the marginal contribution that the standard makes to the value of the end-user product. The price of the end-user product reflects the costs of production (including the royalties paid to patent holders) and consumer demand for the end-user product.

Innovatio's economic experts used the Proportional Contribution methodology. They calculated the FRAND royalty as the product of the price of the final product, a "feature factor," and a 6-percent benchmark royalty rate. The licensed product was a licensed smartphone with Wi-Fi capability.[197] The "feature factor" represented the value of the downstream product attributable to the functionality of the SEPs in question.[198] (It is unclear from Judge Holderman's description of this approach how Innovatio's expert calculated the feature factor and whether, in particular, the value of the feature factor resulted from a formal econometric estimation of hedonic demand for the various features embodied in a licensed smartphone with Wi-Fi capability.[199]) The 6-percent benchmark royalty rate was "derived from comparisons with what Innovatio argues are comparable licenses for other 802.11 standard-essential patent portfolios" and comparable licenses for other SEPs implemented in the standard.[200] Innovatio's methodology thus involves three components, two of which—the marginal contribution of patents to the standard and the marginal contribution of the standard to the value of the downstream end-user product (the feature factor)—cannot be observed directly (from any market transaction or internal transfer pricing exercise or the like) and must therefore be estimated. Such an estimation presumes that the data exist to conduct the estimation, which may not be the case.

Judge Holderman rejected Innovatio's FRAND royalty calculation because of what he regarded as the lack of rigor in the analysis presented by Innovatio's expert witnesses.[201] However, Judge Holderman did not maintain that the underlying methodology that Innovatio used was unsound. Rather, he rejected the royalty estimate derived from the method because the economic experts

[197] RAND Opinion in *Innovatio*, *supra* note 4, at 21.
[198] *Id.* at 22.
[199] *See, e.g.*, Sherwin Rosen, *Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition*, 82 J. POL. ECON. 34 (1974).
[200] RAND Opinion in *Innovatio*, *supra* note 4, at 22.
[201] *Id.* at 26–27.

did not reliably determine the inputs in the model, including the feature factor.[202] Judge Holderman found that the economic experts' determinations of the values of the two unobservable components—the SEPs' share of the value of the 802.11 standard and the 802.11 standard's share of the value of the downstream product—were based on speculation.[203]

As expert economic witness for the alleged infringers, Leonard proposed a different approach, which he called the "Top-Down" methodology. Judge Holderman relied on Leonard's Top-Down methodology to determine the FRAND royalty.[204] Leonard argued that the calculation of a FRAND royalty starts with the average price of a Wi-Fi chip, which Judge Holderman determined to be the smallest-salable component in the downstream end-user product relying on the Wi-Fi standard.[205] Based on that price, Leonard calculated the average profit that a chipmaker earns on the sale of each chip. Leonard then multiplied the profit margin and the price of the chip by an estimate of Innovatio SEPs' share of the value of the Wi-Fi standard.[206] Leonard's Top-Down methodology can be described with the following equation:

$$\textit{FRAND Royalty} = \textit{Price of Smallest Salable Component} \times \textit{Average Profit Margin per Chip} \times \frac{\textit{Contribution of Patent}}{\textit{Value of Standard}}.$$

Leonard's Top-Down approach bears at least two important similarities to the Proportional Contribution methodology.

First, the SEP portfolio's share of the value of the standard is common to both methodologies. Thus, both methodologies address the concern about FRAND royalties including value exceeding the value of the SEP at issue (the so-called holdup value).

Second, both methodologies address the concern that FRAND royalties may result in an excessive aggregate royalty stack that, in theory, could threaten to capture all of the downstream manufacturers' profits. When aggregate royalties exceed a manufacturer's profit margin, the manufacturer will cease producing the product implementing the standard. (Or, more realistically, the manufacturer will cease selling that product in the jurisdiction that issued the SEPs in suit. There are, after all, other markets for smartphones in the world than the United States.) The Top-Down methodology sets a ceiling for aggregate royalties at the level of the manufacturer's profits from the smallest salable component. In *Innovatio*, Judge Holderman deemed that ceiling to be the profit margins of chipmakers. This method guarantees that the FRAND royalty does not drive the aggregate FRAND royalties above the manufacturers' profit

[202] *Id.*
[203] *Id.* at 28.
[204] *Id.* at 73.
[205] *Id.*
[206] *Id.*

margins—which would force them to cease implementing the standard. (Judge Holderman did acknowledge the general possibility that the downstream manufacturers may have the ability to raise prices (such that the existing profit margin would not be a binding constraint), although he seemed to conclude that the facts in *Innovatio* indicated that the allegedly infringing manufacturers lacked such ability.[207]) Similarly, the Proportional Contribution methodology can be used to set a ceiling for aggregate royalties among members of the SSO. For example, if all SEP holders set the aggregate royalty rate (or the percentage contribution of the standard to the downstream product) at 10 percent, and if they derive their royalties by multiplying 10 percent by the respective percentage contribution of their patent portfolios to the standard, then the aggregate royalty would in fact be driven down to 10 percent. If, however, SEP holders set the aggregate royalty component in the formula too high, the aggregate royalty will be high as well.

Both the Top-Down and Proportional Contribution methodologies have limitations. First, the SEP portfolio's share of the standard is not directly observable. Thus, the reliability of the final FRAND royalty estimate using either methodology depends on how rigorously one determines the SEP portfolio's contribution to the standard. Methods that have been used (which I examine in this article) include patent counting and counting approved contributions. I also propose a new model based on an adaptation of the Lorenz curve in Part VI. Leonard apportioned the contribution of Innovatio's SEPs to the 802.11 standard by (1) dividing the patents in the 802.11 standard into groups based on their importance as estimated by technical experts and (2) then assigning each group a fraction of the total value of the standard. Judge Holderman adopted Leonard's apportionment method.[208] One could use the same apportionment method in either the Proportional Contribution methodology or the Top-Down methodology.

The Proportional Contribution methodology has an additional component whose true value is unobservable: the contribution of the standard to the downstream product. The contribution of the standard to the end-user product used in the Proportional Contribution methodology is difficult to estimate, especially for the purposes of hypothetical royalty negotiations. *Ex ante*, the parties to the negotiations do not have complete information as to how important the standard may be for end-user products relative to the other technologies implemented, especially if the standard is not the key source of entrepreneurial profits from innovation for the product.

[207] *Id.* at 75–76. Judge Holderman noted that Innovatio's expert economist, Professor David Teece, "testified that in some cases, widespread infringement may have allowed manufacturers to set their prices very low, essentially ignoring the value of the intellectual property included in their products. Once that value is priced back in (through proper RAND valuations both in court and through license negotiations), manufacturers' current profit margins will certainly be obliterated, but manufacturers will respond simply by raising their prices." *Id.* at 75 (citations omitted).

[208] *Id.* at 71.

Although estimating the standard's precise share of the value of the downstream product is a difficult task, one can use estimates of the aggregate royalty for SEPs in the standard to approximate the value of the standard. For example, the market research firm ABI Research has estimated aggregate 3G royalties (for an implementer who has no SEPs of its own to cross-license) at 17.5 percent of the net sales price of the downstream product as of 2011 and 4G aggregate royalties to reach 35.4 percent.[209] Moreover, the aggregate royalty need not be estimated with exact certainty; rather, one can assume a conservative aggregate so as to put downward pressure on the aggregate royalty. Thus, the limitations in determining the standard's share of the value of the downstream product do not undermine the reliability of the Proportional Contribution methodology.

One limitation of the Top-Down methodology is that if the intermediate product—such as a chip—does not fully contain the value of the standard at issue, then using the profits of the intermediate producer may understate the benefits of the standard for the downstream product and for consumers. Under such circumstances, using the Top-Down approach could lead to underinvestment by SEP holders.

A key difference between the Top-Down and Proportional Contribution methodologies is the royalty base used for the determination of a FRAND royalty. The Proportional Contribution methodology uses the price of the downstream product as the royalty base, whereas the Top-Down methodology uses the price of the smallest-salable component (the chip). Judge Holderman rejected the use of the price of the final downstream product as the royalty base and emphasized that the court must calculate royalties "not on the entire product, but instead on the smallest salable patent-practicing unit."[210]

Both royalty bases are valid. The adequate royalty base depends on the characteristics of the standard, and the specific product produced in compliance with the standard. When a product has an easily observable component that provides all the functionality of the standard, courts should consider the price of the component as the royalty base. For example, Judge Holderman concluded that the Wi-Fi chip essentially contained the entire functionality of the 802.11 standard.[211] However, there are cases in which it is not possible to identify a smaller unit within the final product that solely implements the standard. In such cases, the court should use the downstream product's net retail price as the royalty base, because the end-user product *is* the smallest-salable component implementing the standard. For example, it is the industry practice in voluntary, bilateral licensing of patents essential to the 2G, 3G, and 4G SEPs to use the price of the downstream product (most notably, the smartphones) as the royalty base for a running (*ad valorem*) royalty rate. (Sometimes

[209] Solis & Carlaw, *supra* note 102, at 32, 34.

[210] *Id.* at 23, 28 (citing Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 283, 287–88 (N.D.N.Y. 2009)).

[211] RAND Opinion in *Innovatio*, *supra* note 4, at 27.

such a running royalty will include a ceiling, expressed as fixed dollar amount, which will have the practical effect of capping the share of the price of the smartphone on which royalties will apply—which is a *de facto* way for the parties to acknowledge in bilateral negotiations that some residual amount of the value of the smartphone flows from features that do not read on SEPs.)

When the input values are reliably determined, both the Proportional Contribution and Top-Down approach should yield FRAND royalties. Importantly, both correlate directly with the technological contribution of the SEPs at issue to the standard. The Proportional Contribution approach involves patent holders agreeing to some aggregate royalty rate on the price of the end-user product. SEP holders will want to agree on an aggregate royalty rate that maximizes total profits. However, if the aggregate royalty rate is too high, manufacturers will pass royalty costs to consumers, and the total quantity sold will decrease, reducing total revenues and reducing total profits. Thus, contrary to the patent-holdup and royalty-stacking conjectures, an SEP holder has incentives to assume a conservative aggregate royalty rate. If the aggregate royalty rate is too low, manufacturers and consumers will benefit, but an SEP holder's returns to innovation will decrease. The Top-Down approach similarly seeks the profit-maximizing conditions among SEP holders. An SEP holder licenses the rights to implement its technology to producers of the smallest-salable component implementing the standard-essential technology. That component is priced on the basis of its contribution to the profits from the sale of the end-user product. If each component producer and each downstream manufacturer operates at the profit-maximizing level, the Top-Down approach yields equivalent results as the Proportional Contribution approach.

### *3. Measuring the Relative Contribution of the Various SEPs*

As I explained above, a key input to both the Proportional Contribution and Top Down approaches is the percentage contribution that a particular SEP portfolio (or a set of asserted SEPs) makes to the value of the standard. I examine two methods for quantifying this value: counting approved contributions and deriving a distribution curve for the value of the patents in the standard.

#### *a. Approved Contributions*

An SEP holder's royalty rate should reflect a share of the aggregate royalties for a particular standard based on the SEP holder's relative contribution to the standard. For example, a report by Signals Research Group identified the largest contributors to the LTE standard.[212] A "contribution" is a technical invention, submitted to a working group in an SSO, meant to address a technical problem with a standard. The contribution is "approved" when the SSO votes

[212] SIGNALS RESEARCH GROUP, LLC, THE ESSENTIALS OF INTELLECTUAL PROPERTY, QUANTIFYING TECHNOLOGY LEADERSHIP IN THE DEVELOPMENT OF THE LTE STANDARD 4 (Sept. 2010). Signals Research Group conducted its report at Ericsson's request as an independent audit of an internal Ericsson report.

by consensus to include the comments or suggestions contained within the contribution in the standard.[213] Contributions that are not approved are withdrawn, noted (but not approved), revised, or not acted upon by the working group.[214] The working group does not act upon most unapproved contributions.[215] Signals Research Group counted the approved contributions for each participant. If a contribution was jointly submitted by two parties, Signals Research Group assigned a half contribution to each contributor. Given that the vast majority of contributions are inventions for which the inventor has filed a patent application (or perhaps has already been issued a patent), a company with a large share of approved contributions will likely have a large and strong patent portfolio relating to the same technology. Although there is not a one-to-one mapping between a party's number of approved contributions and its number of patents, the number of approved contributions should highly correlate with the size and strength of a party's patent portfolio.

The Signals Research Group report analyzed publicly available documentation from 3rd Generation Partnership Project (3GPP) meetings to identify approved submissions to the LTE standard over 2007 and 2008. The report identified and counted contributions that the RAN1, RAN2, SA2, SA3, and CT1 working groups within the 3GPP standards body approved in 2007 and 2008.[216] The working groups were chosen to "most closely align[] with the patented technologies that a new entrant, in particular a device manufacturer, would need to license in order to enter the market with an LTE product."[217] Signals Research Group chose the two-year period to include the working group meetings "during which a large majority of the work on the LTE standard was conducted."[218] Although LTE has evolved since 2008, Signals Research Group identified that the majority of the implementation techniques currently associated with LTE were already in place by the end of 2008.[219]

The use of approved contributions to allocate the surplus generated by the standard does not contradict my earlier argument that SEPs have only combinatorial value (versus incremental value). Rather, the analysis of approved contributions is an approach to evaluating a portfolio given the constraint that the incremental value of any individual SEP is zero. This approach is one basis for determining the share of the combinatorial value of all the SEPs in a standard that an individual SEP holder should receive as its royalties.

Signals Research Group identified 42,138 submitted contributions to the 3GPP working groups during the time period.[220] Of those submissions, only

[213] *Id.* at 25.
[214] *Id.*
[215] *Id.*
[216] *Id.* at 21.
[217] *Id.*
[218] *Id.*
[219] *Id.*
[220] *Id.* at 22.

about 55 percent (23,235) related to LTE.[221] Of the LTE-related submissions, only 3,683, or 15.9 percent, were approved by the applicable working groups.[222] The report found that Ericsson contributed the most approved submissions to the standard from 2007 to 2008, which amounted to 18 percent of all approved submissions.[223] The next-highest contributor had 22 percent fewer submissions approved over that time period.[224] Ericsson's approved contributions were more than double those of the third-most prolific contributor.[225] (Signals Research Group did not identify the other companies.) Figure 6 shows approved submissions to LTE working groups by company.[226]

Signals Research Group concedes that not every approved contribution constitutes a patentable technology, but it also states that this caveat does not invalidate the overall conclusions of its study.[227] It also concedes that the study's methodology could have a modest effect on specific findings. However, absent evidence that certain companies disproportionately submitted non-patented contributions (which seems improbable), a given company's relative share of approved contributions should approximate that company's relative share of patented contributions.[228]

The Signals Research Group report reaches the following four conclusions. First, most 3GPP submissions never get approved.[229] Second, Ericsson was the largest single contributor to the development of the LTE standard.[230] Third, companies frequently identified as major holders of LTE patents are not necessarily the leading contributors to the 3GPP standardization process.[231] Fourth, the low rate of submission approval casts doubt on the validity of patent-counting methods for valuing a given company's contribution to the standard.[232] Even if an SEP holder has the highest number of patents declared essential to the LTE standard, it does not necessarily follow that the SEP holder made the largest *meaningful* contribution to creating the LTE standard.

Other independent research is consistent with the Signals Research Group report's findings. ABI Research has also examined relative contributions of patent holders to the LTE standard. In a study not commissioned by any third party, ABI Research focused on approved contributions to multiple 3GPP

[221] *Id.* at 25.
[222] *Id.*
[223] *Id.* at 25–26.
[224] *Id.*
[225] *Id.*
[226] *Id.*
[227] *Id.* at 23.
[228] *Id.*
[229] *Id.* at 25.
[230] *Id.* at 26.
[231] *Id.* at 27. Signals Research Group does not identify the companies that comprise the top ten contributors to the LTE standardization process.
[232] *Id.*

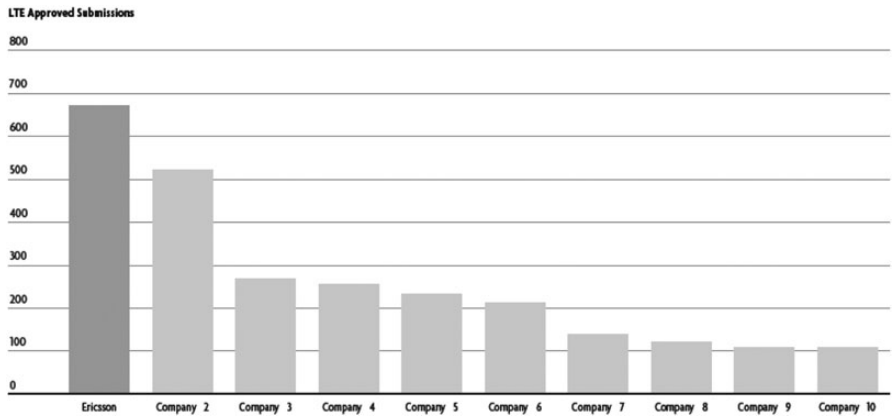


**Figure 6.** 3GPP approved submissions for LTE by company
*Source*: SIGNALS RESEARCH GROUP, *supra* note 212, at 26.

specifications of the LTE standard from 2009 to 2012.[233] ABI Research calculated contributions by examining the submissions to the LTE standard in 3GPP meetings that 3GPP actually accepted as part of the LTE standard.[234]

Consistent with the Signals Research Group study, the ABI Research study concluded that Ericsson is the largest single contributor to the LTE standard, with 6,891 approved contributions from 2009 to 2012, which was about 27 percent of the 25,745 total contributions submitted by the top 10 patent holders.[235] Ericsson's contributions to the standard exceeded the second-place contributor (Huawei) by 50 percent.[236] Therefore, the ABI Research findings for Ericsson's contribution to the LTE standard comport with the Signals Research Group report's results. Figure 7 shows the approved contributions to the LTE standard from 2009 to 2012.[237]

Such evidence on the relative contribution of a patent holder's SEPs to a standard is a significant input in determining the proper FRAND royalty for the patent holder's SEPs. Put differently, the SEP holder's share of the aggregate royalty burden for a standard should be proportional to the SEP holder's relative contribution to the standard. However, an SEP holder's relative contribution to the standard is *not* necessarily the same as the share of the aggregate royalty burden that the SEP holder should receive. Because of the prevalence of cross licensing, the SEP holder's share of the aggregate royalty paid per

[233] Philip Solis & Peter Cooney, *Standards Leadership Within the 3GPP* (ABI Research June 19, 2013). The specifications are RAN (RAN1, RAN2, RAN3, RAN4, and RAN5), SA (SA1, SA2, SA3, SA4, and SA5), and CT (CT1, CT3, and CT4). *Id.* at 3.
[234] *Id.* at 5–6.
[235] *Id.* at 12.
[236] *Id.*
[237] *Id.*

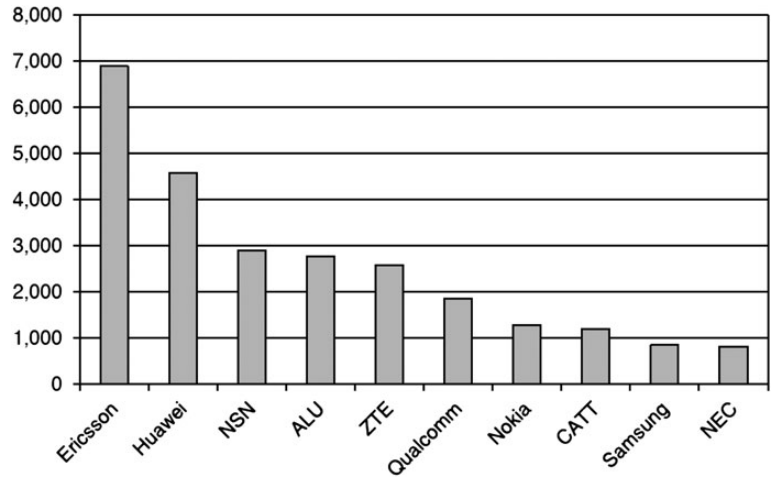


**Figure 7.** Approved contributions to the 3GPP LTE standard, 2009–2012
*Source*: Solis & Cooney, *supra* note 233, at 12.

device will typically exceed the SEP holder's relative contribution to the standard.

Most of the manufacturers that produce standard-compliant devices hold portfolios of patents. When manufacturers enter into cross-licensing agreements, the offsetting values of the cross licenses lower the actual aggregate royalty burdens. Suppose that handset manufacturers hold 50 percent of the standard-essential patents for handsets (which I consider to be a conservative estimate). Then, the observed aggregate royalties on handsets for all LTE-standard-essential patents will be only 50 percent of the total value of the SEPs. The aggregate royalty burden thus includes paid royalties *plus* the value of cross licensing. If the total value of all the SEPs in the LTE standard amounted to $100 per handset, after cross licensing, handset manufacturers would pay an aggregate royalty of only $50 per handset. So Ericsson's 18-percent contribution to the LTE standard, for example, means that 18 percent of the total value of the SEPs in the LTE standard is attributable to Ericsson's SEPs. Thus, using the numerical example of $100 per handset, $18 represents the monetary value of Ericsson's relative contribution. After cross licensing, however, that $18 equates to a 36-percent share of the aggregate LTE royalties paid (of $50 per handset). Therefore, royalty rates can satisfy a FRAND commitment and still have a share of aggregate royalties that exceeds the patent holder's share of contributions to the standard. That relative contribution must be measured using rigorous methodologies, not by simply counting the number of declared-essential patents per patent holder.

Instead of using approved contributions to apportion the surplus generated by the standard, one could use the number of declared-essential patents. However, this alternative approach assumes, unrealistically, that all declared-essential

patents are equally valuable. The peer-reviewed approval process for approved contributions at least serves to check the acceptance of unnecessary contributions into the standard. In contrast, with only rare exceptions, for a declared-essential patent there is no review by the SSO to verify the accuracy of the patent holder's declaration of essentiality. Instead, the SSO member self-certifies its patent to be standard-essential. As a result, patent holders have an incentive to overdeclare their patents as being essential in the knowledge that the cost of verifying *ex ante* the fact of essentiality for every declaration would be prohibitive.

In short, though not a perfect method for allocating the surplus generated by the standard among SEP holders, approved contributions do have the virtues of having a relatively low cost and including a check on the validity of each contribution.

*b. Schankerman's Distribution of the Value of Patents*

In estimating the contribution of the patent holder's SEPs to the standard in *Innovatio*, Gregory Leonard used a crude version of a Lorenz curve when determining the value of Innovatio's patents. To determine their value, Leonard relied on a 1998 article by Mark Schankerman that found that the top ten percent of all electronic (non-standard-essential) patents accounted for 84 percent of the value of all electronic patents.[238] Leonard thus multiplied the profit margin on a Wi-Fi chip by 84 percent to identify the value attributable to the top 10 percent of the SEPs for the 802.11 standard. To identify the share of value attributable to Innovatio's SEPs, Leonard then multiplied the obtained value by 23/300 (which represented the number of Innovatio's SEPs in suit divided by ten percent of the total number of SEPs for the 802.11 standard).[239]

Leonard based his methodology on the generally accepted proposition that the value of SEPs implemented in a standard tends to be highly skewed. However, Leonard based his assessment of the value distribution of SEPs to a standard on data from an article published fifteen years earlier. Although the application of a non-uniform distribution curve is appropriate, the data provided by Mark Schankerman's analysis require some caveats when one uses them to determine the value of the 802.11 SEPs.[240] The distribution curve upon which Leonard relied was computed based on data from 1970 to 1979.[241] Schankerman noted in 1998 that the distribution of the value of patents within industries has shifted over time.[242] Therefore, the distribution

[238] RAND Opinion in *Innovatio*, *supra* note 4, at 84.

[239] *Id.* Leonard suggested that 3000 is a reasonable estimate of the number of SEPs implemented in the 802.11 standard. *Id.* at 82.

[240] Mark Schankerman, *How Valuable is Patent Protection? Estimates by Technology Field*, 29 RAND J. ECON. 77 (1998).

[241] *Id.* at 94.

[242] *Id.* at 91.

curve that Schankerman calculated in 1998 should be applied with considerable caution when assessing the value of patents within standards developed and commercialized decades later.

Further, Schankerman analyzed the relative value of patents in different industries and observed sharp differences among those industries.[243] In other words, the distribution of patent values appears from Schankerman's study to be highly industry-specific. Moreover, Schankerman did not consider the value of SEPs. Therefore, he did not analyze whether the patent value distribution is uniform within different standards belonging to particular industries. His empirical findings, therefore, have limited applicability to the evaluation of SEPs and the calculation of FRAND royalties. Analysis resting on such findings runs the risk of not being sufficiently connected to the facts of the case to be admissible as expert testimony.[244]

In short, Judge Holderman based his analysis on the correct conceptual proposition—that the distribution of value of SEPs for a given standard is skewed, such that the top ten percent of SEPs contributes greater value to the standard than the bottom ten percent. Although Schankerman provided a robust methodology for his intended purposes, courts should not put too much weight on Schankerman's now-dated analysis, which does not focus specifically on the value of SEPs. Rather, courts should use recent data that are specific to SEPs for the standard at issue. As I explain later, reports such as those provided by ABI Research and Signals Research Group are particularly valuable for determining FRAND royalties for SEPs in the telecommunication sector.

### D. Must a FRAND Royalty Disaggregate All of the Value of the Standard Itself?

Must the methodology for determining a FRAND royalty account for the risk of patent holdup? In his determination of the RAND royalty in *Microsoft v. Motorola*, Judge Robart emphasized that an SEP holder has the ability and incentive to hold up licensees, and he recommended that courts develop a royalty methodology that mitigates holdup risk.[245] Judge Robart adopted an *ex ante* incremental value approach (a methodology whose deficiencies I addressed in Part IV), stating that "[r]ewarding the SEP owner with *any* of

[243] *Id.* tbl.5 at 94.

[244] *See, e.g.*, Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 288 (N.D.N.Y. 2009); IP Innovation, LLC v. Red Hat, Inc., 705 F. Supp. 2d 687, 689–90 (E.D. Tex. 2010); Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1315–16 (Fed. Cir. 2011). Expert economic testimony that is correct as a matter of theory may nonetheless be deemed inadmissible if the theory is not applied to concrete facts in the controversy at hand. *See, e.g.*, Concord Boat Corp. v. Brunswick Corp., 207 F.3d 1039, 1057 (8th Cir. 2000) (ruling expert economic testimony on antitrust damages inadmissible because the expert did not tie his use of the Cournot oligopoly model to the facts of the case).

[245] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *10–12, *20, *44 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

the value of the standard itself would constitute hold-up value and be contrary to the purpose behind the RAND commitment."[246] For Judge Robart, therefore, a royalty cannot be FRAND if it contains any holdup value. Judge Holderman expressed the similar view that "one of the primary purposes of the RAND commitment is to avoid patent hold-up."[247]

Judge Davis' approach to evaluating FRAND royalties in *Ericsson v. D-Link* in the Eastern District of Texas contradicts Judge Robart's methodology.[248] Rejecting holdup as a matter of theory, Judge Davis emphasized, in his order on post-trial motions following a jury verdict in Ericsson's favor, that an SEP holder of Ericsson's stature "is a sophisticated licensing entity" that has "an incentive to establish a reasonable licensing rate to maintain credibility in the licensing community."[249] He further said that "the money paid under" licensing agreements for FRAND-encumbered patents stipulated with other licensees "represents the market's valuation of the . . . contributions of Ericsson's patents."[250] Judge Davis rejected the defendant's claim that the jury's award of reasonable-royalty damages (which accounted for Ericsson's FRAND obligation in light of Judge Davis' explicit reference to that obligation in his jury instructions on damages) included excess value associated with holdup.

The conflicting approaches of Judge Robart and Judge Davis leave some uncertainty regarding the approach that courts will adopt to evaluate a FRAND royalty. For at least three reasons, however, patent holdup considerations should not receive weight in the determination of FRAND royalties. First, patent holdup is a conjecture, not a real-world fact. Little, if any, empirical evidence exists that SEP holders actually have engaged in patent holdup and caused lower production of standard-compliant downstream products. As Judge Davis concluded, licensees are sophisticated parties, aware of the existence of an SEP holder's FRAND obligation during licensing negotiations. Consequently, it would be naïve to believe that voluntarily agreed-upon royalties in licenses subject to the FRAND obligation are inflated or excessive because of the licensee's fear of holdup.

Second, one could question whether the FRAND commitment truly aims to address the risk of patent holdup, and therefore whether the parties and the court must identify and disaggregate the quantum of alleged holdup value when identifying a FRAND royalty. The FRAND commitment aims to ensure that implementers have access to the standard. The IPR policies of SSOs such as ETSI and the IEEE do not refer either to patent holdup or to the pricing of SEPs, provided only that such pricing not exclude an implementer of the standard. There is no indication in the ETSI or IEEE IPR policies that, by

[246] *Id.* at *19 (emphasis added).
[247] RAND Opinion in *Innovatio*, *supra* note 4, at 14.
[248] Memorandum Opinion and Order, Ericsson Inc. v. D-Link Sys., Inc., No. 6:10-cv-473 (E.D. Tex. Aug. 6, 2013).
[249] *Id.* at 48.
[250] *Id.* at 30.

requiring SEP holders to make a FRAND commitment, the SSOs aimed to dictate how an SEP holder and a licensee should set FRAND royalties or divide economic rents. The proposition that a FRAND royalty must disaggregate all holdup value is an assertion that is not found in the FRAND commitment.

Third, requiring zero holdup value—that is, zero value attributed to the adoption of the patented technology into the standard—for a royalty to be FRAND requires a peculiar assumption that is counterintuitive and implausible—namely, that the patent holder is not entitled to share any of the value generated by the standard. This assertion invites the question, who *is* entitled to reap the value of the standard? Only implementers? Why should holders of SEPs, without whose participation the SSO could not begin to achieve its intended purpose, be denied the right to capture any share of the value of the standard that they have helped to create? Depriving each SEP holder of any of the value associated with the adoption of its patented invention into the standard would give implementers the entire surplus generated by the standard and would fail to encourage the participation of inventors in standard setting. Because of that perverse incentive, such a royalty cannot be FRAND.

In short, the risk of patent holdup and the supposed need to disaggregate "holdup value" from other components of value are irrelevant to a proper determination of FRAND royalties.

### E. Are Aggregate Royalties Too High?

The FRAND commitment and the fiduciary duty that SEP holders in an SSO have to one another exist to ensure that implementers are not denied access to a standard because the aggregate royalty burden to implement a standard is too high. In principle, a party's FRAND royalty must account for its effect on the aggregate royalty that an implementer must pay to comply with the standard. As a matter of fact, however, have aggregate royalties been so high as to hinder the implementation of standards and the development of new standards and innovations? At least one district court highly experienced in patent litigation has expressed great skepticism: "The best word to describe [the] royalty stacking argument is theoretical."[251] Below, I examine the case of aggregate royalties for 3G standards.

The first release of the 3G UMTS standard was in 1999.[252] In 2002, Nokia petitioned the industry to adopt a 5-percent cumulative royalty for WCDMA.[253] However, a report from Credit Suisse First Boston released in

[251] *Id.* at 36.

[252] *Release 1999*, 3GPP, http://www.3gpp.org/specifications/Releases/article/release-1999.

[253] Press Release, Nokia, Nokia Advocates Industry-wide Commitment to 5% Cumulative IPR Royalty for WCDMA, at 17 (May 8, 2002), http://press.nokia.com/2002/05/08/nokia-advocates-industry-wide-commitment-to-5-cumulative-ipr-royalty-for-wcdma/ ("Under this proposal no manufacturer should pay more than 5% royalties covering all essential WCDMA patents from all patent holders.").

2005—three years after Nokia's unsuccessful appeal for a 5-percent cumulative royalty—estimated the cumulative royalties for WCDMA to be 17.3 percent of the net sales price.[254] Despite the early suggestions for single-digit aggregate royalties, the estimated aggregate royalty rates for 3G following its release were much higher.

In 2011, ABI Research examined 2G, 3G, and 4G patents for mobile devices and estimated the total handset royalties for handsets practicing (1) GSM, (2) GSM/WCDMA, and (3) GSM/WCDMA/LTE standards.[255] ABI Research found that, industry-wide, GSM-only handsets were declining in shipments and had the lowest royalty rates compared with handsets practicing more than one standard.[256] In contrast, handsets practicing both GSM and WCDMA were growing in volume, royalty rates, and retail price. Handsets practicing all three standards (GSM, WCDMA, and LTE) had the highest royalty rates and commanded the highest handset prices but still exhibited relatively small volumes.[257]

ABI Research estimated aggregate royalties for the three categories of standards above. Its methodology involved discussions with industry companies and studies of the related patents to determine the strength of patent portfolios compared with the industry at large. Next, ABI Research ranked companies on a scale from having "weak portfolios" to "very strong portfolios." Using company-weighted market shares, ABI Research derived average royalties paid by companies practicing the standards throughout the forecast period, from 2010 to 2016.[258] Table 2 reproduces the estimates by ABI Research of the aggregate royalty rates for handsets practicing both the GSM and WCDMA standards.[259]

ABI Research estimated aggregate royalty rates between 3.8 percent and 17.5 percent in 2011 for handsets practicing the GSM and WCDMA standards based on portfolio strength. For companies with their own strong to very strong patent portfolios, the royalty rates for handsets practicing the GSM and WCDMA standards were between 3.8 and 6.6 percent, while a licensee with a weaker patent portfolios paid royalties between 13.1 and 17.5 percent. ABI Research's estimates represent royalties being paid twelve years after the release of UMTS. Thus, it is expected that the aggregate royalty rates would have fallen to single-digit figures by 2011 for licensees having strong or very strong portfolios.

The ABI Research estimates are forward-looking. Cumulative royalties depend not only on the strength of the licensor's portfolio, but also on the

[254] Keith Mallinson, *A Compendium of Industry and Market Analysis Articles on Intellectual Property in Mobile Communications Standards: Response to FTC Request for Comments on the Practical and Legal Issues Arising from Incorporation of Patented Technologies in Collaborative Standards* (June 12, 2011) (citing Credit Suisse First Boston's 3G Economics Report).

[255] Solis & Carlaw, *supra* note 102, at 2.

[256] *Id.* at 32–35.

[257] *Id.*

[258] *Id.* at 31–35.

[259] *Id.* at 33.

**Table 2.** ABI Research estimates of GSM/WCDMA likely aggregate royalty rates paid by licensees, by licensee's patent portfolio strength, world market, 2011

| Segment | Rate |
|---|---|
| No Portfolio | 17.5% |
| Weak Portfolio | 13.1% |
| Moderate Portfolio | 11.2% |
| Strong Portfolio | 6.6% |
| Very Strong Portfolio | 3.8% |

*Note*: GSM/WCDMA handsets include GSM, GPRS, EDGE, WCDMA, HSDPA, HSPA, and HSPA+.
*Source*: Solis & Carlaw, *supra* note 102, at 33.

strength of the licensee's portfolio, the volume of licensed product, and the novelty of the technology. Rudi Bekkers and Joel West studied the aggregate GSM and UMTS royalties in the context of the substantially larger number of UMTS patents compared with GSM. They compared patent portfolios for GSM and UMTS six years following standardization. They found that, "[a]fter six years, GSM had a total of 140 essential patents held by 23 organizations. For UMTS, the comparable figures are 1,227 essential patents (an eightfold increase) held by 72 organizations (a threefold increase)."[260] Firms invest in R&D for the next generation of technology. Therefore, once a standard is released, firms will promptly declare any existing patents they consider essential to the standard. As the technology in question evolves, firms will continue to declare more patents, particularly as new standards build upon older ones. The eightfold increase in essential patents may account for the disparity in royalty rates that Bekkers and West found between the two standards. Each declared-essential patent that proves to be essential in fact to a standard has some royalty value. The more patents that are essential in fact to a standard, the greater the number of royalties associated with the standard, and therefore the larger the aggregate royalty rate.

A similar scenario should be expected with 4G standards. Although current estimated royalty rates for 3G standards may be in the observed range of 3.8 to 17.5 percent for the aggregate royalty burden for 3G handsets, the range was much wider immediately following the release of the standard. Double-digit aggregate royalties approaching 30 percent following the release of a standard for mobile handsets can be expected and would be reasonable.[261] Furthermore, the impact of 30-percent estimated aggregate royalties did not dampen the

[260] Rudi Bekkers & Joel West, *IPR Standardization Policies and Strategic Patenting in UMTS*, presented at the 25th Celebration Conference on Entrepreneurship and Innovation: Organizations, Institutions, Systems and Regions (2009).

[261] *See, e.g.*, Rudi Bekkers, René Bongard & Alessandro Nuvolari, *Essential Patents in Industry Standards: The Case of UMTS*, Proceedings of the 6th Internatioanal Conference on Standardization & Innovation in Information Technology, at 12 (2009); Lemley & Shapiro, *supra* note 158, at 2026.

introduction and sale of 3G-compatible devices and therefore should not be considered prohibitively high. 3G-enabled handsets grew 25 percent to 40 percent year-over-year from 2005 to 2008, the early years following the release of the 3G standard.[262] Therefore, the observed aggregate royalties should be considered reasonable and should not raise concerns about stacking or holdup issues.

## VI. THE FAIR AND REASONABLE DIVISION OF THE AGGREGATE ROYALTY BURDEN AMONG SEP HOLDERS

In this part, I consider methods of dividing the aggregate burden of FRAND royalties among the SEP holders contributing to the standard.

### A. The Common-Pool Problem Analogy for Governing Behavior in SSOs

A common pool problem arises with respect to dividing the producer surplus arising from the total number of standard-essential patents necessary to manufacture a downstream product. The holder of any one patent that is genuinely standard-essential can block the creation of the joint producer surplus made possible by the commercial aggregation and exploitation of all the SEPs. It is therefore necessary for SEP holders to achieve an equilibrium of mutual forbearance from opportunistic behavior. This equilibrium, then, is an economic objective of the fiduciary duty that each SEP holder owes to each other SEP holder.

An alternative and inferior equilibrium would be one of mutual opportunism. If it takes a myopic view of profit maximization, each SEP holder has an incentive to extract the greatest possible share of the joint producer surplus by demanding higher royalties. A unit royalty or *ad valorem* running royalty becomes a marginal cost for manufacturers of the downstream products. As the marginal cost of royalties increases, the implementer's profit-maximizing output of the downstream product will decrease. This reduction in output could decrease total royalties to SEP holders in some situations. In the limit, excessive royalties could force the downstream manufacturer from the market completely. This, of course, is the royalty stacking conjecture. An SEP holder's opportunistic behavior thus not only makes it harder for other SEP holders to share in the joint producer surplus accruing to the standard, but also reduces the units of output on which the royalties will be based.

The foregoing is the received wisdom about patent holdup and royalty stacking. The current debate over the meaning of FRAND and the proper level of a FRAND royalty proceeds amid dystopian predictions of market failure because of the supposed intractability of the common-pool problem

[262] Dennis Wassung, Jr., *Mobile Handset Industry: To 3G or Not to 3G? That Is the Question*, Cabot Money Management (undated), *available at* http://www.ecabot.com/white-papers/3G_web.htm.

associated with allocating the value that SEPs combinatorially create. The received wisdom, however, unfolds at a level of theoretical abstraction that is removed from and ignores the lessons from the history of industrial development. Simply because smartphones are new does not mean that they pose legal and economic questions of common pools that are extremely novel.

In the 20th century, the oil and gas industry in the United States faced a similar problem of opportunism no less consequential and disruptive to consumer welfare than the current patent wars over smartphones and the current attempt to achieve a clearer definition of property rights associated with the FRAND commitment. The controversy concerned the "rule of capture," which the Louisiana Supreme Court described as follows:

> In the early days of the oil industry, [the] physical factors [of oil and gas deposits] were poorly understood. It was thought that oil flowed in underground rivers and an analogy was seen between the ownership of oil and the ownership of water and animals which traverse one's property. Thus the "*rule of capture*" was adopted (and has been sustained within certain limitations even after the nature of reservoirs was better understood.) It has been defined
>
> > as a rule of law (sometimes called rule of convenience) arising from ownership of property, or the right to produce oil and gas, by virtue of which an operator who drills on his own land, or land held under an oil and gas lease or other instrument, acquires title to the oil which he legally produces from the well, whether or not drainage takes place from surrounding properties.
>
> Needless to say, the period of oil and gas development that followed the adoption of such a rule was characterized by haste, inefficient operations, and immeasurable waste within the ground and above.[263]

The Texas Supreme Court similarly interpreted the rule of capture to mean "that since the gas in a continuous reservoir will flow to a point of low pressure the landowner is not restricted to the particular gas that may underlie his property originally but is the owner of all that which he may legally recover."[264]

The controversy in the 20th century over the rule of capture has parallels to the FRAND controversy in the 21st century. The owner of a tiny tract of land (the analogue to the holder of an individual SEP) could in theory opportunistically extract all the oil from a reservoir underlying the surrounding acreage (the analogue to the share of the feasible aggregate royalty burden that would be available for all holders of SEPs to divide among themselves); meanwhile, a neighboring land owner (another SEP holder) would have no right to halt the driller's operation on his own land (the first SEP holder). "It is an obvious result," said the Texas Supreme Court in 1962, "that if in a common reservoir

[263] Nunez v. Wainco Oil & Gas Co., 488 So.2d 955, 960 (La. 1986) (emphasis in original) (quoting HARRIET S. DAGGETT, MINERAL RIGHTS IN LOUISIANA 419–21 (La. State Univ. Press 1949) (citation omitted)).

[264] Halbouty v. R.R. Comm'n, 357 S.W.2d 364, 375 (Tex. 1962). *See also* Howard R. Williams, *Conservation of Oil and Gas*, 65 HARV. L. REV. 1155 (1952); Paula C. Murray & Frank B. Cross, *The Case for a Texas Compulsory Unitization Statute*, 23 ST. MARY'S L.J. 1099 (1992).

one tract owner is allowed to produce many times more gas than underlies his tract he is denying to some other landowner in the reservoir a fair chance to produce the gas underlying his land."[265]

The Nash equilibrium under the rule of capture is not mutual forbearance, but rather mutual opportunism: each land owner extracts as much oil as possible, as quickly as possible, before his neighbors takes it. This uncoordinated extraction by many landowners reduces the aggregate value of the common reservoir for two reasons. First, it induces oversupply of oil, which depresses the market price for oil and thus the value of the remaining reserves in the common reservoir. Second, the multiple perforations of the reservoir resulting from the multitude of wells relieves pressure and thus raises the cost of extracting oil from the reservoir. However, there is at least one significant economic difference between oil and gas reservoirs subject to the perverse incentives created by the inappropriate definition of property rights according to the rule of capture and SEPs that are vulnerable to royalty stacking: standard-essential patents are complements, whereas the rival oil and gas wells situated above an expansive common reservoir are perfect substitutes.

Competing producers of oil and gas attempted to overcome the inefficiencies of the rule of capture and the collective action problem through self help. Essentially, they tried to use collective action to work around a defective definition of the relevant property rights. They agreed to limit extraction to avert the premature depletion of the reservoir, which had the predictable effect of raising the market price of petroleum products. But because they were horizontal competitors, the result was the most famous and incoherent price-fixing decision in American antitrust jurisprudence: *United States v. Socony-Vacuum Oil Co*.[266] Eventually, states, clad in exemption from the antitrust laws, regulated oil production by rationing output among competing property owners, much as the private actors had attempted to do. For example, agencies regulated the spacing between wells to prevent excessive drilling, permitting no more than one oil well per forty acres.[267] Through legislation, Texas in effect redefined property rights in a common resource and made a non-cooperative game into a cooperative one: a compulsory pooling statute now permits that state to compel drillers to pool their oil or gas among different small tracts.[268]

Participants in the current debate over royalty stacking and the FRAND commitment should take several lessons from the common-pool problem associated with the rule of capture. First, it is not realistic to suppose that SEP owners would not attempt, through private collective action, to avert excessive royalty stacking, were it to pose a serious risk of reducing the size of the joint

[265] *Halbouty*, 357 S.W.2d at 374.
[266] United States v. Socony-Vacuum Oil Co., Inc., 310 U.S. 150 (1940).
[267] *See* R.R. Comm'n v. Bass, 10 S.W.2d 586 (Tex. Civ. App. Austin 1928), *writ dismissed*, 51 S. W.2d 1113 (Tex. Comm'n App. 1932).
[268] Mineral Interest Pooling Act, TEXAS NATURAL RESOURCE CODE § 103.011 (West 2009).

surplus created by the standard. As noted earlier, a number of SEP holders did in fact make voluntary announcements of what they believed the maximum height of the royalty stack should be for a new standard. The fact that the royalty stack turned out to be higher than initially advocated by prominent SEP holders is certainly not evidence that these SEP holders were oblivious or indifferent to the theoretical possibility of excessive royalty stacking.

Second, if excessive royalty stacking were empirically observed to occur, and if private collective action were insufficient to rectify the market failure caused by ill-defined property rights in the joint surplus created by the standard, then either the legislature or the judiciary would surely respond. Legislation would be enacted to resolve the problem (as in the case of the oil and gas industry in Texas and Louisiana). Or a court would use common law principles to fashion an efficient property right (as, for example, when an Illinois state court in 1926 devised injunctive rules that created property rights to prevent interference in the use of radio spectrum immediately before Congress enacted the Radio Act of 1927, which reflected essentially the same rules[269]). It is naïve and contrary to economic history to suppose that, if a serious market failure were to arise from the excessive stacking of royalties for SEPs, and if that market failure defied solution by private collective action, legislation or common law adjudication would not be promptly forthcoming.

Justice Holmes wrote that "a page of history is worth a volume of logic."[270] His admonition applies with no lesser force to economic theory than to abstract legal reasoning. The dystopian narrative of FRAND royalty stacking should be taken with a grain of salt.

## B. The Fair and Reasonable Division of the Surplus as a Deterrent to Opportunism by SEP Holders

A challenge in determining FRAND royalties lies in dividing the producer surplus among SEP owners. The law of fiduciary duty and the principles of equity can guide courts in preventing opportunistic behavior that would jeopardize the value created when downstream products implement the standard.

### *1. Fiduciary Duty*

If members of an SSO are joint venturers as a matter of law, then they may owe to one another fiduciary duties of loyalty and care, as in the famous opinion in *Meinhard v. Salmon*, authored by Justice Benjamin Cardozo.[271] Judge Posner explains:

[269] *See* Tribune Co. v. Oak Leaves Broadcasting Station Inc. (Cir. Ct. Cook County, Ill. Nov. 17, 1926), *reprinted in* 68 CONG. REC. 216 (Dec. 10, 1926); Thomas W. Hazlett, *The Rationality of U.S. Regulation of the Broadcast Spectrum*, 33 J.L. & ECON. 133 (1990) (discussing *Oak Leaves*).

[270] New York Trust Co. v. Eisner, 256 U.S. 345, 349 (1921) (Holmes, J.).

[271] Meinhard v. Salmon, 249 N.Y. 458, 164 N.E. 545 (1928).

> A fiduciary, unlike an ordinary contract promisor, undertakes to treat the affairs of the promisee as if they were the promisor's own affairs. That is the practical content of all that high falutin' talk of utmost good faith and loyalty, full disclosure, the punctilio of an honor most sensitive, etc. . . . The promisor is to treat the promisee as well, as loyally, as considerately, as faithfully, as the promisor would treat himself.[272]

Viewed from an economic perspective, the fiduciary duty of loyalty prohibits (among other things) a joint venturer's individual expropriation of an opportunity belonging collectively to the joint venture. The equilibrium is one of mutual forbearance from opportunistic behavior, in the sense that Oliver Williamson defines opportunism—"self-interest seeking with guile."[273] More precisely, the equilibrium consists of the mutual forbearance from the expropriation of the quasi rents of other members of the SSO. It is a small step (as we shall see) to conclude that the fiduciary duty of loyalty envisioned in *Meinhard v. Salmon* with greater force prohibits a joint venturer's *destruction* of a joint opportunity.

Fiduciary duties constrain one to act in another party's interest in the course of a business relationship. They include the duties of care, loyalty, and good faith. These duties are typically manifested in the relationship between an officer or director of a corporation and its shareholders, between partners in a business, and between members of a joint venture. The duty of care requires that the fiduciary make informed business judgments to the extent he reasonably believes appropriate under the circumstances. The fiduciary duty of loyalty requires that the fiduciary make a business judgment in good faith and without individual financial gain. For example, a corporate officer owes a duty to act in the best interests of the corporation's shareholders, primarily to maximize shareholder wealth. Parties in a partnership or joint venture are due fiduciary duties by the other partner(s) or joint venturer(s) concerning matters within the scope of the specific business endeavor, and thus these parties have an actionable claim for breach of a fiduciary duty.[274]

Joint venturers breach their fiduciary duty of loyalty when they compete with the joint venture.[275] Justice Cardozo wrote in *Meinhard v. Salmon*:

> Joint adventurers, like copartners, owe to one another, while the enterprise continues, the duty of the finest loyalty. Many forms of conduct permissible in a workaday world for those acting at arm's length, are forbidden to those bound by fiduciary ties. A trustee is held to

[272] Olympia Hotels Corp. v. Johnson Wax Dev. Corp., 908 F.2d 1363, 1373 (7th Cir. 1990) (Posner, J.).

[273] *See* Oliver E. Williamson, *Transaction-Cost Economics: The Governance of Contractual Relations*, 22 J.L. & ECON. 233, 234 n.3 (1979). For an analysis of relevance of the Williamsonian concept of opportunism to the meaning of the FRAND obligation, see F. Scott Kieff & Anne Layne-Farrar, *Incentive Effects from Different Approaches to Holdup Mitigation Surrounding Patent Remedies and Standard-Setting Organizations*, 9 J. COMPETITION L. & ECON. 1091 (2013); Spulber, *Innovation Economics*, *supra* note 182.

[274] *See, e.g.*, Micromuse, Inc. v. Micromuse, PLC, 304 F. Supp. 2d 202 (D. Mass. 2004).

[275] *See, e.g.*, Vista Dev. Corp. v. Doral Terrace Assoc., Ltd., 878 So.2d 462 (Fla. D. Ct. App. 2004).

> something stricter than the morals of the market place. Not honesty alone, but the punctilio of an honor the most sensitive, is then the standard of behavior. As to this there has developed a tradition that is unbending and inveterate. Uncompromising rigidity has been the attitude of courts of equity when petitioned to undermine the rule of undivided loyalty by the "disintegrating erosion" of particular exceptions. Only thus has the level of conduct for fiduciaries been kept at a level higher than that trodden by the crowd. It will not consciously be lowered by any judgment of this court.[276]

Meinhard and Salmon were engaged in a joint venture for the purpose of developing and leasing a property. As the lease approached expiration, Salmon was offered and, without informing Meinhard, accepted a new opportunity involving redevelopment of the same property. The court found that the duty of loyalty obligated Salmon to inform his joint venturer of the opportunity and to share the profits with the venture. Modern courts have further explored the duty of loyalty as it applies to joint ventures and have expressed the duty owed as an obligation not to interfere or compete with the interests of the joint venture. In *Denim North America Holdings, LLC v. Swift Textiles, LLC*, a firm breached its fiduciary duty—owed to a textile manufacturer under the terms of an agreement establishing a joint venture to manufacture and sell denim products—when the firm sold products that undercut the joint venture's sales.[277] The case illustrates that a joint venturer may breach his fiduciary duty of loyalty by exploiting an opportunity to compete with the joint venture. Courts call this particular application of the fiduciary duty of loyalty the corporate opportunity doctrine (though of course it is not limited to businesses that are organized as corporations).

The corporate opportunity doctrine is a common law doctrine that restricts a fiduciary from pursuing new business opportunities without first presenting them to the corporate entity to which the fiduciary duty is owed. As enunciated in 1900 in the seminal case of *Lagarde v. Anniston Stone & Lime Co.*, the doctrine derives from the duty of loyalty and applies whether or not the improper appropriation of a corporate opportunity harms the business association.[278] The court in *Lagarde* stated that the doctrine applies when a fiduciary "has acquired property in which the corporation has an interest already existing or in which it has an expectancy growing out of an existing right, or when his interference will in some degree balk the corporation in effecting the purposes of its creation."[279] *Lagarde* requires two elements for the corporate opportunity doctrine to apply. First, the corporation must have an interest or expectancy in the agreement. Second, the fiduciary must have interfered with a corporate purpose.

[276] *Meinhard v. Salmon*, 249 N.Y. at 463–64 (citation omitted).
[277] Denim North Am. Holdings, LLC v. Swift Textiles, LLC, 857 F. Supp. 2d 1343 (M.D. Ga. 2012).
[278] Lagarde v. Anniston Lime & Stone Co., 28 So. 199 (Ala. 1900) (creating the so-called "interest and expectancy" test for finding an appropriation of a corporate opportunity).
[279] *Id.* at 201.

Writing in his corporate law treatise in 1986, Robert Clark, former dean of Harvard Law School, provides an interpretation of *Lagarde* and the other early common law cases that is particularly salient to the FRAND commitment made to an SSO by an SEP holder.[280] Clark stresses the fiduciary's access to asymmetric information: "Fiduciaries will often have better information than independent third parties do about the corporation's needs and vulnerabilities—its true demand curve—and may therefore be superior exploiters of market power against their corporation."[281] With access to this asymmetric information comes the fiduciary's duty of self restraint. A fiduciary "should not exploit the market power that third parties have over his corporation but which, for whatever reasons, they have so far failed to exploit."[282] This understanding of the appropriation of a corporate opportunity dovetails with the standard narrative of royalty stacking, which portrays the patent holder as threatening the standard's economic viability by demanding from implementers a royalty that exploits the incremental market power created when the SSO chose to incorporate into the standard the SEP holder's particular technology instead of an available alternative under consideration. Clark explains: "The fiduciary should not deliberately harm his corporation. He is not supposed to take steps to further his own interest that will rather clearly and directly thwart the corporation's interest."[283] These constraints command self-restraint with respect to the common pool of value that the joint venture creates for its members. "In sum," writes Clark, "the gist of the interest or expectancy test is that it defines the concept of corporate property in light of the general principle that a fiduciary may not harm, compete with, or take advantage of his beneficiaries."[284]

Continuing with the characterization of an SSO as a joint venture, each member of the SSO owes a duty to each other individual member and to the interests of the SSO collectively not to jeopardize the existence and functioning of the standard and the SSO. Members of an SSO have a cognizable "interest" in seeing that other members comply with the SSO's standards. Members of an SSO also have a cognizable "expectancy" that each SEP holder will negotiate licensing agreements on FRAND terms. The SEP holder's breach of loyalty harms the SSO collectively because SEP holders and licensees will be less willing to participate in the SSO if they believe that in the future its members will disregard their FRAND licensing commitments. Thus, flouting the FRAND commitment amounts to interference with the SSO's essential "corporate purpose" of efficiently bringing standard-compliant products to market.

[280] ROBERT C. CLARK, CORPORATE LAW 225–27 (Little Brown 1986).
[281] *Id.* at 226.
[282] *Id.*
[283] *Id.*
[284] *Id.* at 226–27.

It bears repeating that the extent of one's fiduciary duty depends on the scope of the business venture, which in the FRAND situation is the creation and commercial implementation of a successful standard. For example, the fiduciary duty owed within an SSO does not mean that two rival manufacturers of smartphones have a duty to disclose to one another confidential information about their competitive strategies on the (false) rationale that the good-faith negotiation of a FRAND license between the two of them requires sharing such information. To the contrary, such information exchange could raise antitrust concerns. Similarly, licensors and licensees have separate fiduciary duties to their investors. So the fiduciary duty that one SSO member owes to another cannot limit the first firm's ability to negotiate as favorable a license as possible, consistent with the firm's not jeopardizing the success of the standard. As noted earlier, the language of economics describes a FRAND framework as a situation of constrained (rather than unconstrained) profit maximization for an individual firm belonging to the SSO. But the constraint on profit maximization can be binding to different degrees. In the case of the constraint that a FRAND obligation places on a firm, as long as the negotiated royalty does not threaten the viability of the standard and the SSO, licensors and licensees have discretion in making royalty demands and offers. Subject to that constraint, each firm may still seek to maximize the profits it can individually earn from the standard, and indeed each has a fiduciary duty to its investors to try to do so.

*2. Using Equity to Prevent Unjust Enrichment and to Deter Opportunistic Behavior*

"Equity refuses to confine within the bounds of classified transactions its precept of a loyalty that is undivided and unselfish."[285] To date, the contractual documentation surrounding the adoption of standards has failed to provide an economic definition of FRAND. The absence of an answer may speak volumes. One possible explanation is that the parties consciously or intuitively chose to leave the definition blank and rely on principles of equity to guide the determination of the ultimate royalty. This possibility is consistent with the characterization of SSO members as fiduciaries to one another with respect to the success of the standard. This possibility is also consistent with the Rawlsian depiction of standard setting as a process evolving from an original position of ignorance with respect to whether one will eventually be buying or selling patented technology, such than even an undefined price would be satisfactory *ex ante* as long as the SSO's members shared the common assurance that that price would be fundamentally fair.

Another possible explanation is that no mutually satisfactory answer exists to the question, "What is a FRAND royalty?" This interpretation has an important implication: the parties lack mutual assent. No meeting of the minds has occurred. A contract has not been formed. An essential element of

[285] *Meinhard v. Salmon*, 249 N.Y. at 467.

contract formation—the unambiguous specification of a price—never occurred. That the parties subsequently disagree so vociferously about what FRAND means merely confirms that they never had a common understanding of price that they could reduce to an unambiguous written expression. If so, then a FRAND royalty commitment is not enforceable because mutual assent with respect to the contract's price is absent.[286]

Curiously, this second interpretation could lead to the same destination as the first. When there is a failure of contract formation, equity will determine the monetary remedies necessary to place each party in the *status quo ante*. Of course, no one can undo the standard on that late day and pretend that smartphones do not exist. So a court's task of preventing unjust enrichment would require infusing the setting of a reasonable royalty with special concern for achieving fairness.

The 1937 version of the Restatement of Restitution provided that a person unjustly enriched at another's expense must make restitution to the other.[287] The Restatement (Third) of Restitution and Unjust Enrichment of 2011 replaced the Restatement of Restitution of 1937 and defines unjust enrichment as "result[ing] from a transaction that the law treats as ineffective to work a conclusive alteration in ownership rights."[288] When a contract is rescinded or is deemed never to have been formed, a court orders the parties to make restitution of the wealth transfer—the enrichment—that the parties conferred upon one another. Therefore, if a court found that the FRAND commitment between the SEP holder and the SSO lacked a meeting of the minds over price and that this lacuna therefore prevented the formation of a contract by which implementers (including third-party beneficiaries) could license the SEP, then the court would invoke equity to restore the *status quo ante* among the parties. However, it would be impossible for the court to reverse the sunk costs that the parties would have incurred after the adoption of the standard. Therefore, that best that the court could do would be to try to determine the "just" level of enrichment for the implementer's unauthorized use of the SEP.

[286] Courts have found that a party's licensing declaration to SSOs give rise to an enforceable contract. *See, e.g.*, Realtek Semiconductor Corp. v. LSI Corp., No. C–12–034512013 WL 2181717, at *5 (N.D. Cal. May 30, 2013) ("[t]here is no dispute . . . that defendants entered into a binding contract with the IEEE to license their declared standard-essential patents . . . on RAND terms"); Microsoft Corp. v. Motorola, Inc., 696 F.3d 872, 878 (9th Cir. 2012).

[287] RESTATEMENT OF RESTITUTION § 1 (1937). *See also* Warren A. Seavey & Austin W. Scott, *Restitution*, 54 L.Q. REV. 29 (1938). Seavey and Scott were the reporters of the 1937 Restatement of Restitution. They described unjust enrichment as "a postulate underlying the law of restitution, analogous to the postulates underlying tort law (a right against unjust harm) and contract law (a right against breach of promise)." *Id.* at 31–32. *Cf.* Peter Birks, *Unjust Enrichment and Wrongful Enrichment*, 79 TEX. L. REV. 1767, 1178 (2001) (describing unjust enrichment as an event and, more specifically, a causative event of the restitution); Andrew Kull, *Rationalizing Restitution*, 83 CAL. L. REV. 1191 (1995) (describing restitution and unjust enrichment as one subject).

[288] RESTATEMENT (THIRD) OF RESTITUTION AND UNJUST ENRICHMENT § 1, comment b (2011). Andrew Kull is the reporter of the Restatement (Third) of Restitution.

## C. Alternative Methods for Dividing the Joint Surplus Among SEP Holders

I consider now five alternative methods for allocating shares of the aggregate royalty among the SEP holders: (1) heuristic use of the Lorenz curve (2) the Shapley value, (3) bargaining theory and the ultimatum game, (4) patent counting, and (5) patent pools.

### *1. The Heuristic Use of the Lorenz Curve*

In law and other disciplines, one might sometimes invoke a heuristic to use one's experience from other contexts to identify a satisfactory though admittedly nonoptimal method for answering a complex question.[289] This reliance on rules of thumb or intuition or innate attitudes—which I argued earlier is embodied in a judge's concept of fairness in his exercise of equitable powers—finds its counterpart in economics and psychology in the writings of Nobel laureates Herbert Simon, Amos Tversky, and Daniel Kahneman.[290] I propose here a heuristic for fairly apportioning the aggregate royalties of SEP holders in an unequal manner.

#### *a. The Lorenz Curve*

Empirical studies in a number of countries have shown that the distribution of the economic value of patents is highly skewed.[291] It is reasonable to expect that the economic value of patents reading on a standard is similarly skewed. That is, the presence of outliers, or extremely valuable patents, causes the mean value of the patents to be orders of magnitude above the median value. Trying to solve the indivisibility problem of SEPs by requiring equal sharing of the aggregate royalty earned from the downstream manufactured product would ignore the tendency for SEPs to have vastly different values. At the same time, it may be prohibitively costly to try to measure the incremental contribution that each individual SEP makes to the downstream product on which royalties are imposed. However, two intuitive shortcuts could produce equitable outcomes.

The first shortcut is a qualitative ranking of the SEPs or families of SEPs in a given standard in terms of their relative contribution to making the downstream product feasible to produce. Economists call this kind of ranking an "ordinal" ranking, as opposed to a "cardinal" ranking, which would measure the difference between any two rankings according to some established

[289] *See, e.g.*, HEURISTICS AND THE LAW (Gerd Gigerenzer & Christoph Engel eds., MIT Press 2007).

[290] *See, e.g.*, Herbert A. Simon, *A Behavioral Model of Rational Choice*, 69 Q.J. ECON. 99 (1955); Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decisions under Risk*, 47 ECONOMETRICA 263 (1979); Tversky & Kahneman, *Judgment Under Uncertainty: Heuristics and Biases, supra* note 105.

[291] *See, e.g.*, Bronwyn H. Hall, Adam Jaffe & Manuel Trajtenberg, *Market Value and Patent Citations*, 36 RAND J. ECON. 16, 18 (2005).

metric.[292] As Paul Samuelson succinctly explained, an ordinal ranking "involve [es] 'more' or 'less' but not 'how much.'"[293] For simplicity, the ordinal ranking exercise would place SEPs (or, more likely, families of SEPs) in groups by increments of a fixed number of percentiles, such as deciles. One would assign all SEPs within each decile the same economic value. For example, all SEPs in the top 10 percent of the standard (which contribute the most to the standard) would have the same royalty. That royalty would differ from the royalty assigned to each SEP in the next 10 percent.

The second shortcut is to ask, how equal or unequal is the distribution of the marginal contributions of the SEPs to the standard? Economists use the Lorenz curve to represent the distribution of income among households in a country.[294] The analogue in the patent context is to decide qualitatively the distribution of the various SEPs in a standard in terms of their relative contributions to the standard or to the downstream product implementing the standard.

Figure 8 shows a hypothetical Lorenz curve for depicting a country's income distribution. The cumulative percentage of families is on the *X*-axis, and the cumulative percentage of income is on the *Y*-axis. The straight, 45-degree line represents perfect income equality, where, for example, 25 percent of households receive 25 percent of the nation's income, 75 percent of households receive 75 percent of the nation's income, and so forth. When one extends this framework to setting FRAND royalties, this 45-degree line represents the hypothetical scenario in which all SEPs in a standard are equally valuable. In the Lorenz curve in Figure 8, the bottom 25 percent of households earn less than 10 percent of the nation's income, and the top 25 percent earn more than 50 percent of the nation's income. In the context of FRAND royalties for SEPs, one would use a Lorenz curve to measure the cumulative percentage of economic value contributed to a standard (replacing the cumulative percentage of income) by the cumulative percentage of SEPs in the standard (replacing the cumulative percentage of families). Thus, in Figure 8, the bottom 25 percent of SEPs contribute less than 10 percent of the standard's economic value, whereas the top 25 percent of SEPs contribute more than 50 percent of the standard's economic value.

In the context of income distribution, one uses the Lorenz curve to calculate the Gini index of a country, a summary measure of the degree of income inequality in the country. A country's Gini coefficient is the ratio of the area between the country's Lorenz curve and the line of perfect equality to the total area below the line of perfect equality. (This ratio also equals twice the area

[292] *See, e.g.*, Louis Phlips, Applied Consumption Analysis 11–13 (Elsevier 1974); James M. Henderson & Richard E. Quandt, Microeconomic Theory: A Mathematical Approach 7–9 (McGraw-Hill 2d ed. 1971).

[293] Paul A. Samuelson, Foundations of Economic Analysis 91 (Harvard Univ. Press 1947).

[294] *See, e.g.*, Martin Bronfenbrenner, Income Distribution Theory 47–50 (Aldine 1971).

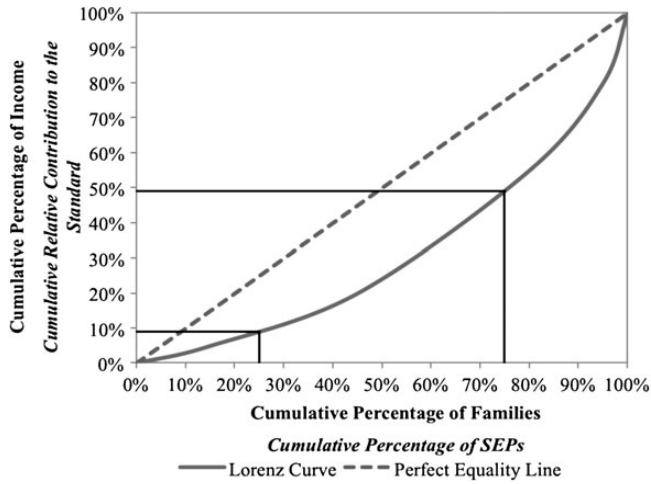


**Figure 8.** Lorenz curve depicting income inequality and the unequal distribution of the relative contributions of SEPs in a standard

between the country's Lorenz curve and the line of perfect equality, because the area below the 45-degree line of perfect equality is necessarily 0.5). The Gini coefficient ranges from zero (representing perfect equality) to 100 (representing perfect inequality). The closer the income distribution is to perfect equality, the smaller the Gini coefficient is. Thus, in the patent context, if a large number of SEPs in a standard contribute little value to the standard and a small number of SEPs contribute a large share of the standard's value, then the Gini coefficient for the standard would be relatively large. The Gini coefficient would represent what one might call the "economic inequality of technological contribution" of the various SEPs in the standard corresponding to the intuitive understanding of the technology.

*b. Using the Lorenz Curve to Determine the Royalty for SEPs*

One could thus use the Lorenz curve to estimate the FRAND royalty for a single SEP or for groups of SEPs according to their ranking by percentiles (such as deciles). The royalty therefore would reflect the economic contribution of the SEP to the standard relative to the economic contribution of all other (complementary) SEPs that read on the standard. Although the Lorenz curve in theory consists of an infinite number of points, in practice, one would need only to obtain a finite number of points to plot an approximate curve. For instance, the exercise could consist of deriving the relative contributions of SEPs by increments of a fixed number of percentiles, such as deciles. Suppose that when the SSO adopted the standard, there were 1,000 SEPs in a standard. Suppose further that subsequent technical testimony credibly establishes that the top 10 percent of the SEPs contribute 50 percent of the value of the

standard. Suppose further that the aggregate royalty burden for the standard constitutes 20 percent of the net revenue of a downstream product. The SEPs in the top 10 percent would together receive 50 percent of the aggregate royalty. One would then divide that share of the royalty evenly among the SEPs in the top 10 percent. Given that 100 SEPs belong to the top 10 percent, each individual SEP in the top 10 percent would receive $(50\% \times 20\%)/100 = 0.1\%$ of the net revenue of the downstream product. If the next 10 percent of the SEPs contribute 20 percent of the value of the standard, then each SEP in that decile would receive $(20\% \times 20\%)/100 = 0.04\%$ of the net revenue of the downstream product. Table 3 outlines the resulting royalty shares for the SEPs in the remaining deciles based on this hypothetical example. Figure 9 shows the distribution curve based on this example.

Under this method, the parties would present evidence and opposing argument over (1) the ordinal ranking of the SEPs and (2) the shape of the Lorenz curve approximated by a finite number of points. Once the finder of fact resolved these two questions, the relative shares of the downstream royalty base would emerge from the arithmetic exercise outlined above. If the data were available, empirical evidence to assess the degree of inequality across the SEPs would come from estimating a model of patent value based on information such as patent citations, patent counts, and the number of countries in which a patent is licensed—although, as I explained earlier, approved contributions are likely to be a more reliable and less biased indicator of the value of a given SEP portfolio.[295] In addition, one could draw from other standard distributions as close approximations for the distribution of technological contribution. For example, the famous Pareto distribution, which is commonly found among observable phenomena,[296] would predict that approximately 20 percent of SEPs contribute 80 percent of the total value that consumers attach to the downstream product.

As noted earlier, standard setting is a dynamic process, and the relative value of any given SEP may change over time. In particular, over time a noninfringing substitute may emerge for an SEP, causing the patent in suit no longer to be essential in the sense of its having no substitute. Consequently, the Lorenz curve and the Gini coefficient for a standard or downstream product may change over time.

A limitation of this approach is that ranking the value of every SEP in a standard, either individually or within groups of percentiles, may be costly. For practical purposes, therefore, one could categorize SEPs into groups based on the relative economic significance of their technological contribution to the standard. For example, one could start by creating three groups for SEPs:

[295] *See, e.g.*, Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. ECON. 172 (1990).

[296] 2 WILLIAM FELLER, AN INTRODUCTION TO PROBABILITY THEORY AND ITS APPLICATIONS 50 (Wiley 1971).

**Table 3.** Hypothetical relative contributions to standard by deciles of SEPs under the assumption of 1,000 SEPs in standard

| Ranking by Decile (from Highest to Lowest) | Hypothetical Contribution | % Royalty |
|---|---|---|
| 1st Decile | 50.00% | 0.100% |
| 2nd Decile | 20.00% | 0.040% |
| 3rd Decile | 12.50% | 0.025% |
| 4th Decile | 6.00% | 0.012% |
| 5th Decile | 4.00% | 0.008% |
| 6th Decile | 2.50% | 0.005% |
| 7th Decile | 2.00% | 0.004% |
| 8th Decile | 1.50% | 0.003% |
| 9th Decile | 1.00% | 0.002% |
| 10th Decile | 0.50% | 0.001% |

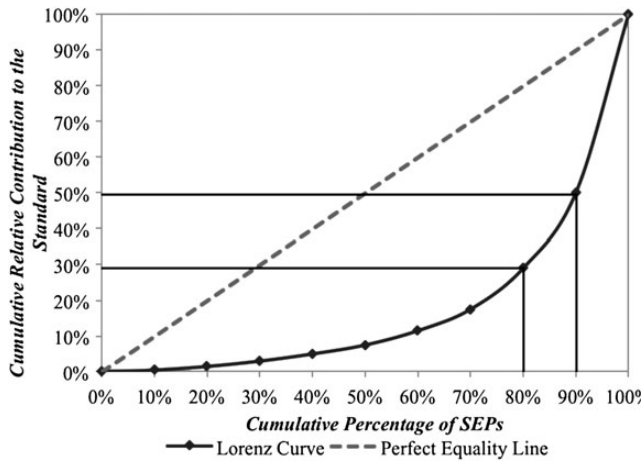


**Figure 9.** Hypothetical Lorenz curve of the relative contributions of SEPs under the assumption of 1000 SEPs in a standard

SEPs that are essential to the creation and existence of the standard, SEPs that are practiced in the standard but that have substitutes that could have been adopted into the standard, and SEPs that are not actually practiced by any downstream manufacturer in implementing the standard. As one increases the number of different groups, the total error between the "true" value of the SEPs and their royalties will decrease, but the transactions costs of determining the royalties will increase.

Although this method is admittedly arbitrary, it is not capricious. This approach holds promise because it creates a theoretical approach to an otherwise intractable problem. With sufficient simplification, the method may be possible to implement and may be able to satisfy all parties concerned that rough justice has been done. In contrast, with a uniform royalty for a group of SEPs,

it is certain that some SEPs in each group will be undervalued and some will be overvalued.

### c. *Using the Lorenz Curve to Determine SEP Holder's Royalty Rates for Their Portfolios*

Alternatively, one can use the Lorenz curve to estimate the appropriate royalty rate for each SSO member's *portfolio* of patents essential to a given standard. Indeed, the licensing of a firm's entire portfolio of patents essential to a given standard is the usual outcome of a litigation or negotiation over FRAND royalties. Such a portfolio license can be one-way or it can one-half of a cross license with the licensee, if the licensee has its own portfolio of SEPs for the same standard. In that case, the license can (but need not be) structured in terms of a net balancing royalty from one firm to the other. To be clear, in the discussion that follows, I am considering only a one-way running royalty rate.

As an example, consider the LTE standard used in the current generation of smartphones. As discussed earlier, ABI Research determined the number of contributions submitted by various holders of patents declared essential to the LTE standard that were approved by ETSI.[297] Figure 7 in Part V.C shows the top ten patent holders in terms of approved contributions to the LTE standard. Suppose, for simplicity, that those ten contributors were the only holders of LTE SEPs. Instead of grouping all the LTE SEPs individually by deciles, one can place Ericsson's portfolio of LTE SEPs as constituting the top 10 percent of LTE SEPs, Huawei's portfolio as constituting the next 10 percent, and so forth. Figure 10 shows the Lorenz curve for the LTE standard based on the top ten contributors' number of approved contributions. (In reality, there are more than ten holders of patents declared essential to the LTE standard. Consequently, the Lorenz curve for the LTE SEPs will be an even sharper curve.)

ABI Research found that, on the basis of the number of approved contributions, Ericsson's portfolio contributed 27 percent of the LTE standard as of December 2012, Huawei's portfolio contributed 18 percent, and Nokia Siemens Networks (NSN) contributed 11 percent. Each patent holder's royalty rate would equal its relative share of contributions to the LTE standard multiplied by the aggregate royalty rate. If one were to assume an aggregate royalty rate for SEPs equal to 10 percent of the net retail price of the handset, then the FRAND royalty rates directly correlated with the relative value of each SEP holder's technology would be 2.7 percent for Ericsson, 1.8 percent for Huawei, and 1.1 percent for NSN.

[297] Solis & Cooney, *supra* note 233, at 12. In *Innovatio*, Judge Holderman considered ABI Research to be a credible source of industry evidence. RAND Opinion in *Innovatio*, *supra* note 4, at 79.

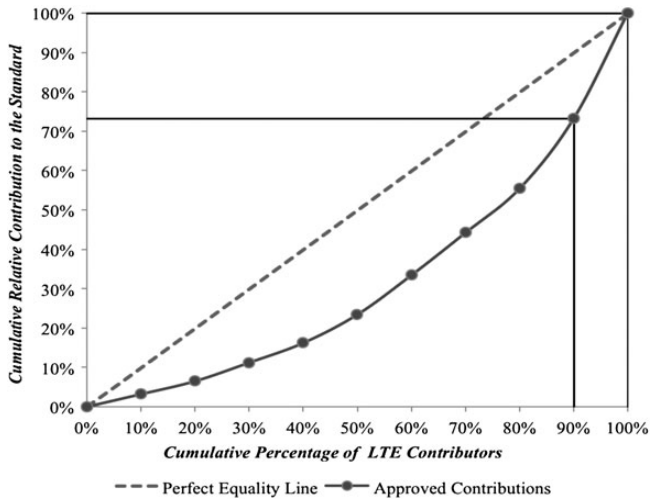


**Figure 10.** Lorenz curve of the approved contributions to the LTE standard

*2. The Relevance of the Shapley Value to FRAND Royalty Rates*

Economists have applied cooperative game theory to determining FRAND royalty rates in patent licensing negotiations.[298] One such method is the Shapley value, developed by Nobel laureate Lloyd Shapley in 1953.[299] Although the axioms of the Shapley value are consistent with the aim of FRAND licensing, practical application of the Shapley value would require two components: (1) complete market transparency with respect to the value of all patents and (2) additional refinement to eliminate "shirking"[300] by players whose patents do not contribute to the value of the standard, which I explain below.

The Shapley value builds upon the theory of games developed by John von Neumann and Oskar Morgenstern.[301] It analyzes the value (rents) attributable to each player's participation in a game.[302] In the FRAND context, participation in the game corresponds to participation in the standard-setting process—including participation of SEP holders and participation of implementers

[298] *See* Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 671; Salant, *supra* note 161.

[299] Lloyd S. Shapley, *A Value for n-Person Games*, *in* THE SHAPLEY VALUE: ESSAYS IN HONOR OF LLOYD S. SHAPLEY 31 (Alvin E. Roth ed., Cambridge Univ. Press 1988).

[300] *See* Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AM. ECON. REV. 777, 780 (1972) ("[S]ince costs must be incurred to monitor each other, each input owner will have more incentive to shirk when he works as part of a team, than if his performance could be monitored easily or if he did not work as a team.").

[301] *See* Alvin E. Roth, *The Shapley Value as a von Neumann-Morgenstern Utility*, 45 ECONOMETRICA 657 (1977).

[302] Alvin E. Roth, *Introduction to the Shapley Value*, *in* THE SHAPLEY VALUE: ESSAYS IN HONOR OF LLOYD S. SHAPLEY 1 (Alvin E. Roth ed., Cambridge Univ. Press 1988).

seeking to license the SEPs. One aspect of game theory is to provide for each player a numerical value to playing the game, for each game or alternative among the potential universe of all players. As described by Alvin Roth, with whom Shapley shared the Nobel Prize in 2012, Shapley's insight was

> to summarize the complex possibilities facing each player in a game in characteristic function form by a single number representing the 'value' of playing the game. Thus the value of a game with a set $N = (1, \ldots, n)$ of players would be a vector of $n$ numbers representing the value of playing the game in each of its $n$ positions.[303]

This value became known as the Shapley value and is analogous to the concepts of consumer surplus and producer surplus in market-based analysis. The Shapley value, consumer surplus, and producer surplus each measure how much better off an agent is for having participated in some economic interaction, compared with the agent's outside alternative of zero, which would be the agent's payoff for not participating in the game. Applied to standard setting, the players of the game contribute to creating the joint surplus associated with a standard. These players consist of both those who participate in creating the standard (that is, SEP holders) and those who participate in implementing the standard (that is, licensees and implementers). Each participant can receive a positive Shapley value associated with its contribution to the joint value of the standard.

The Shapley value has three axiomatic attributes: symmetry, efficiency, and additivity.[304] The symmetry axiom "states that the value is essentially a property of the abstract game"[305]—that is, the value attributed to any player is based only on that player's contribution to the game's overall value. Applying this axiom to a hypothetical FRAND patent-licensing negotiation implies that, if the patents owned by SEP holder $A$ and SEP holder $B$ contribute identical value to the standard, then $A$'s Shapley value equals $B$'s Shapley value.

One can view the second axiom—the efficiency axiom, also known as the carrier axiom[306]—as two separate axioms.[307] The axiom states that "the value [of the game] represents a distribution of the full yield of the game."[308] That is, "nothing is left over."[309] So, the sum of the Shapley values of the individual SSO members (which includes SEP holders as well as implementers that do not own SEPs but nonetheless participate in the SSO) would equal the value of the game representing the standard-setting process. Consequently, a player that contributes nothing to the value of the game receives no payoff.[310] This effect represents the second part of this second axiom, called the "null player" axiom.

[303] *Id.* at 4.
[304] Shapley, *supra* note 299, at 33.
[305] *Id.*
[306] Roth, *Introduction to the Shapley Value*, *supra* note 302, at 5.
[307] *Id.*
[308] Shapley, *supra* note 299, at 33.
[309] Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 624.
[310] *Id.*

Applied to patent-licensing negotiations, the null player axiom implies that a patent holder whose patents contribute nothing to the standard receives no royalty.

Finally, the third axiom, additivity, posits that, "when two independent games are combined, their values must be added player by player."[311] In other words, the value of each independent game, or standard, is based solely on the patents contained within the standard. Applied to FRAND licensing, this axiom implies that the Shapley value of a portfolio's SEPs is equal to its payoff as if all of the standards on which the patent portfolio reads were combined into a single standard.

These three axioms are necessary and sufficient to provide a unique distribution of the value of a game to its players. None of the axioms is inherently inconsistent with common interpretations of a FRAND commitment. In addition, a result of the Shapley value is that the payoff to either player is based purely on the quality of the player's SEPs and is completely unrelated to the player's brand name, market share, or other qualities unrelated to the strength of its patent portfolio. Therefore, using the Shapley value of a standard is an attractive theoretical solution to distributing the surplus generated by a standard to the members of the SSO.

The formula of the Shapley value determines each player's incremental contribution to the total of any subset of all possible games and produces a weighted average contribution of any one player to all possible coalitions that could contain that individual player.[312] The Shapley value is therefore compatible with FRAND because it anticipates that each SEP holder will receive a payment equal to its marginal contribution to the standard. SEP holders that contribute more to the standard will receive a greater payout. Players that do not obtain positive payoffs from the game will not participate, and thus the Shapley value accounts for the position of SEP holders *ex ante*. Finally, the Shapley value accounts for increased competition among claimants to the standard's rents as additional patents are declared essential to the standard: "the fraction of coalitions to which an IP owner has a large marginal contribution decreases, and its IP value measured by the average marginal contribution falls as well."[313]

When attempting to move from theory to practice, however, it becomes clear that at least three problems limit the feasibility of using the Shapley value in FRAND licensing.

First, the Shapley value depends on the ability of each player to have complete knowledge of the value of all essential patents for all SEP holders participating in the game, so that each player can identify each other player's marginal contribution. David Salant observes that "application of the Shapley value in setting royalty rates or license fees would require measures of surplus created by each coalition, that is, of each patent and set of patents."[314] This information

[311] Shapley, *supra* note 299, at 33.
[312] Salant, *supra* note 161, at 69.
[313] Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 701.
[314] Salant, *supra* note 161, at 70.

requirement underscores the fundamental difficulty with dividing the aggregate royalty burden of SEPs. The highest priority in setting a FRAND royalty for an SEP is to identify its marginal contribution to value of the downstream product. It is a secondary matter whether the division of that joint surplus can be performed in a universally fair manner, as opposed to some rough approximation of justice. In effect, the application of the Shapley value approach to FRAND royalties assumes unrealistically that one possesses the very information that is most valuable and most costly to acquire; based on the assumed possession of that precious information, the methodology then performs a calculation to divide the joint surplus in an intellectually elegant manner. However, the "fair and reasonable" component of FRAND does not primarily concern the division of the aggregate royalty burden among SEP holders; rather, this component primarily addresses the division of surplus between SEP holders and implementers. The division of joint surplus through Shapley values includes an apportionment of value to implementers that do not participate in the SSO, but it excludes patent holders that do not participate in the SSO, and therefore does not directly address the division of surplus between SEP holders and implementers. At present, the task of identifying the full set of SEPs in a standard is difficult. Further, securing perfect information about the value of each patent for each player (which can change over time) is so costly as to render the Shapley value virtually impossible to apply to patent-licensing negotiations or FRAND disputes.

The second problem with using the Shapley value to set royalties is that it is possible for SEP holders contributing nothing to the standard to receive a non-zero royalty.[315] The Shapley game considers the order in which a patent is introduced to the standard. The average marginal contribution calculated by the Shapley value is the average payoff for a given game taking the order of the players participating into consideration. In some orderings, a patent that is eventually excluded from the standard may be introduced before the patent that replaces it.[316] Consequently, the payoff to the patent ultimately excluded from the standard is non-zero—until the Shapley value is recalculated based on the new set of patents in the standard. Of course, adjusting every participant's Shapley value—and thus royalties—every time a patent is added or removed from the standard further increases the cost of implementing the Shapley value (and the potential for erroneous assessments of patent value).

The third problem with using the Shapley value to set FRAND royalties appears not to have been recognized in the scholarly literature: If SEPs are genuinely essential to the standard, then the combinatorial nature value of their value causes the Shapley value to collapse to the trivial solution of numerical proportionality. Suppose that one has three SEPs, $A$, $B$, and $C$, with a total surplus of 1. The SEP have no value when used independently or in any

[315] Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 695–97.
[316] *Id.*

**Table 4.** Illustrative combinatorial value of SEPs causing the Shapley value to collapse to the trivial solution of numerical proportionality

| Patent Added | Total Utility | Marginal Value |
|---|---|---|
| A | 0 | 0 |
| B | 0 | 0 |
| C | 1 | 1 |

pairwise combination. Only a three-way combination of the SEPs has value. One possible three-way combination is listed in Table 4.

There are six possible combinations of the three SEPs.[317] All six combinations yield the same sequence of marginal contributions: 0,0,1. Averaging the marginal contribution of each SEP (*A*, *B*, *C*) across every one of the six possible combination of sequential orderings yields an average marginal contribution of 1/3 for each SEP.[318] Therefore, when the value of the marginal contributions is combinatorial, as in the case of SEPs, the Shapley value calculates royalties manifesting numerical proportionality. Economists have examined and disputed the soundness of using numerical proportionality—patent counting—to set FRAND rates. As I explained in Part VII.A.1, the underlying assumptions for patent counting are flawed, specifically because this method assumes that all SEPs in a standard are of equal value.

In short, one cannot reliably use the Shapley value to measure FRAND royalties without first correcting for the method's current deficiencies. Otherwise, a patent holder may believe that the value it can obtain from abstaining from the coalition will exceed the value it can achieve as a member. The limited experience with the Shapley value in a rate-setting proceeding for intellectual property is not encouraging. In 2007, an MIT-trained economic expert witness used the Shapley value to calculate the royalty in a proceeding before the Copyright Royalty Board to determine royalties for the distribution of recorded music over satellite digital audio radio services. The expert used the Shapley model to divide the surplus among the relevant inputs. The Board was skeptical. It concluded that "questionable assumptions coupled with concerns over the reliability of the data used in the [expert] analysis cause[d] [the Board] to regard the findings of the [expert] analysis as carrying little weight."[319]

### *3. Bargaining Theory and the Ultimatum Game*

The ultimatum game is a type of bargaining game in which a player makes a single take-it-or-leave-it offer, rather than multiple offers and counteroffers

[317] They are (1) A,B,C, (2) A,C,B, (3) B,C,A, (4), B,A,C, (5) C,A,B, and (6) C,B,A.

[318] For example, for SEP *A*, the payoffs are as follows for each of the possible sequences: (1) 0/6 + (2) 0/6 + (3) 1/6 + (4) 0/6 +(5) 0/6 +(6) 1/6 = 2/6 = 1/3.

[319] Final Determination of Rates and Terms, Determination of Rates and Terms for Preexisting Subscription Services and Satellite Digital Audio Radio Services at 49, No. 2006-1 CRB DSTRA (U.S. Copyright Royalty Board Jan. 10, 2008).

that occur in a typical bargaining game.[320] In a typical bargaining game, the players divide some fixed asset or endowment.[321] By limiting the number of offers and counteroffers in a game, the strategy space for the players decreases. In an ultimatum game, negotiations will end in either an agreement of the unaltered terms of the first offer or no agreement at all.[322] If the second party rejects the offer, neither party benefits—the first party does not keep any portion of the asset but rather forfeits it all. Thus, both parties have an incentive to agree, and the division will depend on a fair offer.

In non-ultimatum negotiations, the process with unlimited possible offers and counteroffers allows the parties to ascertain information about the other's attitudes toward risk and time, informing each party's upper and lower boundaries. These boundaries delineate the most one party is willing to pay and the least the other is willing to accept. Many times these limitations are self-imposed or are functions of bargaining power. Such bargaining situations are most helpful in discovering the point that either party has decided will be an initial starting place based on one's own preference, time and risk pressures, and the possibility of not reaching an agreement at all.

In an ultimatum game, however, the offeror has less influence over the outcome of negotiations. He has one shot at making an offer that will be accepted by the other party. In many cases, the offeror must make a blind offer, uninformed as to the other party's preferences. Because the decision is uninformed, an offeror at a lesser bargaining position who is unwilling to risk the negotiation terminating without an agreement will make a risk-averse offer that he is certain the offeree will accept.

Consider, for example, an amount of money that is divided between two players. Player 1 chooses an amount to offer the second party and an amount to keep. Player 2 evaluates the offer, and decides whether to accept or reject the offer. The ultimatum game does not allow the offeror to obtain any additional information regarding the likelihood of negotiations achieving a successful outcome, and the offeror is aware in the ultimatum game that the likelihood of an agreement depends on the probability that the offer exceeds the Player 2's minimum willingness to accept. If Player 2 accepts, the parties agree to receive the predetermined offer. If Player 2 rejects, negotiations cease without the anticipated exchange. Player 1 can make an offer that is more favorable (*F*) or more unfavorable (*U*) to Player 2, and Player 2 can either accept (*A*) or reject (*R*) the offer.

Finding the Nash equilibrium of a two-player ultimatum game is straightforward. A Nash equilibrium describes a set of actions such that each player in

[320] *See, e.g.*, Richard H. Thaler, *Anomalies: The Ultimatum Game*, 2 J. ECON. PERSP. 195 (1988); Ariel Rubinstein, *Perfect Equilibrium in a Bargaining Model*, 50 ECONOMETRICA 97 (1982).

[321] *See, e.g.*, Rubinstein, *supra* note 320, at 100.

[322] Paul Pecorino & Mark Van Boening, *Fairness in an Embedded Ultimatum Game*, 53 J.L. & ECON. 263 (2010).

a game cannot improve his payoff by choosing another action. That is, each player is maximizing his payoff given the actions of the other players.[323] Nash equilibria are the most commonly used solution concept in game theory, and finding Nash equilibria to predict the outcome of strategic interactions is commonly used in many areas of microeconomic theory, including the analysis of imperfect competition, voting models, and bargaining, among others. (The Nash equilibrium of a bargaining game and the Nash bargaining solution are separate concepts, as Nash bargaining is a special case of more general bargaining analysis and Nash equilibrium is a general solution concept in all games.[324])

Consider the following example, represented in extensive form by Figure 11. Assume ten units of exchange, given to Player 1 by a neutral third party on a condition that Player 1 and Player 2 agree to a division of the money.[325] In this example, Player 1 can offer \$4 to Player 2 (represented in the extensive form game by strategy *F* (more favorable)) or \$1 to Player 2 (represented by strategy *U* (more unfavorable)).

There are two pure strategy Nash equilibria in this game:[326]

(1) Player 1 offers \$4 and Player 2 accepts all offers (U; A|F, A|U); and
(2) Player 1 offers \$1 and Player 2 accepts an offer of \$4 and rejects an offer of \$1 (F; A|F, R|U).[327]

However, only (U; A|F, A|U) is a subgame perfect Nash equilibrium.[328] The other Nash equilibria will require Player 2 to play some strictly dominated strategy in at least one subgame. Therefore, the strategy (U; A|F, A|U) is the expected outcome of the game, and Player 1, the offeror, will have received a more favorable result (of \$9) compared with Player 2 (who receives \$1).

[323] *See, e.g.*, TIROLE, *supra* note 164, at 206.

[324] *See* John F. Nash, Jr., *The Bargaining Problem*, 18 ECONOMETRICA 155 (1950); John Nash, *Non-Cooperative Games*, 54 ANNALS MATH. 286 (1951).

[325] BINMORE, *supra* note 1, at 68; Thaler, *supra* note 320, at 195–96.

[326] A pure strategy is a specific action for a player, compared with a mixed strategy, which represents a set of probabilities that a player will take each possible action. A pure strategy can be viewed as a special case of a mixed strategy where a player takes a specific action with probability of 1 and the remaining actions with probability 0. In a pure strategy Nash equilibrium, each player's actions are characterized as pure strategies.

[327] Strategies for Player 2 are listed as an action for Player 2 conditional on an action by Player 1. So (A|F, R|U) means that Player 2 will accept given the more favorable offer (\$4) by Player 1 and reject given the unfavorable offer (\$1) by Player 1.

[328] Subgame perfect Nash equilibria are a subset of Nash equilibria intended to eliminate "non-credible" threats. In the above example, for Player 2 to reject an offer of \$1 may be viewed as non-credible because it requires Player 2 to choose a payoff of \$0 over a payoff of \$1 after Player 1 makes an unfavorable offer. In layman's terms, an equilibrium is a subgame perfect Nash equilibrium only if no player could improve his payoff from unilaterally deviating at *any* point in the game. A strategy that requires Player 2 to play *R* after Player 1 plays *U* does not satisfy this criterion because Player 2 could increase his payoff by playing *A* after Player 1 plays *U*. *See, e.g.*, DAVID M. KREPS, A COURSE IN MICROECONOMIC THEORY 421–25 (Princeton Univ. Press 1990).

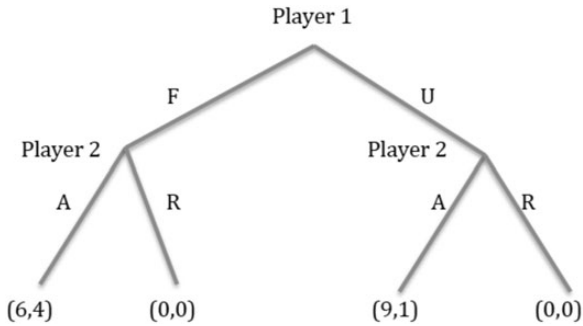


**Figure 11.** Extensive form ultimatum game

Theoretically, ultimatum games are expected to have two results: (1) Player 1 will make an offer that approaches zero and (2) Player 2 will accept any positive offer.[329] However, experiments have shown that both parties act differently from what is expected.[330] Observed outcomes do not necessarily align with the subgame perfect Nash equilibrium strategy. In fact, offering a low amount of money can be risky.[331] Even though Player 2 would be better off by accepting the unfavorable offer, experiments show several cases where Player 2 rejects an unfavorable offer.[332] In most experimental situations, Player 2 will end up with an amount that is less than but close to 50 percent of the total sum.[333] This result is similar to the second Nash equilibrium of the game in Figure 11. Conditional on Player 2 rejecting a low offer from Player 1, it is a best response for Player 1 to offer a more equitable division of the endowed amount. Likewise, conditional on Player 1 offering the more equitable division, it is a best response for Player to reject lower payments and accept the higher payment. Thus, although the experimental results do not reflect play of a subgame perfect Nash equilibrium, the outcome can still be a Nash equilibrium.

Ultimatum games are interesting in analyzing the FRAND commitment not because FRAND represents an ultimatum game, but because the results of experiments on ultimatum games shed light on which sort of bargains players would characterize as fair or reasonable. Without a FRAND commitment, the SEP holder could essentially play the role of Player 1 in an ultimatum game, making a take-it-or-leave-it offer to the implementer. Game theory suggests that this offer would be a royalty rate close to the implementer's maximum willingness to pay, such that nearly all of the surplus generated by

[329] BINMORE, *supra* note 1, at 68; Pecorino & Van Boening, *supra* note 322, at 263.
[330] Thaler, *supra* note 320, at 197.
[331] *Id.* at 196.
[332] *Id.* at 197.
[333] BINMORE, *supra* note 1, at 68.

the standard would flow to SEP holders. This scenario is commonly called "holdup" in the literature on FRAND.[334]

Conversely, using the flawed *ex ante* incremental value approach, the bargaining would produce results similar to an ultimatum game in which the implementer makes the take-it-or-leave-it offer. In that case, the offer would be close to zero, and nearly all of the surplus would flow to the implementers. Proponents of the *ex ante* incremental value approach present *ex ante* negotiations as being similar to ultimatum games and derive results where the SEP holder is offered royalties close to zero.[335] Essentially, the *ex ante* analysis assumes that competing technologies exist and that the implementer can play an ultimatum game with a patent holder, reserving virtually the entire surplus generated by the standard for implementers.[336] As a result, royalty rates under the *ex ante* approach are very low.

In contrast to the theory of ultimatum games, the surprising experimental results of ultimatum games suggest two implications for the determination of a FRAND royalty. First, even if viewed as one of the above ultimatum-game-like settings, the expected bargaining outcome is not likely to be so extreme as the ultimatum-game subgame perfect Nash equilibrium suggests, where one player captures nearly all the surplus. As a result, it is plausible that (1) parties would agree that fair and reasonable terms reserve some of the surplus generated by the standard to SEP holders and (2) that holdup by SEP holders (or reverse holdup by implementers) is less likely to occur in practice than theory would suggest.

Second, the *ex ante* incremental value approach is conceptually analogous to the situation where the SEP holder has not made a FRAND commitment. The only difference is which party is Player 1 and which party is Player 2. In both cases, the bargaining power is concentrated in a single party. In both cases, the outcome reserves nearly the entire surplus for only one of the bargaining parties. If it is not fair and reasonable to set royalties based on an ultimatum game where the SEP holder makes the take-it-or-leave-it offer, then it is also not fair and reasonable to set royalties based on an ultimatum game where the implementer makes the take-it-or-leave-it offer.

In experiments of ultimatum games, the outcomes do not correspond to the lopsided outcomes that the theory of the ultimatum game predicts. Evidently, the theory of ultimatum games needs to catch up to the experimental results. Because the parties to a FRAND contract will have beliefs at the time of

[334] *See, e.g.*, Lemley & Shapiro, *supra* note 158.

[335] *See, e.g.*, HAL R. VARIAN, JOSEPH FARRELL & CARL SHAPIRO, THE ECONOMICS OF INFORMATION TECHNOLOGY: AN INTRODUCTION 81 (Cambridge Univ. Press 2005) ("If the participants in the standard-setting organization are aware of the relevant patent(s) early on, they can pick an alternative specification that does not infringe on the patent or they can negotiate acceptable license terms with the patent holder(s), perhaps even a royalty-free license.").

[336] *Id.*

contracting about what range of royalties would be fair and reasonable, it is reasonable to expect that those beliefs also do not correspond to the extreme values suggested by the patent-holdup theory and the *ex ante* incremental value methodology.

### *4. Patent Counting—and Its Greater Possible Justification in the Context of Cross Licensing of Patent Portfolios*

The "patent-counting" method for determining FRAND royalties prices SEPs by dividing the aggregate royalty stack for a standard by the number of patents that have been declared essential to that standard. The underlying assumption for this method is that all SEPs have equal value. The assumption is problematic. First, not all declared-essential patents are essential in fact. As I explained in Part III.C, patent holders may have an incentive to overdeclare their patents as standard-essential, especially if patent holders come to expect that patent counting will determine the magnitude of their FRAND royalties. Second, patents cover technologies and inventions, which are differentiated goods, and the royalty for a patent reflects the particular value of the technology it covers.[337] Otherwise, there would be no need to negotiate the royalties paid on different patents and portfolios—there would be a single price for every patent or every broad category of patents.

The economics literature recognizes that patent counting is neither a realistic nor an accurate method for determining the value of an individual patent in a standard due to the underlying assumption that all SEPs have equal value.[338] The courts recognize this problem. Judge Holderman held in *Innovatio* that "it is not appropriate to determine the value of the non-asserted standard-essential patents based merely on numbers. If a patent holder owns ten out of a hundred patents essential to a given standard, it does not automatically mean that it contributes 10% of the value of the standard."[339] Instead of engaging in strict patent counting, some scholars recommend that patent pool members implement *value*-proportional rules, such that the members of the pool negotiate royalties based on the quality or strength of each member's contributed technology.[340] Such an arrangement is predicated on the proposition

[337] *See, e.g.*, Layne-Farrar, Padilla & Schmalensee, *supra* note 161, at 675.

[338] *See, e.g.*, *id.* at 682–85; F.M. Scherer & Dietmar Harhoff, *Technology Policy for a World of Skew-Distribution Outcomes*, 29 RES. POL'Y 559 (2000); Mark Schankerman & Ariel Pakes, *Estimates of the Value of Patent Rights in European Countries During the Post-1950 Period*, 96 ECON. J. 1052 (1986) (finding that the distribution of the value of patents in the United Kingdom, France, and Germany is sharply skewed); Teece, Grindley & Sherry, *supra* note 138, at 19 ("there is no reason to believe that the value of different patents (or portfolios of patents) is proportional to the number of patents in the portfolio, even for 'essential' patents.").

[339] RAND Opinion in *Innovatio*, *supra* note 4, at 18–19.

[340] *See, e.g.*, Claudia Tapia Garcia, *Realities of Patent Pools in the Telecommunication Sector*, *in* PROCEEDINGS OF THE 7TH STANDARDIZATION & INNOVATION IN INFORMATION TECHNOLOGY CONFERENCE (STIIT 2011) 233 (Knut Blind & Kai Jacobs eds., Mainz 2011).

that not all patents have equal value. For these reasons, any expert economic testimony on FRAND royalties that rested on patent counting would face a significant risk in the United States of being ruled inadmissible at the *Daubert* stage of federal district court litigation.[341]

Patent counting can be particularly misleading because a firm can inflate its number of SEPs to exaggerate the true strength of its patent portfolio. For example, the firm can file for patents over the same technology in many different countries, fragment a patent over the same technology into many continuation patents, or overdeclare more patents to be standard-essential. Furthermore, the number of issued patents is a trailing indicator of a patent portfolio's strength, whereas the number or share of approved contributions is a leading indicator. It can take years for a patent application to be granted. Thus, by including patent applications in the patent-counting exercise, one will exaggerate the portfolio's patent strength. In contrast, it generally takes a few months for a contribution to be approved and voted into the standard by SSO members. Most approved contributions correspond to inventions for which patents will eventually be granted. Consequently, a firm's number of approved contributions is an intellectually sound proxy for the strength of that firm's patent portfolio. Because approved contributions are peer-reviewed by the SSO's own members, those approvals are less susceptible to gaming by SSO members than is the process of unilaterally declaring one's patents to be essential to the standard. Obviously, a legal rule that relied on simple patent counting to infer the strength of a firm's portfolio of SEPs for purposes of determining a FRAND royalty would create a powerful incentive for SSO members to inflate their declarations of SEPs.

One approach to determining a FRAND royalty would be to treat patent counting, or the assumption that all declared-essential patents are equally valuable, as the presumption, which a party could overcome with evidence showing an unequal distribution of values among SEPs. However, no empirical evidence indicates that it is more probable than not that all SEPs in a standard are of equal valuable. Therefore, the patent-counting method could be misleading and bias the FRAND royalty determination. Without adequate empirical evidence to support or refute the use of patent counting to determine the FRAND royalties for the patent in suit, a court's wiser course would be to refrain from using patent counting whenever a more rigorous method is available.

To an economist, the notion that all SEPs are (by remarkable coincidence) equally valuable is hard to defend. In practice, patent holders and implementers do not license individual SEPs. The cost of setting a price for each SEP would be prohibitive. If the licensing of SEPs were like the recurring

[341] Daubert v. Merrill Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993). For a discussion of how economic analysis can inform a judge's determination of the admissibility of expert testimony on patent royalties, see J. Gregory Sidak, *Court-Appointed Neutral Economic Experts*, 9 J. COMPETITION L. & ECON. 359 (2013).

transactions of selling "boxes" of rough diamonds among wholesale diamond merchants, it would be easier to accept that, over many transactions over time, the exceedingly good values would offset the exceedingly bad values, such that an individual measurement of value would not be efficient to undertake for each individual transaction. Roy Kenney and Benjamin Klein studied the wholesale diamond-trading mechanism used by De Beers and found that diamond sellers and buyers do not bother determining a price for every rough diamond (unless it is large enough to warrant doing so). One simple solution to reduce the transaction costs of measuring the value of every diamond is to set an average price for "a group of goods of individually uncertain and difficult-to-measure quality."[342] However, in a box of diamonds, some diamonds will be of lower quality, and, without perfect information on the exact value of every diamond in the box, the seller will set an average price that overvalues the lower-quality diamonds and undervalues the higher-quality diamonds.[343] Consequently, the buyer has an incentive to search for and reject the lower-quality diamonds, as well as select the higher-quality diamonds. If the seller expects that the buyer will identify and exclude lower-quality diamonds, then the seller will also invest in searching for lower-quality diamonds itself and sorting the diamonds into more finite classifications.[344] The lower-quality diamonds that would be left over would need to be grouped and given a lower average price, but then the same round of search for and selection of lower-quality diamonds would continue with each new batch.[345] Even though the sellers would not intend to do so, they would essentially end up trying to set a price for each diamond. Such duplicative search would waste resources.

To avoid oversearching, a mechanism is necessary to induce buyers to pay for the over-valued diamonds. According to Kenney and Klein, De Beers achieved this outcome by assigning each "sight" of diamonds to a preselected buyer, and "by pricing in such a way that buyers on average are earning rents the present discounted value of which is greater in almost all cases than the short-run profit that can be achieved by rejecting the sights of lower than average quality" diamonds.[346] If the buyer rejects a sight, the buyer loses those rents and is "terminated from the list of invited buyers."[347] Under this mechanism, the *seller* "'pays a premium to its *buyers* by selling diamonds at less than (costless-search) market-clearing prices."[348] That premium from seller to buyer "encourage[s] the buyer to take low-quality goods occasionally."[349]

[342] Roy W. Kenney & Benjamin Klein, *The Economics of Block Booking*, 26 J.L. & ECON. 497, 500 (1983).
[343] *Id.* at 503.
[344] *Id.* at 505.
[345] *Id.*
[346] *Id.* at 506.
[347] *Id.*
[348] *Id.* (emphasis added).
[349] *Id.*

Furthermore, for the seller, the premium, or lower price, is "offset by savings in marketing costs, that is, the avoidance of oversearching."[350] The repeat-play game results in implicit settling up through offsetting errors.

Similarly, by cross licensing SEPs in portfolios, patent holders can avoid the transactions cost of evaluating each of their patents, and they can offset the cost of errors through repeated transactions. When patent holders expect repeat transactions, they need not invest in searching for the exact value of each of their SEPs, because the errors will be evenly distributed between the parties over the repeated transactions. Overpayments cancel out underpayments, and the cost of determining the true value of every SEP—in terms of the monetary cost and the cost of delayed transactions—should outweigh any remaining cost of errors. Patent holders, of course, are not likely to cross-license patent portfolios as frequently as diamond traders exchange boxes of diamonds, but the interactions of SEP holders and implementers are nonetheless recurring and bilateral. Just as it is the efficiency norm for diamond trading to sell sights of diamonds of varying quality, it is no surprise that cross licensing of an entire patent portfolio (or an entire subset of patents regarding a particular standard) is the efficiency norm for patent holders. The hypothetical negotiation over the royalty for an individual SEP is largely a legal fiction. For the purpose of determining reasonable-royalty damages for an infringed SEP, using the one-way FRAND royalty for the portfolio containing the infringed SEP would be a reasonable starting point.

### *5. Patent Pools*

In a patent pool, member patent holders share their patents with the pool, and a single license covers all patents in the pool. Thus, a licensee obtains the right to implement the patents available in the pool without conducting bilateral negotiations with each pool member. The pool collects the royalty revenues and distributes them among its members according to a predetermined formula. Do patent pools offer any guidance on how one would develop a distribution of the value of SEPs in a standard? Do they indicate how one could rigorously divide the aggregate royalties associated with a standard among SEP holders?

One-Blue is a patent pool consisting of patents "essential to any of the optical standards used for Blu-ray Disc products."[351] Those standards include Blu-ray standards, DVD standards, and CD standards.[352] In distributing royalties among its members, One-Blue distinguishes (1) between parent patents and continuation patents, as well as (2) between physical format inventions

[350] *Id.*

[351] Ruud Peters, *One-Blue: A Blueprint for Patent Pools in High Tech*, 2011 INTELLECTUAL ASSET MGMT. 38, 38 (2011).

[352] *See Patent Coverage*, ONE-BLUE, http://www.one-blue.com/patent-coverage/.

and application format inventions.[353] Parent patents receive higher royalties than continuation patents; likewise, physical format patents receive higher royalties than application format patents, based on the premise that "more costly research is needed for a physical format invention—the real hardcore technology."[354] The royalty for a Blu-ray Disc player is $9 per unit, whereas the royalties for Blu-ray Disc software range from $1.25 to $3.[355] One-Blue's categorization of its patents provides an example of a simple method for differentiating royalties based on the value of categories of SEPs.

Unlike One-Blue, most patent pools establish participants' royalties using the patent-counting method.[356] Consequently, as Anne Layne-Farrar and Josh Lerner observe, "firms with higher value patent portfolios are less likely to join a numeric proportional pool," wherein the royalty revenues that the pool collects are divided among the members based on their relative share of patents.[357] Similarly, Judge Holderman noted in *Innovatio* that "patent holders with valuable patents will not contribute their technology to the pool" but "will instead attempt to license their patents bilaterally, where they often can obtain higher rates."[358]

The use of equal or proportional sharing may explain why there currently are few working patent pools for wireless communications standards, where the distribution of the value of SEPs is likely skewed.[359] Judge Holderman noted that this relative lack of success of pools suggests that the offered compensation is "too low to give patent holders a reasonable return on their technology."[360] The largest contributors to the standard—in terms of the value of their SEPs rather than the number of their declared essential patents—are unlikely to join a pool, so the only patent holders willing to join the pool would have less valuable SEPs, making the pool less attractive to implementers of the standard. According to ABI Research,[361] as of October 2013 only one of the top ten contributors to the LTE standard, ZTE, was part of the Via LTE

[353] Peters, *supra* note 351, at 41.

[354] *Id.*

[355] *Royalty Rates*, ONE-BLUE (July 1, 2011), http://www.one-blue.com/royalty-rates/.

[356] Microsoft Corp. v. Motorola Inc., No. C10-1823JLR, 2013 WL 2111217, at *74 (W.D. Wash. Apr. 25, 2013) (Robart, J.); Josh Lerner & Jean Tirole, *Public Policy Toward Patent Pools*, *in* 8 INNOVATION POLICY AND THE ECONOMY 157, 171 (Univ. of Chicago Press 2008).

[357] Anne Layne-Farrar & Josh Lerner, *To Join or Not To Join: Examining Patent Pool Participation and Rent Sharing Rules*, 29 INT'L J. INDUS. ORG. 294, 296 (2011). *See also Microsoft v. Motorola*, 2013 WL 2111217 at *80 ("Another problem with using patent pools as the *de facto* RAND royalty rate is that the patent-counting royalty allocation structure of pools does not consider the importance of a particular SEP to the standard or to the implementer's products[.]"). *See also* Anne Layne-Farrar & Gerard Llobet, *Payments and Participation: The Incentives to Join Cooperative Standard Setting Efforts*, presented at the Research Roundtable on Innovation and Technology Standards (2013); Llanes & Poblete, *supra* note 183, at 12.

[358] RAND Opinion in *Innovatio*, *supra* note 4, at 70.

[359] *See, e.g.*, Goodman & Myers, *supra* note 86.

[360] RAND Opinion in *Innovatio*, *supra* note 4, at 70.

[361] Solis & Cooney, *supra* note 233, at 12.

patent pool,[362] and only one entity, the China Academy of Telecommunication Technology, was part of the Sisvel LTE patent pool.[363] Layne-Farrar and Lerner examined nine patent pools in high-technology sectors, one of which was a pool for the WCDMA standard. Among the nine pools, the WCDMA pool had the lowest firm participation rate (at 29 percent) and the lowest rate of patents covered by the pool (at 10 percent).[364] The pool lasted only three years.[365]

Generally speaking, patent pools are not useful benchmarks for determining FRAND royalties because pools often use patent counting. Patent pools are ill-suited to measuring the distribution of the value of SEPs in a standard or dividing aggregate royalties in a way that would encourage participation by patent holders with the largest contributions to a standard. Further empirical research is needed on patent pools, such as One-Blue, that distinguish between patents based on their technical merit and distribute royalties based on the patent holder's relative contributions to the standard.

## VII. CONCLUSION

In articulating a framework for determining FRAND royalties for standard-essential patents, it is important that courts adopt an approach that favors neither net infringers nor net licensors. Unfortunately, Judge Robart's RAND ruling in *Microsoft v. Motorola*, if widely accepted by courts, would shift the risk associated with investing in standard-setting largely to patent holders. It is not clear that Judge Robart accounted in his incremental value approach for the infringer's cost of lawfully acquiring the next-best alternative—a factor crucial for ensuring the correct identification of the next-best alternative and thus the correct calculation of the incremental value of the patent in suit. Setting the hypothetical negotiation between the SEP holder and the infringer at the time of standard adoption fails to compensate the inventor for its contribution to the standard. The FRAND royalty should not be set according to Judge Robart's understanding of the *ex ante* incremental value of the SEP. Judge Holderman's opinion in *Innovatio* corrects some of these problems in Judge Robart's approach and thus significantly advances the nascent jurisprudence on FRAND toward a more neutral footing.

My framework has endeavored to show the compatibilities and incompatibilities among the many differing views on how to measure FRAND royalties. The combinatorial value of SEPs shows that the value associated with SEPs in a standard is shared among all the SEPs. Thus, the starting point for setting a FRAND royalty is the task of dividing the surplus that SEP holders collectively earn on the downstream product generated by the standard. The next question

[362] *Licensors*, VIA LICENSING, http://www.vialicensing.com/licensecontent.aspx?id=1514.
[363] *LTE Patent Owners*, SISVEL, http://www.sisvel.com/index.php/lte/patent-owners.
[364] Layne-Farrar & Lerner, *supra* note 357, at 299.
[365] *Id.*

is what share of the aggregate royalties to that standard a given patent holder should receive. The facts of the case, particularly the relative contribution of the patent holder's SEPs to the standard, dictate the answer to that question. Ultimately, FRAND royalties should be set to maximize the joint surplus resulting from the creation of the standard and the commercial exploitation of the combined contribution of all SEPs. Maximizing that surplus requires that patent holders and implementers alike are properly dissuaded from acting opportunistically. Instead, the legal and economic principles underlying the determination of FRAND royalties should induce SEP holders and implementers to choose an equilibrium of mutual forbearance from opportunism. Implementers should be able profitably to manufacture downstream products that read on standard-essential patents. And SEP holders should receive royalties sufficient to ensure their continued participation in setting open standards. A FRAND royalty that satisfies the individual-rationality constraint for both the patent holder and the implementer will encourage participation in the standard and discourage opportunistic behavior.

The second part of this article, to be published separately, will analyze the extent to which the FRAND commitment limits, under various sources of law, a patent holder's right to seek an injunction against the infringer of a standard-essential patent. That analysis will also address the anterior question of what constitutes good-faith negotiation to set a FRAND royalty before the SEP holder may seek an injunction.