THE PROPER ROYALTY BASE FOR PATENT DAMAGES

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ABSTRACT

How should a court determine the proper royalty base when calculating either reasonable-royalty damages for patent infringement or fair, reasonable, and non-discriminatory (FRAND) royalties for infringement of, or licensing disputes over, standard-essential patents (SEPs)? This determination is particularly challenging in the context of a multi-component device, such as a smartphone. It is established patent jurisprudence that a reasonable royalty should reflect the terms of a hypothetical license resulting from a voluntary negotiation between a willing licensor and a willing licensee at the moment just before first infringement. In real-world patent negotiations, firms often calculate royalties with reference to the retail price of the downstream product. Therefore, using that downstream retail price as the royalty base is the most authentic assumption about the royalty base that a court could use for a hypothetical negotiation between a willing licensor and a willing licensee. Nonetheless, as a result of a recent series of confusing and contradictory opinions, the Federal Circuit in all but exceptional cases now decidedly favors using, for purposes of the hypothetical negotiation, a royalty base equivalent to the price of the infringing product's "smallest salable patent-practicing component" instead of the "entire market value" of the product. In cases where the downstream product is the "smallest salable patent-practicing component" and unpatented features constitute a substantial proportion of the product, the Federal Circuit favors subtracting the value of these unpatented elements from the royalty base. This development in the law of the entire market value rule (EMVR) has perverse consequences that the Federal Circuit has yet to recognize. Using the price of the smallest salable patent-practicing component as the royalty base risks undercompensating the patent holder, because it ignores (1) the effects that the patented technology has on the value of the downstream product and (2) the value that synergies between complementary technologies create. A more complete economic approach would account for such complementarity effects by permitting the use of the retail price of the downstream product as the royalty base. The Federal Circuit's choice of royalty base in its EMVR jurisprudence seems based on a theory that juries tend to overcompensate patent holders due to cognitive bias. However, the Federal Circuit fails to explain

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the logic and limits of its concern over cognitive bias. It therefore fails to justify its preference for the smallest salable patent-practicing component and risks under-compensating patent holders. Finally, I show that risk-averse firms should prefer structuring damages awards in a manner that reduces errors. This analysis of risk bearing indicates that, if a royalty with a low rate and high base is more accurate than one with a high rate and low base, courts should use the EMVR when awarding damages. The Federal Circuit's jurisprudence on patent damages currently ignores this concern.

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

I. INTRODUCTION

How should a court determine the proper royalty when calculating either reasonable-royalty damages for patent infringement or fair, reasonable, and nondiscriminatory (FRAND) royalties for infringement of, or licensing disputes over, standard-essential patents (SEPs)? This determination is particularly challenging in the context of disputes involving a multi-component device such as a smartphone, where the interaction of the patented technology with other components of the downstream product generates complementarity of demand and network effects that increase the downstream product's value. Royalty compensation for patent infringement must reward the patent holder not only for the individual value of its patented technology, but also for a share of the value arising from complementarity and network effects. Only patent damages that meet this requirement are likely to maintain optimal incentives for investment in innovation.

In Part II of this article, I explain the economic justifications that support the use of the retail price of the downstream product as a royalty base when calculating damages for the infringement of patents implemented in a multi-component device. It is established patent jurisprudence that a reasonable royalty should reflect the terms of a hypothetical license resulting from a voluntary negotiation between a willing licensor and a willing licensee at the moment just before first infringement. In real-world patent licensing negotiations, firms often calculate royalties with reference to the retail price of the downstream product. Therefore, using that downstream retail price as the royalty base is the most authentic assumption about the royalty base that a court could use for a hypothetical negotiation between a willing licensor and a willing licensee. This norm may exist because, as an economic matter, a patented technology implemented in a multi-component device may create value through powerful network effects and complementarity of demand with other patented technology.

However, in Part III, I show that as a result of a recent series of confusing and contradictory opinions, the Federal Circuit in all but exceptional cases now decidedly favors using, for purposes of the hypothetical negotiation, a royalty base equivalent to the price of the infringing product's "smallest salable patent-practicing component" instead of the "entire market value" of the

product. In cases where the downstream product is the "smallest salable patent-practicing component" and unpatented features constitute a substantial proportion of the product, the Federal Circuit favors subtracting the value of these unpatented elements from the royalty base. This development in the law of the entire market value rule (EMVR) has perverse consequences that the Federal Circuit has yet to recognize. Using the price of the smallest salable patent-practicing component as the royalty base risks undercompensating the patent holder, because it ignores (1) the effects that the patented technology has on the value of the downstream product and (2) the value that synergies between complementary technologies create. The Federal Circuit's approach creates a conflict between the royalty base that is normally used by the patent holder and the licensee in actual licensing agreements and the hypothetical negotiation used for damage calculations. If parties in the real world do not use the price of the smallest salable patent-practicing component as their royalty base when negotiating a license, then the Federal Circuit contradicts reality when it uses that price as its royalty base in the hypothetical negotiation. Because it contradicts the real world, the Federal Circuit's practice transforms the hypothetical negotiation from something that might have occurred into something that never would have occurred.

The Federal Circuit's strong preference for using the price of the smallest salable patent-practicing component as the hypothetical royalty base is illogical as a matter of legal reasoning and unmindful of the pertinent economic analysis of the consequences of such a rule. So why does the Federal Circuit so fervently embrace this reasoning? It is not a satisfactory explanation that using the value of the downstream product as the hypothetical royalty base would mean that the royalty would exceed the value of the patented invention, for a court can address that concern simply by reducing the size of the royalty rate. Instead, the Federal Circuit expresses concern that the jury will behave in a way that manifests what economists call "cognitive bias" and award excessive reasonable-royalty damages when presented with a damages estimate predicated on a small royalty rate multiplied by a large royalty base. At the same time, the Federal Circuit has not analyzed the severity of juries' alleged cognitive bias, and it fails to explain the logic and limits of its concern. As a result, a patent holder can have no confidence that the Federal Circuit's jurisprudence on the EMVR will produce royalty awards large enough to satisfy the Supreme Court's principle that damages for patent infringement "should be consistent with Congress' overriding purpose of affording patent owners *complete* compensation."[1]

In Part IV, I explain that both the Federal Circuit and the existing literature in law and economics neglect the implications of the patent holder's risk aversion

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[1] Gen. Motors Corp. v. Devex Corp., 461 U.S. 648, 655 (1983) (emphasis added). Judge Frank H. Easterbrook has observed that patent damages must "give the patent holder the economic benefits it would have enjoyed had its intellectual property been respected." Grain Processing Corp. v. Am. Maize-Prods. Co., 979 F. Supp. 1233, 1235–36 (N.D. Ind. 1997).

in selecting the royalty base in patent litigation. A court's choice between (1) a low royalty rate with a large royalty base and (2) a high royalty rate with a small royalty base entails differing levels of risk and uncertainty for the patent holder. A mean-preserving spread of the probability distribution of royalty outcomes reduces utility to a risk-averse patent holder by imposing greater risk bearing. The Federal Circuit's preference for the use of the smallest salable patent-practicing component as the royalty base induces a mean-preserving spread and thus imposes a cost—in the form of enhanced risk bearing—on any risk-averse patent holder that the court fails to recognize. This neglected cost of risk bearing is an additional economic consideration that favors the use of a larger royalty base—such as the retail price of the downstream product incorporating the patent-practicing component. If the Federal Circuit recognized this cost of risk bearing, it would more easily understand why the choice of a larger royalty base in a hypothetical voluntary license negotiation would more closely approximate real-world voluntary license negotiations.

II. THE PROPER ROYALTY BASE FOR THE HYPOTHETICAL NEGOTIATION

When calculating patent damages to approximate a reasonable royalty, courts aim to reproduce the outcome of a hypothetical negotiation between the patent holder and the infringer. Given that framework, what is the proper royalty base for calculating damages for patents implemented in multi-component products?

A. The Methodology of the Hypothetical Negotiation

A patent authorizes an inventor to exclude others from using its invention for a limited time. Patent law is based on the premise that a company must have an incentive to invest in risky research and development (R&D). A patent rewards a company with the right to control the use of its invention until the patent's expiration. This right enables the inventor to monetize the invention and to invest further in risky R&D, which promotes technological progress and innovation.[2]

   Section 284 of the Patent Act says that patent damages shall be of an amount "adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer . . . ."[3] Patent law does not treat SEPs differently from other types of patents in this respect. Royalties for the infringement of SEPs aim to compensate the patent holder for its innovative contribution. At the same time, FRAND royalties also must compensate the SEP holder sufficiently for its

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[2] *See, e.g.*, WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 294 (Harvard Univ. Press 2003).

[3] 35 U.S.C. § 284.

contribution to the standard that the SEP holder has the incentive to continue participating in standard setting.[4]

A court's calculation of reasonable-royalty damages typically entails estimating the royalty upon which the willing patent holder and the willing infringer would have agreed in a hypothetical negotiation at the moment just before first infringement.[5] The analysis yields an amount as close as possible to the royalty that the parties would have actually negotiated.[6]

In the hypothetical negotiation, the parties' negotiating positions would determine a range within which they would agree upon a mutually acceptable royalty. The lower bound of the bargaining range is the minimum royalty that the patent holder would accept (while still being better off than if it had not issued a license). This value depends on the opportunity cost of licensing the patent to the would-be licensee at the time of the hypothetical negotiation.[7] The upper bound of the bargaining range is the maximum royalty that the licensee would be willing to pay (while still being better off than if it had not purchased the license). The licensee 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.[8] Because a successful voluntary transaction necessarily makes both parties better off,[9] a negotiated royalty must lie between these upper and lower bounds. As a result, courts will generally determine the upper and the lower bound of the licensing range, and then determine a point estimate of the royalty to derive the exact damage amount.

B. Does the Royalty Base Capture Complementarity Effects and Network Effects?

Real-world licensing agreements typically use the retail value of the downstream product as a royalty base when determining the royalty for a patent covering technology implemented in a multi-component product. Such a royalty

[4] J. Gregory Sidak, *The Meaning of FRAND I: Royalties*, 9 J. COMPETITION L. & ECON. 931, 933 (2013).

[5] Minks v. Polaris Indus., Inc., 546 F.3d 1364, 1372 (Fed. Cir. 2008) (citing Hanson v. Alpine Valley Ski Area, Inc., 718 F.2d 1075, 1078 (Fed. Cir. 1983)); Mahurkar v. C.R. Bard, Inc., 79 F.3d 1572, 1579 (Fed. Cir. 1996); Rite-Hite Corp. v. Kelley Co., Inc., 56 F.3d 1538, 1554 (Fed. Cir. 1995).

[6] *See, e.g.*, Wordtech Sys., Inc. v. Integrated Networks Solutions, Inc., 609 F.3d 1308, 1319 (Fed. Cir. 2010) (citing Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1325 (Fed. Cir. 2009)); *Rite–Hite*, 56 F.3d at 1554; *see also* Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 4, at 934; Roy J. Epstein & Paul Malherbe, *Reasonable Royalty Patent Infringement Damages After UNILOC*, 39 AIPLA Q.J. 3, 27 (2011); Roy J. Epstein & Alan J. Marcus, *Economic Analysis of the Reasonable Royalty: Simplification and Extension of the Georgia-Pacific Factors*, 85 J. PAT. & TRADEMARK OFF. SOC'Y 555, 557 (2003).

[7] *See* Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 4, at 938.

[8] *Id.* at 935.

[9] *See, e.g.*, ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 584 (Pearson 6th ed. 2005).

base enables the licensing parties to capture the complementarity effects and network effects resulting from the interactions of the patented technology with other patented and non-patented components of the downstream product. Therefore, the use of the retail value of the downstream product as a royalty base enables the patent holder to obtain an adequate compensation for the contribution that its technology made to the value of the downstream product.

1. Complementarity Effects and Network Effects

Michael Katz and Carl Shapiro have defined technological "systems" as "collections of two or more components together with an interface that allows the components to work together."[10] Such components "are strongly complementary, although they need not be consumed in fixed proportions."[11] The combinatorial interaction among patented technologies creates value that transcends a simple component or sum of components, especially in the context of SEPs. For example, the smartphone user's experience is a function of numerous complementary components, including, among other features, the processing power of the smartphone, its design, its screen, the availability of a stable and fast network connection, and the mobile applications developed for the specific operating system.

The complementarity effect among individual technologies increases the value of other features of the downstream product. Each implemented patented component has value by itself, but the *interaction* among the multiple patented technologies adds additional value to the entire downstream product. For example, upgrading the baseband chip in a mobile phone from 3G to LTE will enhance the user's ability to use data-intensive apps. The complementarity effects of a patented technology may enhance existing network effects—the benefit to society that accrues as the size of the network grows.[12] A smartphone user might share pictures with other users and, in turn, receive messages or pictures from the recipients. In this way, the complementarity effects from bringing components together to create additional uses might enhance the network effects already present among users of smartphones.

The market price of an individual patented component (such as a camera lens contained within a mobile device) may not account for the value of the complementarity effects and the network effects that the component generates. By using the market price of an individual patented component as a reference, the manufacturer of that component does not internalize the benefits that its technology creates when used in conjunction with the other components of the downstream product. The failure to award damages that included the

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[10] Michael L. Katz & Carl Shapiro, *Systems Competition and Network Effects*, 8 J. ECON. PERSP. 93, 93 (1994).

[11] *Id.*

[12] *See, e.g.*, J. GREGORY SIDAK & DANIEL F. SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT: THE COMPETITIVE TRANSFORMATION OF NETWORK INDUSTRIES IN THE UNITED STATES 547 (Cambridge Univ. Press 1998).

value of complementarity effects and network effects would frustrate "Congress' overriding purpose of affording patent owners *complete* compensation" for infringement.[13] In the long run, this failure of complete compensation would reduce the supply of the patented components for downstream products, all other factors remaining constant.

2. *Measuring the Value of Complementarity Effects and Network Effects*

Two different approaches might quantify the value-added from complementarity among components within a downstream product. One approach would be to estimate the value that the patented component contributes to all other components with which it interacts. However, this computational exercise would be cumbersome, prone to disputes, and unlikely to inspire confidence in the accuracy of its results. For example, scholars have examined the Shapley value approach (which resembles this first approach) as a benchmark for determining a FRAND royalty. The Shapley value approach divides rents (or costs) among participants of any cooperative group according to their average marginal (or average incremental) contribution to alternative combinations (or alternative sequences of production) of the cooperative group's members.[14] However, that method still fails to capture satisfactorily the complexities of the real world. As I have previously explained, it cannot reliably measure FRAND royalties.[15]

A second approach is to use the entire market value of the downstream product as the royalty base. Using the retail price of the downstream product as the royalty base enables the patent holder to capture the complementarity and network effects generated by its technology. When complementarity effects are strong, the full social value of a patent implemented in a complex product is captured in the end user's demand for the downstream product. In the case of a patented technology implemented in a smartphone, the demand for the handset approximates the value generated by the sum of all individual patented technologies *when used in combination with one another*. That combined value is greater than the sum of the parts, and it is at least as great as the amount that consumers willingly pay for the downstream product. Consequently, the retail price of the downstream product is an appropriate royalty base.

C. What Royalty Base Do Licensors and Licensees Voluntarily Choose in Actual License Negotiations?

On economic grounds, the use of the value of the downstream product as a royalty base is generally warranted when strong complementarity effects exist

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[13] Gen. Motors Corp. v. Devex Corp., 461 U.S. 648, 655 (1983) (emphasis added).

[14] *See* 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).

[15] *See* Sidak, *The Meaning of FRAND, Part I: Royalties, supra* note 4, at 1040–44.

between the component featuring the patented technology and the downstream product's other components. This consideration is particularly relevant for SEPs, for which the complementarity effects and network effects arising from the interaction of the technologies implemented in the standard typically are significant.

The real-world licensing agreements between patent holders and licensees comport with these insights of economic theory. Voluntary licenses negotiated for patented technologies implemented in multi-component products typically use the entire market value of the downstream product as the royalty base.[16] For example, Nokia, a former smartphone manufacturer, stated in 2013 that "royalty rates for [standard essential] patents are typically based on, and applied against, the price of the end product."[17] ZTE revealed a similar understanding in 2008 when it declared that it would "license its LTE essential patents for mobile communication terminals with a maximum 1% from the sales price of an end-user device."[18] Nortel also said in 2008 that it "license[d] its LTE standard essential patent claims for LTE handsets at a royalty rate of about 1 percent on the [handset's] sale price . . . ."[19] Similarly, the Federal Circuit observed in 2013 that one expert witness in *LaserDynamics, Inc. v. Quanta Computer, Inc.*, who had worked in patent licensing at IBM, testified that IBM's practice was to use the entire value of the downstream product as the royalty base for a patented component.[20]

In sum, leading technology companies in the United States, Europe, and Asia that license patents implemented in multi-component products routinely use the retail price of the downstream product as the royalty base for calculating royalties on a patented component. This industry norm characterizes actual negotiations that have successfully produced patent licenses between willing licensors and willing licensees. Therefore, in litigation involving infringement of a component for a multi-component product, a court, if it seeks to approximate faithfully the practices and outcomes of real-world transactions when conducting its analysis of a hypothetical license negotiation between the parties to the

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[16] RESEARCH IN MOTION, RESPONSE CONCERNING CALL FOR EVIDENCE BY THE INDEPENDENT REVIEW OF INTELLECTUAL PROPERTY AND GROWTH 6 (2011).

[17] *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 (Fed. Cir. May 6, 2013).

[18] Press Release, ZTE, The Licensing Policy on LTE Essential Patents of ZTE (Dec. 22, 2008), http://wwwen.zte.com.cn/en/press_center/news/200810/t20081008_350799.html.

[19] *Nortel Strengthens the Case for Deployment of LTE by Publishing Competitive Patent Royalty Rates*, BLOOMBERG (May 5, 2008), http://www.bloomberg.com/apps/news?pid=newsarchive&sid= aWGOAy0V7QO4.

[20] LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 69–70 (Fed. Cir. 2012) ("LaserDynamics further points to Mr. [Emmett] Murtha's testimony that, in his prior experience working in patent licensing at IBM, IBM would often base royalties on entire products to address such accounting difficulties. Thus, LaserDynamics concludes that the parties would have had to use the value of the entire laptop computer as the royalty base in structuring a hypothetical license agreement.").

litigation, should use the retail price of the downstream product as the royalty base. If a court refuses to do so, or if it conditions the use of that royalty base on the patent holder's meeting impossible evidentiary requirements, then the court would defy an industry norm in its analysis of a hypothetical negotiation.

That norm most plausibly has evolved and persisted not by happenstance, but because it embodies more efficient aspects of contracting than any other alternative that informed parties have considered. This view regards an industry norm as an evolutionary institution, one that reflects and summarizes information that has been revealed over time regarding the optimal ordering of relationships among economic actors. The legitimacy of an industry norm arises from objective knowledge indicating that the norm is superior to all other currently known means of ordering that specific kind of economic relationship or transaction. Economists associate this view of the organization of industry with the works of Armen Alchian[21] and Nobel laureates Ronald Coase,[22] Douglass North,[23] George Stigler,[24] and, most significantly, Friedrich Hayek.[25]

Suppose that two persons view an organizational chart showing all of the jobs and lines of reporting in a factory. The first person sees a consciously devised network of authority. The second person sees the same chart as the summation of a vast quantity of knowledge. To the second observer, the hierarchy within the factory reveals and summarizes the knowledge gleaned from years of experience, in which alternative and less productive hierarchies have been tried and rejected or, if not rejected, have caused the companies that have continued to adhere to them to wither. Thus, to the second person, the legitimacy of the management chart as a means of organizing production does not lie in the fact that the chief executive officer or the board of directors has the authority to draw and redraw the chart however it likes, but rather in the objective inferiority of all predecessors to this particular ordering of management responsibilities. If a superior ordering of production subsequently becomes known, even this present management chart will cease to have legitimacy for the second observer.

Like the first person in the example above, the Federal Circuit may be unaware of the possibility that an industry norm exists for using a given royalty base to price the license for a patented component of a downstream product precisely because the experience of private parties engaged in voluntary

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[21] Armen A. Alchian, *Uncertainty, Evolution, and Economic Theory*, 58 J. POL. ECON. 211 (1950).

[22] Ronald H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386 (n.s.) (1937).

[23] DOUGLASS C. NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE (3d ed. Cambridge University Press 1990).

[24] *See* George J. Stigler, *The Economies of Scale*, 1 J. L. & ECON . 54 (1958). Stigler argued that the optimum scale of a firm in an industry could be inferred from what he called "the survivor principle," whose "fundamental postulate is that the competition of different sizes of firms sifts out the more efficient enterprises." *Id.* at 55.

[25] Friedrich A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519 (1945). For a summation of Hayek's writings on the evolution of economic and legal institutions, see FRIEDRICH A. HAYEK, THE FATAL CONCEIT: THE ERRORS OF SOCIALISM (W.W. Bartley III ed., Routledge 1988).

negotiations has shown that all of the known alternatives are, from the perspective of maximizing the returns to production, demonstrably inferior. The Federal Circuit's power to interpret the Patent Act does not ensure that its decisions will produce a transactional structure for calculating a reasonable royalty that is more efficient than the industry norm that patent holders and licensees actually use in successful voluntary negotiations.

The agent of the firm responsible for monetizing its intellectual property will not necessarily understand why the use of one particular royalty base is preferred to another. The agent follows the industry norm, knowing what he is doing, but not necessarily able to articulate why he is doing it.[26] Industry norms will emerge as firms experiment with various different strategies. The strategies that survive are those that best suit the business environment,[27] tacitly incorporating a myriad of variables too extensive and complex ever to be fully captured by any one individual, or even by the most sophisticated computer general equilibrium model that man may devise. Judges and arbitrators neglect such tacit knowledge at the expense of economic efficiency. Whatever model an economic expert may propose will necessarily abstract from reality on some set of variables.[28] Tacit knowledge as revealed by industry norms should receive a degree of deference comparable to the precedents of the common law, which has emerged in a similar process and which similarly incorporates the tacit knowledge of human experience.[29] Though an economic model may occasionally demonstrate a more efficient policy than that which existing norms suggest, an empirical success can just as likely arise from a lucky guess regarding which variables are most influential in a given case. Norms that survive are those that aggregate information from among all of the relevant parties influenced by a policy and will be more robust over a variety of unique settings than the very best that an economic expert can model.[30]

III. WHY DEMAND A HYPOTHETICAL ROYALTY BASE THAT CONTRADICTS THE NORM ACTUALLY USED IN VOLUNTARY LICENSING NEGOTIATIONS?

Recent Federal Circuit decisions run counter to the industry norm by which willing licensors and willing licensees use the entire market value of the downstream product as the royalty base for calculating the royalties for one of the

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[26] 1 FRIEDRICH A. HAYEK, LAW, LEGISLATION, AND LIBERTY: RULES AND ORDER 19, 80 (Univ. of Chicago Press 1973).

[27] Alchian, *supra* note 21, at 213–14.

[28] Milton Friedman, *The Methodology of Positive Economics*, *in* ESSAYS IN POSITIVE ECONOMICS 3, 4 (Univ. of Chicago Press 1953).

[29] *See* Eric Posner, *Efficient Norms*, *in* 2 THE NEW PALGRAVE DICTIONARY OF ECONOMICS AND THE LAW 19, 20 (Peter Newman ed., Macmillan 1998).

[30] *See* David M. Levy & Sandra J. Peart, *Analytical Egalitarianism, Anecdotal Evidence and Information Aggregation Via Proverbial Wisdom*, 11 J. ECON. METHODOLOGY 411 (2004).

product's patented components. The Federal Circuit seems unaware of the market-generated information that it ignores when it says that the value of the downstream product's smallest salable patent-practicing component must be used as the royalty base for calculating patent damages, unless the patent holder can make a series of heroic evidentiary showings. The Federal Circuit's approach is misguided. Almost without exception, this approach fails to recognize the complementarity effects and network effects that the patented technology often (if not routinely and predictably) generates when interacting with other components of the downstream product. It also departs from the method routinely used in real-world licensing agreements. In many cases, therefore, the use of the smallest salable patent-practicing component as a royalty base necessarily fails to award damages approximating a reasonable royalty upon which the patent holder and the infringer would have willingly agreed in a hypothetical negotiation. In such cases, the Federal Circuit's insistence that the smallest salable patent-practicing component be the royalty base undermines the goal "of affording patent owners *complete* compensation" for infringement.[31]

The Federal Circuit's decisions limiting the application of the EMVR appear to rest on the belief that doing otherwise would cause juries to award the patent holder damages that far exceed the value of the patented component, and some of the decisions explicitly express this concern. Unfortunately, the Federal Circuit has not clearly articulated, much less substantiated, its concerns about the cognitive bias of jurors in patent litigation. In fact, behavioral economics does not necessarily support the Federal Circuit's apparent concern that cognitive bias is likely to result in damages that overcompensate the patent holder. In the absence of evidence that such bias exists, the Federal Circuit lacks a persuasive justification for disfavoring the application of the EMVR when calculating damages awards for the infringement of a patented technology implemented in a multi-component product.

A. The Elevated Standard for Applying the Entire Market Value Rule

When it is not the industry norm to set a reasonable royalty as a fixed fee per unit sold or used, the determination of the proper royalty base becomes an essential step in calculating a reasonable running royalty for patent infringement. The determination of the correct royalty base is particularly important in pricing patents practiced in multi-component products, for which the assessment of the value that each patented and non-patented component contributes to the end product can be extremely difficult.

The Federal Circuit has applied the EMVR on several occasions when calculating damages for technologies implemented in multi-component products. In the 1997 case *Fonar Corp. v. General Electric Co.*, the court found the rule appropriate for determining the royalty base, on the rationale that the

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[31] Gen. Motors Corp. v. Devex Corp., 461 U.S. 648, 655 (1983) (emphasis added).

patented technology "help[ed] to enhance efficiency and patient throughput" and thus drove demand for the downstream medical device.[32] In 1999, the Federal Circuit applied the EMVR in *Tekmax, Inc. v. Exide Corp.*, ruling that the patent holder's feeder technology increased throughput of the wrapper-stacker machines produced by the alleged infringer, and thus the patent in suit for the component directly increased demand for the downstream product.[33] On both occasions, the Federal Circuit ruled that the value of the downstream product constituted the appropriate royalty base.

Nonetheless, as I explain below, the Federal Circuit has subsequently elevated the evidentiary burden for applying the EMVR to where it is exceedingly difficult for a patent holder to use the value of the downstream product as a royalty base for the calculation of patent damages for a component of that downstream product. The Federal Circuit instead favors using the value of the smallest salable patent-practicing component as the royalty base and makes use of the entire market value of the downstream product in exceptional cases only. Even in cases where the downstream product is the smallest salable patent-practicing component, the Federal Circuit has stated that, if the product contains substantial unpatented features, one should subtract the value of these features from the royalty base. However, the Federal Circuit has failed to provide guidance for when apportionment of value to a patented feature should stop.

1. Chief Judge Rader's District Court Decisions on the EMVR

Former Chief Judge Rader of the Federal Circuit, sitting by designation as the trial judge, issued rulings in 2009 and 2010 that were early steps toward limiting the applicability of the EMVR.

a. Cornell University v. Hewlett-Packard Co.

In *Cornell University v. Hewlett-Packard Co.*, the patent in suit concerned a method by which instructions were issued within a computer processor that was included in Hewlett-Packard servers and workstations.[34] Cornell's expert initially calculated damages by using Hewlett-Packard's revenues from its sales of servers and workstations as the royalty base—that is, the value of the downstream products.[35] At a *Daubert* hearing, Judge Rader excluded the expert's damages testimony. Judge Rader found that the downstream products whose revenues were used as the royalty base included "vast amounts"[36] of technologies that did not infringe the patent in suit and that Cornell had failed to offer "credible and sufficient economic proof that the patented invention drove

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[32] 107 F.3d 1543, 1552–53 (Fed. Cir. 1997).
[33] Nos. 97-1386, 97-1387, 215 F.3d 1339 (Table), 1999 WL 435755, at *7 (Fed. Cir. Jan. 27, 1999).
[34] 609 F. Supp. 2d 279, 283 (N.D.N.Y. 2009).
[35] *Id.* at 284.
[36] *Id.* at 283.

demand for Hewlett-Packard's entire server and workstation market."[37] Judge Rader reasoned that Cornell's expert "did not offer a single demand curve or attempt in any way to link consumer demand for servers and workstations to the claimed invention."[38] Expressing concern that the jury would be deceived by the evidence that Cornell's expert presented, but without detailing precisely why, Judge Rader found that the expert had "tried to present evidence *that would mislead the jury* to award damages far in excess of their compensatory purpose."[39]

Judge Rader allowed Cornell to use a revised royalty base "that [took] into account . . . the fact that the claimed invention is not the entire system but only a component of a component of that system."[40] However, Cornell's revised royalty base of $23 billion was composed of central processing unit (CPU) bricks, which again contained components in addition to the infringing processor. The jury initially awarded Cornell royalty damages of $184 million by applying a 0.8-percent royalty rate to that $23 billion royalty base.[41]

Hewlett-Packard then moved for a judgment as a matter of law (JMOL), remittitur, or a new trial on damages to reduce the royalty base, arguing that the damages should be calculated on the basis of Hewlett-Packard's revenues attributable only to the infringed patent.[42] In general, both JMOL and remittitur address what a "reasonable" jury would find. JMOL is appropriate when a reasonable jury would not have sufficient evidentiary basis to find in favor of the opposing party,[43] and remittitur is appropriate, in general, when a damages award is "intrinsically excessive" and a reasonable jury would have awarded lower damages.[44]

In the JMOL hearing, Judge Rader ruled that Cornell's expert again had failed to provide sufficient economic evidence to support use of the downstream product as the royalty base.[45] Judge Rader therefore excluded the expert's testimony.[46] He set a high evidentiary burden for use of the EMVR. He held that the CPU bricks—the selected royalty base—contained numerous non-patented components in addition to the infringing processors,[47] and that Cornell's revised royalty base was still "beyond the scope of the claimed

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[37] *Id.* at 284.

[38] *Id.*

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

[40] *Id.*

[41] *Id.* at 282.

[42] *Id.*

[43] A judgment as a matter of law with respect to an issue is appropriate when "a reasonable jury would not have a legally sufficient basis to find for the [non-moving] party on that issue." FED. R. CIV. P. 50(a)(1).

[44] *Cornell*, 609 F. Supp. 2d 279, 292 (citing Lanfranconi v. Tidewater Oil Co., 376 F.2d 91, 96–97 (2d Cir.), *cert. denied*, 389 U.S. 951 (1967)).

[45] *Id.* at 284.

[46] *Id.*

[47] *Id.* at 284–85.

invention."[48] Judge Rader emphasized that the EMVR "permits damages on technology beyond the scope of the claimed invention, but only upon proof that damages on the unpatented components or technology is necessary to fully compensate for infringement of the patented invention."[49] He found that it is not enough to show that the infringing and non-infringing components are sold together.[50] Rather, citing precedent, Judge Rader emphasized that, to justify use of the EMVR, the patent holder must prove that:

> (1) the infringing components must be the basis for customer demand for the entire machine, including the parts beyond the claimed invention;[51] (2) the individual infringing and non-infringing components must be sold together so that they constitute a functional unit, or are parts of a complete machine or single assembly of parts;[52] and (3) the individual infringing and non-infringing components must be analogous to a single functioning unit.[53]

Judge Rader found that Cornell did not satisfy these three prerequisites.[54] He was again dissatisfied with the type of evidence provided by Cornell's expert, who in Judge Rader's assessment did not provide any more evidence for Cornell's consumer demand argument than the expert had provided during the *Daubert* hearing.[55] For example, the expert could have provided evidence in the form of customer surveys.[56] Consequently, Cornell did "not provide any real world support for [its] royalty base claim" to use the EMVR.[57] Judge Rader further found that using a royalty base "including revenues from the sale of non-infringing components is not permissible simply because the royalty rate is adjustable."[58] However, he did not explain why using a large royalty base with a downward adjustment of the royalty rate would be inappropriate.

Judge Rader then introduced the concept of the smallest salable patent-practicing component as a royalty base.[59] He found that not only was there no evidence that the patented feature drove the demand for CPU bricks, but there was also no evidence of a market for these products, such that the use of the value of the smallest salable patent-practicing component as the royalty base was a more logical alternative:

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[48] *Id.* at 285.
[49] *Id.*
[50] *Id.* at 287.
[51] *Id.* at 286 (citing Fonar Corp. v. Gen. Elec. Co., 107 F.3d 1543, 1552 (Fed. Cir. 1997); State Indus., Inc. v. Mor-Flo Indus., Inc., 883 F.2d 1573, 1580 (Fed. Cir. 1989)).
[52] *Id.* (citing Paper Converting Mach. Co. v. Magna-Graphics Corp., 745 F.2d 11, 23 (Fed. Cir. 1984)).
[53] *Id.* at 286–87 (internal citations omitted) (citing Kalman v. Berlyn Corp., 914 F.2d 1473, 1485 (Fed. Cir. 1990)).
[54] *Id.* at 285.
[55] *Id.* at 288–89.
[56] *Id.* at 290.
[57] *Id.*
[58] *Id.* at 286 (citing Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1549 n.9 (Fed. Cir. 1995)).
[59] *Id.* at 288.

> Without any real world transactions, or even any discernable market for CPU bricks, less intrepid counsel would have wisely abandoned a royalty base claim encompassing a product with significant non-infringing components. The logical and readily available alternative was the smallest salable infringing unit with close relation to the claimed invention—namely the processor itself.[60]

Judge Rader then turned to the issue of the royalty rate and Cornell's challenge to the remittitur amount under the "maximum recovery rule," in terms of which the remittitur amount must be "based on the highest amount of damages that the jury could properly have awarded based on the relevant evidence."[61] Judge Rader rejected Cornell's argument on the rationale that the purpose of the maximum recovery rule is to minimize judicial interference. He concluded that, "where . . . the jury has articulated what it identified as the appropriate royalty rate[,] . . . this court has no reason to disturb that rate simply because it found error in the separately articulated royalty base determination."[62] Judge Rader therefore did not adjust the royalty rate upward to compensate for the smaller royalty base. He granted Hewlett-Packard's motion for JMOL, or remittitur in the alternative, and awarded Cornell damages of $53.5 million.[63] The court computed this reduced damages award by multiplying the jury's undisputed 0.8-percent royalty rate by a royalty base of $6.7 billion rather than $23 billion.[64]

b. IP Innovation, L.L.C v. Red Hat, Inc.

The following year, Judge Rader reiterated in *IP Innovation, L.L.C v. Red Hat, Inc.* his concern about using a large royalty base.[65] IP Innovation had used as the royalty base 100 percent of Red Hat's and Novell's total revenues from their sales of subscriptions to the infringing Linux-based operating systems.[66] Sitting by designation on the U.S. District Court for the Eastern District of Texas, Judge Rader excluded the damages testimony of IP Innovation's damages expert, on the grounds that it was based on irrelevant or unreliable evidence as it improperly used the EMVR when the patented invention at

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[60] *Id.* at 287–88.
[61] *Id.* at 292–93 (citing Unisplay, S.A. v. American Elec. Sign Co., Inc., 69 F.3d 512, 519 (Fed. Cir. 1995)).
[62] *Id.* at 293.
[63] *Id.*
[64] *Id.* at 292. The $6.7 billion royalty base was equal to an $8 billion estimate of processor revenue minus approximately $1.4 billion in Intel-made processor revenues, which Hewlett-Packard lawfully earned from an implicit license it had with Intel. *Id.* The difference between the $8 billion and $6.7 billion figures was not germane to the question of whether Cornell should be able to use a larger royalty base (of $23 billion) that encompassed the value of the downstream product.
[65] 705 F. Supp. 2d 687 (E.D. Tex. 2010).
[66] *Id.* at 689.

issue was "one relatively small component of the accused operating systems" and it inflated the royalty rate.[67]

IP Innovation's expert attempted to provide evidence that the patented feature was the basis for customer demand for the infringing operating systems. He cited comments on an online user forum for a third-party product describing the patented feature as essential.[68] Rejecting this evidence, Judge Rader said that "selected users' statements in isolation and without a relationship to the actual claimed technology do not show an accurate economic measurement of total market demand for the [patented] feature, let alone its contribution to the demand for the entire product asserted as the royalty base."[69]

To the contrary, Judge Rader found that IP Innovation had not accounted for evidence that many consumers of the infringing operating systems did not use the patented feature: "Most of Red Hat's and Novell's accused sales come from their Server products, the majority of which . . . do not take advantage of the [patented] workspace switching feature."[70] In addition, "some accused operating systems are sold to the public with a default setting that does not enable the [patented] function."[71] Judge Rader also found that "most users of the accused operating systems [did] not seem to use the workspace switching feature at all."[72] Judge Rader held that the expert's "stunning methodological oversight" rendered his damages testimony unreliable and inadmissible.[73] Judge Rader cited another reason for excluding IP Innovation's expert's testimony regarding the appropriate royalty rate—that it was "arbitrarily" chosen and far exceeded the existing royalty rates for licenses to the patents at issue.[74]

Judge Rader's opinion in *IP Innovation* is noteworthy in three respects. First, like *Cornell*, it gave some guidance as to the nature of proof required before the patent holder may use the value of the downstream product as the royalty base: it is evidence of an economic connection between the patented feature and the downstream product, such as the relative demand for a patented component, based on economic measurement of consumer demand and substitution. Second, unlike *Cornell*, Judge Rader's opinion in *IP Innovation* did not cite jury bias or deception as a factor for excluding the patent holder's expert testimony using the value of the downstream product as

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[67] *Id.* Federal Rule of Evidence 702 (c) and (d) explain: "A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if . . . (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case." FED. R. EVID. 702 (c), (d).

[68] *IP Innovation*, 705 F. Supp. 2d at 690.

[69] *Id.*

[70] *Id.*

[71] *Id.*

[72] *Id.*

[73] *Id.*

[74] *Id.* 690–91.

the royalty base. Third, Judge Rader again did not explain why a reduction in the royalty rate could not offset the danger that an inflated royalty base posed to producing an exaggerated estimate of damages.

2. Federal Circuit Decisions on the EMVR

Federal Circuit decisions after *Cornell* have largely followed Judge Rader's cue in erecting a higher evidentiary barrier to a patent holder's use of the value of the downstream product as the royalty base for a patented technology in multi-component product. These decisions favor instead the use of the value of the smallest salable patent-practicing component as the royalty base. The latest in this series of Federal Circuit decisions finds where the smallest salable patent-practicing component is the downstream product and it contains substantial unpatented features, a patent holder must apportion damages even further by identifying a narrower patent-practicing feature as the royalty base.

a. Lucent Technologies v. Gateway

In *Lucent Technologies, Inc. v. Gateway, Inc.*,[75] the Federal Circuit in 2009 did not use the value of the downstream product to set the royalty base, as it found there was insufficient evidence for doing so, although it recognized that the value of the downstream product might constitute the appropriate royalty base in some instances. On appeal from the U.S. District Court for the Southern District of California, the defendant, Microsoft, challenged the jury's finding of infringement and its $357.7 million lump-sum royalty award.[76] The patent in suit involved a method of entering information into fields on a computer screen without using a keyboard.[77] Microsoft challenged the royalty award on the rationale that the jury erroneously based the award on the entire market value of the infringing downstream software products—Microsoft Money, Microsoft Outlook, and Windows Mobile.[78] The Federal Circuit agreed, holding that substantial evidence did not support the royalty award, as Lucent had not proven that the patented feature was the "basis—or even a substantial basis—for the consumer demand" for the infringing products.[79]

The Federal Circuit focused on a single software product, Microsoft Outlook, because infringement of this downstream product constituted the majority of the award.[80] The Federal Circuit said that "the glaring imbalance between infringing and non-infringing features must impact the analysis of

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[75] 580 F.3d 1301 (Fed. Cir. 2009). The panel consisted of Judges Michel, Newman, and Lourie. Judge Michel wrote the opinion.

[76] *Id.* at 1308.

[77] *Id.*

[78] *Id.* at 1336.

[79] *Id.* at 1338.

[80] *Id.* at 1325.

how much profit can properly be attributed to the use of the date-picker compared to non-patented elements and other features of Outlook"[81] and that "the only reasonable conclusion supported by the evidence is that the infringing use of the date-picker tool in Outlook is but a very small component of a much larger software program."[82] The Federal Circuit consequently found that Lucent did not meet the necessary evidentiary burden to justify using the entire market value of Outlook as the royalty base, as Lucent did not show that anyone purchased Outlook *because* of the patented technology.[83] The Federal Circuit remanded the case for a new trial on damages.[84]

Despite rejecting Lucent's damages calculation, the Federal Circuit appeared to show a flexible approach to the use of the EMVR. The Federal Circuit said that "the base used in a running royalty calculation can always be the value of the entire commercial embodiment, as long as the magnitude of the rate is within an acceptable range (as determined by the evidence)."[85] It added that, "even when the patented invention is a small component of a much larger commercial product, awarding a reasonable royalty based on either sale price or number of units sold can be economically justified."[86] The Federal Circuit explicitly rejected the suggestion of Mark Lemley and another commentator that the EMVR should play little role in the calculation of a reasonable royalty.[87] It held that "such general propositions ignore the realities of patent licensing and the flexibility needed in transferring intellectual property rights."[88] The Federal Circuit emphasized that "sophisticated parties routinely enter into license agreements that base the value of the patented inventions as a percentage of the commercial products' sales price."[89] It consequently held that "[t]here is nothing inherently wrong with using the market value of the entire product, especially when there is no established market value for the infringing component or feature, so long as the multiplier accounts for the proportion of the base represented by the infringing component or feature."[90]

In sum, although it did not explicitly recognize the danger of jury deception or bias, the Federal Circuit in *Lucent* found that a patent holder did not make

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[81] *Id.* at 1333.

[82] *Id.* at 1337.

[83] *Id.*

[84] *Id.* at 1340.

[85] *Id.* at 1338–39.

[86] *Id.* at 1339.

[87] *Id.* (citing and rejecting Mark A. Lemley, *Distinguishing Lost Profits From Reasonable Royalties*, 51 Wm. & Mary L. Rev. 655, 656 (2009) ("courts have distorted the reasonable royalty measure" by "importing inapposite concepts like the 'entire market value rule' in an effort to compensate patent owners whose real remedy probably should have been in the lost profits category"); Amy Landers, *Let the Games Begin: Incentives to Innovation in the New Economy of Intellectual Property Law*, 46 Santa Clara L. Rev. 307, 362 (2006) ("The current iterations of the entire market value rule are inconsistent with the Patent Act's statutory language.")).

[88] *Id.*

[89] *Id.*

[90] *Id.*

the requisite evidentiary showing for using the EMVR, as the patent holder did not present sufficient evidence to show that the patented method was the basis of consumer demand for the downstream product. In contrast to Judge Rader's decisions, the Federal Circuit in *Lucent* did recognize that the use of the downstream product as a royalty base could sometimes be appropriate, even when the patented technology contributes a small part of the downstream product's value, as long as one adjusted the royalty rate accordingly. However, given the Federal Circuit's restrictive approach to the EMVR in *Lucent*, it is questionable whether the Federal Circuit would readily accept a larger royalty base in practice.

b. *Uniloc USA, Inc. v. Microsoft*

The Federal Circuit illustrated the preceding point when in 2011 it again resisted, in *Uniloc USA, Inc. v. Microsoft*, the use of the EMVR in the absence of sufficient economic evidence of the determinants of demand for the downstream product.[91] The Federal Circuit again limited a patent holder's ability to use the entire market value of the infringing downstream product to compute a reasonable-royalty award, even with a corresponding reduction in the royalty rate.[92] The Federal Circuit reiterated Judge Rader's concern about jury bias.[93]

Microsoft allegedly infringed Uniloc's patent on a software-registration system designed to deter software copying.[94] Microsoft's product-activation feature—attached to its Word XP, Word 2003, and Windows XP software— was a software-registration system also designed to deter software copying.[95] Microsoft's product-activation feature centered on two algorithms, which Uniloc alleged were identical to its patented registration system.[96] Microsoft and Uniloc both agreed that the product-activation feature "did not create the basis for customer demand or substantially create the value of the component parts."[97] According to Uniloc, the royalty base was not calculated by using the entire market value of Microsoft Office or Windows.[98]

Uniloc's damages expert took the value of the patented feature—between $10 and $10,000, depending on usage—as a starting point for a reasonable royalty in a hypothetical negotiation. The damages expert (who had been IP Innovation's expert in *IP Innovation*) also testified to the jury that his calculated royalty accounted for only 2.9 percent of Microsoft's $19 billion *total* revenues

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[91] Uniloc USA, Inc. v. Microsoft Corp. (*Uniloc I*), 632 F.3d 1292 (Fed. Cir. 2011). The panel consisted of Chief Judge Rader and Judges Linn and Moore. Judge Linn wrote the opinion.

[92] *Id.* at 1320.

[93] *Id.*

[94] *Id.* at 1296.

[95] *Id.* at 1297.

[96] *Id.* at 1298–99.

[97] *Id.* at 1319.

[98] *Id.* (quoting Uniloc USA, Inc. v. Microsoft Corp. (*Uniloc II*), 640 F. Supp. 2d 150, 184–85 (D.R.I. 2009)).

for the infringing products.[99] He testified that "2.9% was a reasonable royalty based on his experience that royalty rates for software are 'generally above—on average, above 10% or 10, 11%.' "[100] Microsoft argued that Uniloc improperly applied the infringing product's entire market value, which biased the jury's determination of damages upward.[101] The U.S. District Court for the District of Rhode Island agreed and granted Microsoft a new trial on damages.[102]

On appeal, Uniloc emphasized that "the entire market value of the product can be used if the royalty rate is low enough."[103] Uniloc's justification rested on the Federal Circuit's statement in *Lucent*.[104] The Federal Circuit rejected that argument, ruling that Uniloc had taken *Lucent*'s rationale out of context. The Federal Circuit said that in *Lucent* it disallowed use of the EMVR because there was a "lack of evidence demonstrating the patented method . . . as the basis—or even a substantial basis—of the consumer demand for Outlook."[105] Citing as controlling the Supreme Court's 1884 decision in *Garretson v. Clark*, the Federal Circuit said that *Lucent* does "not allow consideration of the entire market value of accused products for minor patent improvements simply by asserting a low enough royalty rate."[106] Because the parties had agreed that Uniloc's patented feature was not the basis for consumer demand for Microsoft Office or Windows, the Federal Circuit rejected Uniloc's reduction of the royalty rate to justify its reference to Microsoft's total revenues on the infringing products.

Uniloc justified its reliance on the EMVR by arguing that its expert's reference at trial to Microsoft's $19 billion revenue figure was used only as a "check" and that the court had instructed the jury not to use the entire market value of Microsoft's infringing product in calculating reasonable-royalty damages.[107] The Federal Circuit rejected this argument,[108] saying that "[t]he disclosure that a company has made $19 billion dollars in revenue from an infringing product *cannot help but to skew the damages horizon for the jury*."[109] The Federal Circuit concluded that Uniloc exacerbated this bias by emphasizing that Microsoft's proposed reasonable royalty accounted for only 0.00003

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[99]   *Id.* at 1318.
[100] *Id.*
[101] *Id.* at 1319.
[102] *Id.* (citing *Uniloc II*, 640 F. Supp. 2d at 184–85).
[103] *Id.*
[104] *Id.* (quoting Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1338–39 (Fed. Cir. 2009)).
[105] *Id.* at 1320 (quoting *Lucent*, 580 F.3d at 1337).
[106] *Id.* (citing Garretson v. Clark, 111 U.S. 120, 121 (1884); *Lucent*, 580 F.3d at 1336; Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1549 (Fed. Cir. 1995); Bose Corp. v. JBL, Inc., 274 F.3d 1354, 1361 (Fed. Cir. 2001); TWM Mfg. Co. v. Dura Corp., 789 F.2d 895, 901 (Fed. Cir. 1986)).
[107] *Id.* at 1321.
[108] *Id.*
[109] *Id.* at 1320 (emphasis added).

percent of the company's *total* revenue from the accused products.[110] In particular, the Federal Circuit quoted at length the cross-examination at trial of Microsoft's damages expert, during which Uniloc's counsel asked: "And at the end of the day, the infringer, Microsoft . . . they get to keep 99.9999% of the box and the inventor, whose patent they infringed, he gets the privilege of keeping .00003%?"[111] Such cross-examination, without showing that the patent at issue affected the entire market value of the accused products,[112] was in "clear derogation" of the Federal Circuit's EMVR precedents.[113] After rejecting Uniloc's arguments for admitting evidence on the entire market value of Microsoft's accused products, the Federal Circuit affirmed the district court's grant of Microsoft's motion for a new trial on damages.[114]

In sum, in *Uniloc*, the Federal Circuit still did not entirely abandon the use of EMVR and the possibility of a compensating, downward adjustment of the royalty rate to match a high royalty base. However, the Federal Circuit again emphasized that the EMVR is appropriate only when the patent holder has made the court's demanding evidentiary showing concerning demand for the downstream product. In *Uniloc*, the Federal Circuit expressed most strongly its concern about jury bias, although it did so still without explaining the nature of the supposed bias or how it would manifest itself. Put differently, the Federal Circuit did not identify any limiting principle to its concern over jury bias when the patent holder seeks to use the value of the downstream product as the royalty base for reasonable-royalty damages for infringement of a patented component.

c. *LaserDynamics, Inc. v. Quanta Computer, Inc.*

In 2012, the Federal Circuit adopted an even more restrictive standard for using the EMVR when it decided *LaserDynamics Inc. v. Quanta Computer, Inc.*[115] Quanta Computer, Inc. (QCI), a laptop computer manufacturer, and its partially owned subsidiary Quanta Storage, Inc. (QSI), a manufacturer of optical disc drives (ODDs), allegedly infringed LaserDynamics' patented method of optical disc discrimination. This method enables an ODD to automatically identify the type of optical disc—for example, a compact disc (CD) or a digital video disc (DVD)—that one has inserted into the disc drive.[116] This automated process obviates the user's manual identification of the type of

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[110] *Id.* at 1320–21 ("Moreover, Uniloc's derision of Microsoft's damages expert by virtue of the .00003% of the entire market value that his damages calculation represented may have inappropriately contributed to the jury's rejection of his calculations.").

[111] *Id.*

[112] *Id.* at 1321.

[113] *Id.*

[114] *Id.*

[115] 694 F.3d 51, 66 (Fed. Cir. 2012). The panel consisted of Judges Dyk, Clevenger, and Reyna. Judge Reyna wrote the opinion.

[116] *Id.* at 56.

disc before inserting the disc into the ODD so that the computer can read the data on the disc. At the time of the parties' hypothetical license negotiation, a laptop computer was not commercially viable without including this patented feature.[117]

LaserDynamics' damages expert based his report on the price of the downstream product. He used a 2-percent running royalty rate over the total sales of QCI's laptop computers—$2.53 billion—and presented to the jury a $52.1 million damages figure, which was nearly the same amount that the jury later awarded.[118] In the Federal Circuit's opinion, LaserDynamics' use of this method was, by definition, an application of the EMVR.[119]

The Federal Circuit echoed the concerns expressed in *Lucent* and *Uniloc* that the patent holder's improper use of the EMVR would likely skew the jury's perception of adequate damages.[120] The Federal Circuit observed that, for electronic devices consisting of many different components, assessing "how much value each patented and non-patented component individually contributes to the overall end product . . . can be an exceedingly difficult and error-prone task."[121] Further, it held that when a patented technology is a small component of a complex product, calculating a royalty payment on the value of the entire product risks improperly compensating the patent holder for noninfringing components.[122] Embracing Judge Rader's decision in *Cornell*, the Federal Circuit ruled that royalties for patented technologies that are small components of complex products should generally be based on the "smallest salable patent-practicing unit," rather than on the entire value of the downstream product.[123] The court held that the EMVR "is a narrow exception to this general rule" and that this exception should be applied only when "it can be shown that the patented feature drives the demand for an entire multi-component product."[124] The Federal Circuit held that the improper use of the EMVR "only serves to make a patentee's proffered damages amount appear modest by comparison," and, consequently, "artificially inflate[s] the jury's damages calculation."[125]

The Federal Circuit rejected LaserDynamics' use of the EMVR, ruling that LaserDynamics did not present evidence that its patented disc-discrimination method drove or caused demand for laptop computers.[126] The court imposed an extremely high evidentiary burden and held that, to use the value of the

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[117] *Id.* at 60.
[118] *Id.* at 68.
[119] *Id.*
[120] *Id.*
[121] *Id.* at 66.
[122] *Id.* at 67.
[123] *Id.* (citing Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 283, 287–88 (N.D.N.Y. 2009) (quotation omitted)).
[124] *Id.*
[125] *Id.* at 68.
[126] *Id.*

downstream product as the royalty base, it did not suffice for the patent holder to show that the patented component was "viewed as valuable, important, or even essential" to using the downstream product.[127] Nor did it suffice to show that a downstream product lacking the patented feature "would be commercially unviable."[128] According to the Federal Circuit, the fact that consumers would not purchase the downstream product without the patented features "is not tantamount to proof that any one of those features *alone* drives" demand for the downstream product.[129] The Federal Circuit ruled that only evidence that the specific patented functionality motivated consumers to buy the downstream product would justify the patent holder's use of the EMVR.[130]

The Federal Circuit also rejected LaserDynamics' argument that "practical and economic necessity compelled" using the downstream product as the royalty base.[131] LaserDynamics argued that QCI did not track the actual "prices, revenues, or profits associated with individual components," such that there was no sufficient evidence of the components' real value.[132] Further, LaserDynamics' expert maintained that parties to a license agreement would often base "royalties on entire products to address such accounting difficulties."[133] The Federal Circuit clearly understood that "LaserDynamics concludes that the parties would have had to use the value of the entire laptop computer as the royalty base in structuring a hypothetical license agreement, as it reflects the only true market value of anything that QCI sells."[134] The Federal Circuit rejected this argument with the *non sequitur* that "a per-unit running royalty is not the only form of a reasonable royalty that the parties might have agreed to in a hypothetical negotiation."[135] "An alternate form" of royalty, the court said, "is evidenced by the many license agreements to the [patent in suit] in the record for lump sum royalties that are not calculated as a percentage of *any* component or product, which immediately belies the argument that using a laptop computer as the royalty base is 'necessary.' "[136] The Federal Circuit then reasoned that the patent holder's use of the EMVR would simply shift the difficulty of apportioning the value of the patent in suit from an apportionment of the royalty base to an apportionment of the royalty rate: "if difficulty in precisely identifying the value of the ODDs is what justifies using complete laptop computers as the royalty base, when it comes time to then apportion a royalty rate that accounts for the ODD contribution only, the

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[127] *Id.*
[128] *Id.*
[129] *Id.* (emphasis added).
[130] *Id.*
[131] *Id.* at 69.
[132] *Id.*
[133] *Id.* at 70.
[134] *Id.*
[135] *Id.*
[136] *Id.* (emphasis in original).

exceedingly difficult and error-prone task of discerning the ODD's value relative to all other components in the laptop remains."[137]

In sum, *LaserDynamics* imposed an even stricter evidentiary showing than *Uniloc* for patent holders seeking to use the EMVR. The court found that it no longer sufficed that the patented feature creates the basis for customer demand or substantially creates the value of the component parts. To justify use of the EMVR, the patented feature must *solely* drive the demand for the downstream product. For cases involving multi-component products, the general rule after *LaserDynamics* is that the value of the smallest salable patent-practicing component determines the royalty base unless the patent holder can prove that the patent feature solely drives demand for the multi-component downstream product. Like Judge Rader's approach in *IP Innovation*, the Federal Circuit's approach in *LaserDynamics* implies that, to justify using the EMVR, a patent holder seeking to meet its evidentiary burden must perform an economic evaluation of consumer demand by conducting market studies or consumer surveys[138] to show that the patented technology alone drove demand for the downstream product. To the Federal Circuit, the fact that real-world licensing agreements in the industry use the value of the downstream product as a royalty base does not justify using the EMVR to inform a hypothetical license negotiation. Unmindful of economic reasoning, this conclusion in *LaserDynamics* sends the hypothetical negotiation tumbling down a rabbit hole, where patent holders and licensees contradict their observed behavior in the real world.

d. University of Pittsburgh v. Varian Medical Systems, Inc.

In a nonprecedential decision issued in April 2014, the Federal Circuit contradicted itself on the use of the EMVR. It found in *University of Pittsburgh v. Varian Medical Systems* that the patent holder's expert met the evidentiary burden to justify using the EMVR, even though the patented feature did *not* solely drive demand for the downstream product.[139] The Federal Circuit found that evidence of complementarity effects between the patented and non-patented features sufficed to justify the patent holder's use of the EMVR—although, notably, the alleged infringer had conceded this point.[140]

The University of Pittsburgh (Pitt) sued Varian Medical Systems, alleging that the Varian Real-Time Position Management Respiratory Gating System (known as the RPM system)—a system that monitors and tracks a patient's respiratory movements during treatment—infringed Pitt's patent.[141] Pitt's invention aimed to reduce damage to healthy tissue by synchronizing a radiation

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[137] *Id.*

[138] *Id.* at 69.

[139] 561 Fed. Appx. 934 (Fed. Cir. 2014) (nonprecedential opinion). The panel consisted of Judges Lourie, Dyk, and O'Malley. Judge O'Malley wrote the opinion.

[140] *Id.*

[141] *Id.* at 936.

treatment beam with a patient's movements. The RPM system was used with Varian's Clinac radiotherapy—a linear medical accelerator for radiotherapy treatments—and with Varian's Trilogy radiotherapy machines. The jury awarded damages for patent infringement based on a 10.5-percent running royalty on the sales of the RPM System and a 1.5-percent running royalty on the sales of the Clinac and Trilogy devices sold in combination with, or incorporating, the RPM System.[142]

Varian appealed the part of the award based on Varian's sales of Clinac and Trilogy devices.[143] Varian argued that Pitt failed to "apportion its damages according to damages jurisprudence."[144] First, Varian contended that Pitt's damages calculation, which was based on the sale of Clinac and Trilogy devices, ignored the precedents limiting use of the EMVR.[145] Varian argued that the royalty base must exclude the entire value of accelerators, which were components of the downstream products that did not practice Pitt's patent. Second, Varian argued that, even if the EMVR did apply, the damages calculation ignored jurisprudence limiting damages to "the value of the claimed improvement and . . . excluded the value of any conventional or prior art elements recited in the claim language."[146] In other words, Varian argued that Pitt could seek a royalty only on stand-alone RPM sales.[147]

Contrary to the line of cases leading to *LaserDynamics*, the Federal Circuit rejected Varian's arguments. It said that *Lucent* requires the separation or apportionment of the damages attributable to the patented features.[148] In the present case, the patent claim used open-ended language that explicitly included references to non-patented elements.[149] The Federal Circuit found that those non-patented elements were not merely accessories used in conjunction with the RPM system. Instead, the combined use of the patented and non-patented features created added value: "there was a value a would be purchaser would find in the combination system . . . that would not be found when the components were sold separately and not designed to be immediately interoperable."[150] The Federal Circuit thus recognized the presence (and economic significance) of complementarity effects between the patented features and the nonpatented features. Furthermore, "Varian itself . . . acknowledged the value added by the function of the combined apparatus."[151] The Federal Circuit consequently found that, by using the value of the entire apparatus as

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[142] *Id.* at 939.
[143] *Id.*
[144] *Id.*
[145] *Id.* at 945.
[146] *Id.* at 946.
[147] *Id.* at 948.
[148] *Id.* at 947 (citing Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1337 (Fed. Cir. 2009)).
[149] *Id.*
[150] *Id.* at 948 ("the combination devices claimed in claim 38 were more valuable to Varian than was the RPM System and linear accelerator when sold separately").
[151] *Id.* at 947.

the royalty base, Pitt *did not* attempt to include in the royalty base the value of nonpatented features; consequently, the district court was correct to use the sales of the downstream products as a royalty base.[152] Finally, the Federal Circuit said that Pitt was not entitled to *all* the profits that Varian generated from its devices, but only to a limited percentage—1.5 percent—which in the jury's view reflected the value that the patented technology added to Varian's devices.[153]

University of Pittsburgh shows that, although the Federal Circuit has raised the patent holder's evidentiary prerequisites for using the value of the downstream product as the royalty base, a patent holder still can use the EMVR in exceptional cases. In particular, when evidence shows that combinational value between components exists, the price of the entire downstream product, rather than the price of the component, may determine the appropriate royalty base, as long as one limits the royalty rate to a percentage that properly reflects the component's contribution to the value of the downstream product. Why is *University of Pittsburgh* nonprecedential? Because the Federal Circuit cannot reconcile it with *LaserDynamics*? Regardless of the fact that one may not cite *University of Pittsburgh* as precedent, the opinion is significant because it illustrates the extent to which, even after five years of doctrinal reexamination since 2009, the Federal Circuit's opinions left the law in a state of confusion, subjecting the federal district courts and their litigants to continued uncertainty over how to determine the proper royalty base for calculating damages for the infringement of patented technologies implemented in multi-component products.

e. VirnetX, Inc. v. Cisco Systems, Inc.

In *VirnetX, Inc. v. Cisco Systems, Inc.*, the Federal Circuit in September 2014 affirmed its commitment to applying the EMVR in exceptional cases only and reiterated its concern that a large royalty base for the calculation of patent damages could bias a jury's findings.[154] Unlike in *LaserDynamics*, the Federal Circuit did not find that a patent holder seeking to rely on the EMVR must show that the patented feature alone drove demand for the downstream product. However, the Federal Circuit did reiterate its established principle that the patented features must "[create] the basis for customer demand or substantially [create] the value of the component parts" and found that

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[152] *Id.* at 947–48.

[153] *Id.* at 950.

[154] VirnetX, Inc. v. Cisco Sys., Inc., 767 F.3d 1308, 1326 (Fed. Cir. Sept. 16, 2014) (citing LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 67–68 (Fed. Cir. 2012)). The panel consisted of Chief Judge Prost and Judge Chen. Chief Judge Prost wrote the opinion. Judge Rader participated in oral argument but retired from the Judiciary on June 30, 2014 and did not participate in the panel's decision.

VirnetX had failed to prove that requisite link between the patented features and the final products in which they were incorporated.[155]

VirnetX alleged that the FaceTime feature of Apple's iPad, iPod, and iPhone products (referred to in the decision as "iOS devices") and Mac computers, as well as Apple's virtual private network (VPN) feature of its iOS devices, called VPN on Demand, had infringed four VirnetX patents that claimed technology for providing security over networks. Specifically, VirnetX alleged that (1) Apple's FaceTime feature, which enables secure video calling between Apple products, had infringed two of VirnetX's patents that facilitated establishing "secure communication links," thereby enabling data to be transmitted securely across a network, and (2) Apple's VPN on Demand feature on its iOS devices had infringed two patents that facilitated a system initiating a virtual private network (VPN) between a proxy site and a secure site.

In 2012, a jury in the Eastern District of Texas reached the verdict that all of VirnetX's claims were valid and infringed and that VirnetX should be awarded damages in the amount of $368,160,000. Apple then moved for a JMOL or, alternatively, a new trial or remittitur. Chief Judge Leonard Davis denied Apple's motions in 2013,[156] and Apple appealed to the Federal Circuit. The Federal Circuit vacated the jury's damages award and remanded the case to the district court for further proceedings.[157]

The Federal Circuit considered the three approaches to the damages award upon which VirnetX's damages expert had relied and which the district court had admitted into evidence despite a *Daubert* challenge by Apple. In his first approach, VirnetX's damages expert analyzed allegedly comparable licenses to which VirnetX was a party. In these licenses, the parties had agreed to a 1- to 2-percent royalty rate applied to a downstream product. Using the licenses as support, VirnetX's expert applied a 1-percent royalty rate to a royalty base consisting of the accused iOS devices (the downstream product) to yield a total damages award of $708 million. The damages consisted of $566 million for products including FaceTime and VPN on Demand and $142 million for products including only VPN on Demand.[158] The second and third approaches focused on FaceTime alone and relied on the Nash bargaining solution to support the conclusion that " 'the parties [would have] split between themselves the incremental or additional profits that are associated with the use of the patented technology.' "[159] Under his second approach, VirnetX's expert derived damages of $588 million, having found that VirnetX and Apple would have negotiated a 45/55 split of the profits associated with FaceTime in favor of Apple, owing to VirnetX's likely weaker bargaining position at the time of first

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[155] *Id.* (citing Versata Software, Inc. v. SAP Am., Inc., 717 F.3d 1255, 1268 (Fed. Cir. 2013)).
[156] VirnetX, Inc. v Apple, Inc., 925 F. Supp. 2d 816 (E.D. Tex. 2013).
[157] *VirnetX*, 767 F.3d at 1326.
[158] *Id.* at 1325–26.
[159] *Id.* at 1325 (alteration in original).

infringement.[160] VirnetX's expert had estimated the profits associated with
FaceTime based on the price of a "front-facing" camera included in certain of
Apple's products.[161] Under his third approach, the expert relied on a customer
survey to find that 18 percent of all iOS device sales would not have occurred
without the inclusion of FaceTime.[162] The expert then estimated the profits at-
tributable to the FaceTime feature on iOS devices and apportioned to VirnetX
45 percent of 82 percent of the estimated profits of the FaceTime feature on
iOS devices, which yielded damages for FaceTime of $5.13 per unit, or $606
million in total.[163]

The Federal Circuit rejected all three of these methodologies on the basis
that, although a damages calculation can be approximate, the patent holder
must prove the link between the patented feature and market demand for the
final product.[164] The Federal Circuit reiterated its finding in LaserDynamics
that, without this proof, it is not sufficient "merely [to] show that the [patented
feature] is viewed as valuable, important or even essential to the use of the
[overall product]."[165] The Federal Circuit found that VirnetX's expert had in-
correctly used the value of the iOS products as the royalty base because he had
not properly apportioned the value of the patented feature from the value of
unpatented features in the iOS products.[166]

The Federal Circuit also found the district court's jury instructions to be er-
roneous. The instructions stated that, when considering whether to use the
EMVR, the jury should consider (1) whether the patented feature drives
demand for the entire product, or (2) whether the product constitutes the
smallest salable patent-practicing unit. The Federal Circuit rejected the
second exception on the grounds that it mistakenly implies that there is no
need to limit the royalty base further when the final product is the smallest
salable patent-practicing unit. The Federal Circuit found that this approach
ignores that "a patentee's obligation to apportion damages only to the patented
features does not end with the identification of the smallest salable unit if that
unit still contains significant unpatented features."[167] The Federal Circuit
found that, instead of relying on the value of the iOS products, VirnetX should
have identified a patent-practicing feature with a "sufficiently close relation to
the claimed functionality."[168] Once again, the Federal Circuit expressed
concern about jury bias. It affirmed its findings in *Uniloc* that using a large

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[160] *Id.* at 1325–26.
[161] *Id.* at 1325; VirnetX, Inc. v. Apple, Inc., 925 F. Supp. 2d 816, 839 (E.D. Tex. 2013).
[162] *VirnetX*, 767 F.3d at 1325–26.
[163] *Id.*
[164] *Id.* at 1327 (citing ResQNet.com, Inc. v. Lansa, Inc., 594 F.3d 860, 869 (Fed. Cir. 2010)).
[165] *Id.* (citing LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 68 (Fed. Cir. 2012))
     (alterations in original).
[166] *Id.* at 1328–29.
[167] *Id.* at 1329.
[168] *Id.* at 1329.

royalty base "cannot help but skew the damages horizon for the jury"[169] and that a "patentee may not balance out an unreasonably high royalty base simply by asserting a low enough royalty rate."[170] However, the Federal Circuit again neglected to provide any explanation—legal, economic, psychological, or otherwise—to substantiate its theory of jury bias.

The Federal Circuit's reasoning in *VirnetX* is self-contradictory and unpersuasive in at least two respects. It cites VirnetX's failure to consider "real-world" situations when determining a reasonable royalty, but the court itself fails to consider "real-world" practice. First, when responding to Apple's challenge to the royalty rate in VirnetX's first approach to the damages calculation, the Federal Circuit found that the licenses upon which VirnetX had relied were sufficiently comparable to the license that would have resulted from a hypothetical negotiation and that the district court had not abused its discretion when it permitted VirnetX to rely on these licenses when providing testimony about the proper royalty rate.[171] However, the Federal Circuit curiously failed to accept that the licenses correctly used the downstream product as a royalty base.

In a second self-contradiction, the Federal Circuit rejected VirnetX's expert's second and third approaches on the basis that the Nash bargaining solution, like the now-abandoned 25-percent heuristic, is arbitrary and risks "inappropriately skewing the jury's verdict."[172] The court rejected the use of Nobel laureate John Nash's bargaining theorem on the rationale that VirnetX "assert[ed] nothing about what situations in the real world" would fit the Nash bargaining solution's premises.[173] Yet the Federal Circuit itself neglected to consider parties' real-world practice of choosing downstream products as the royalty base in patent negotiations.

VirnetX indicates that, to account for an unsubstantiated fear of jury bias, the Federal Circuit is committed to requiring patent holders to produce a high degree of proof that the value of a patented feature can be apportioned to the downstream product, even where the downstream product is the smallest salable patent-practicing component, although the court neglected to specify in what instances this requirement will be met. The decision also confirms that the Federal Circuit is opposed to using the EMVR in the absence of sufficient proof, even when the finder of fact could adjust the royalty rate downward. Further, the decision indicates that, although the Federal Circuit stresses the need for a hypothetical negotiation to mirror real-world negotiations, it breaks its own rule by disregarding evidence that firms in real-world negotiations use a larger royalty base than the court will allow in a hypothetical negotiation.

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[169] *Id.* at 1327, 1333 (citing Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir. 2011)).
[170] *Id.* at 1333.
[171] *Id.* at 1330.
[172] *Id.* at 1333.
[173] *Id.* at 1332.

B. The Shortcomings of Using the Value of the Smallest Salable Patent-Practicing Component to Set the Royalty Base

The Federal Circuit's recent opinions on the EMVR favor the use of the value of the smallest salable patent-practicing component as the royalty base when calculating damages for the infringement of patented technologies implemented in multi-component products. Some district courts have obediently used the smallest salable patent-practicing component as the royalty base when calculating patent damages.[174] In April 2014, for example, the District Court for the Northern District of California analyzed the royalty base for the computation of damages for SEPs in *GPNE Corp. v Apple Inc.*[175] Judge Lucy Koh said that she was applying the "smallest salable patent-practicing unit doctrine"[176] when she ruled that the appropriate royalty base for the calculation of FRAND damages was the value of a baseband processor chip. She explained that "the smallest salable patent-practicing unit doctrine exists because disclosure of overall product revenues threatens to 'skew the damages horizon for the jury.'"[177] She said that reference to the "'overall revenues [for the accused device], which have no demonstrated correlation to the value of the patented feature alone, only serve to make a patentee's proffered damages amount appear modest . . . and to artificially inflate the jury's damages calculation beyond that which is adequate to compensate for the infringement.'"[178]

However, using the value of the smallest salable patent-practicing component as the royalty base has at least three weaknesses. First, the Federal Circuit has not yet given a cogent limiting principle for the smallest salable patent-practicing component. It is the component within the downstream product that practices the patent in suit and is manufactured and sold separately from the downstream product. That much is not controversial. It might contain both patented and non-patented features, although the non-patented features

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[174] *See, e.g.*, Network Protection Sciences, LLC v. Fortinet, Inc., No. C 12-01106 WHA, 2013 WL 5402089 (N.D. Cal. Sept. 26, 2013); Axcess Int'l, Inc. v Savi Techs., Inc., No. 3:10-cv-01033-F, 2013 WL 6839112 (N.D. Tex. Jan. 25, 2013); Digital Reg of Tex. v. Adobe Sys., Inc., No. C 12-1971 CW, 2014 WL 4090550 (N.D. Cal. Aug. 19, 2014); *see also* Atlas IP, LLC v. Medtronic, Inc., No. 1:13-CIV-23309-CMA, slip op. at 7 (S.D. Fla. Oct. 6, 2014) (finding that a patent holder would circumvent the EMVR by applying an apportionment to the entire market value of the downstream product without showing that the patented feature drives demand for it); GPNE Corp. v. Apple Inc., No. 12-cv-02885-LHK, 2014 WL 1494247, at *11–12 (N.D. Cal. Apr. 16, 2014); Golden Bridge Tech. v. Apple Inc., No. 5:12-cv-04882-PSG, 2014 WL 2194501, at *5 (N.D. Cal. May 18, 2014); Memorandum Opinion and Order at 7, Wi-Lan Inc. v. Alcatel-Lucent USA Inc., No. 6:10-cv-00521, No. 6:13-cv-00252 (E.D. Tex. June 28, 2013), ECF No. 421.

[175] GPNE Corp. v. Apple, Inc., No. 12-CV-02885-LHK, 2014 WL 1494247 (N.D. Cal. Apr. 16, 2014).

[176] *Id.* at *13.

[177] *Id.* at *12 (quoting Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir.2011)).

[178] *Id.* at *13 (alteration in original) (quoting LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 67–68 (Fed. Cir. 2012)).

may not constitute a substantial proportion of the component.[179] The Federal Circuit seems to have implicitly recognized in its *VirnetX* decision that using the value of the smallest salable patent-practicing component as a royalty base is arbitrary if the courts do not provide any rationale for choosing a component that transcends the patent other than that it be the smallest physical item that is "salable." However, the Federal Circuit does not seem to have acknowledged the converse of this reasoning. The case law has identified the smallest salable patent-practicing component as a *physical* component on which the patent reads.[180] However, as Judge Richard Posner has observed, "[a]lmost every product can be viewed as a package of component products."[181] Nearly any component will consist of smaller and even smaller components. The *reductio ad absurdum* of the Federal Circuit's current case law is that the search for the smallest salable patent-practicing component ends with the patent itself.

Second, the use of the value of the smallest salable patent-practicing component as the royalty base fails to recognize the complementarity and network effects that a patented technology creates when implemented in a multi-component product. As explained earlier, the Federal Circuit itself has emphasized the importance of complementarity effects in its nonprecedential opinion in *University of Pittsburgh*. Chief Judge Leonard Davis of the Eastern District of Texas made a similar observation in 2014 in *Commonwealth Scientific & Industrial Research Organisation v. Cisco Systems, Inc.*[182] He found that the benefit of the patented technology, which was a combination of techniques that solved the multipath problem for indoor wireless data communication, lay outside the wireless chip in which it was physically implemented. Chief Judge Davis said that "[t]he benefit of the patent lies in the idea, not in the small amount of silicon that happens to be where that idea is physically implemented."[183] He further reasoned:

> Basing a royalty solely on chip price is like valuing a copyrighted book based only on the costs of the binding, paper and ink needed to actually produce the physical product. While such a calculation captures the cost of the physical product, it provides no indication of its actual value.[184]

If a patented component is highly complementary with other features in the downstream product and there is no precise way to measure the value of those individual complementarity effects, then using the price of the smallest salable patent-practicing component as the royalty base would understate the patent's value and generate an erroneously small royalty (assuming that the court

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[179] VirnetX, Inc. v. Cisco Sys., Inc., 767 F.3d 1308, 1329 (Fed. Cir. 2014).
[180] Tomita Techs. USA, LLC v. Nintendo Co., No. 11-cv-04256-JSR, 2013 WL 4101251, at *8 (S.D.N.Y. Aug. 14, 2013).
[181] Jack Walters & Sons Corp. v. Morton Bldg., Inc., 737 F.2d 698, 703 (7th Cir. 1984).
[182] No. 6:11-cv-00343, 2014 WL 3805817, at *11 (E.D. Tex. July 23, 2014).
[183] *Id.*
[184] *Id.*

permit a substantially larger royalty rate). Using the price of the smallest salable patent-practicing component as the royalty base would likely undercompensate the patent holder for its innovative contribution, and consequently reduce the returns to investment in innovation.

Third, and most striking, using the price of the smallest salable patent-practicing component as a royalty base deviates from real-world practice. As I explained in Part II, the patent holder and the licensee often use the value of the downstream product as a royalty base, even when no evidence indicates that the patented feature drives the demand for the downstream product. The Federal Circuit's demanding prerequisites for the patent holder's use of the EMVR are unrealistic because they expect great sophistication and knowledge of the parties at the time of their hypothetical negotiation, which the parties may not have or may not be able to apply. Some courts have observed that using the value of the smallest salable patent-practicing component as the royalty base contradicts the objective to award damages that mirror the outcome of a hypothetical negotiation between the parties. Judge Charles Everingham IV of the Eastern District of Texas said in *Mondis Technology, Ltd. v. LG Electronics, Inc.* that, "[i]f [the EMVR] were absolute, then it would put Plaintiff in a tough position because on one hand, the patented feature does not provide the basis for the customer demand, but on the other hand, the most reliable licenses are based on the entire market value of the licensed products."[185] Judge James Robart of the Western District of Washington adopted a similar approach in *Microsoft v. Motorola* when he observed that "district courts have permitted license agreements based on the entire product value as evidence of a reasonable royalty rate despite a lack of showing that the patented feature formed the 'basis for customer demand.'"[186] Requiring the patent holder to make a high evidentiary showing for using the value of the downstream product as a royalty base creates a gap between the damages awarded in court, and a reasonable royalty upon which the parties would have agreed in a hypothetical negotiation, given existing industry norms.

In sum, requiring the patent holder to use the value of the smallest salable patent-practicing component as the royalty base is misguided as a general proposition. This conclusion is particularly compelling in the context of SEPs, where complementarity effects and network effects are likely to be significant. Further, the benefit of court decisions on FRAND terms and royalties is that they can provide guidance on the meaning of a FRAND royalty, which can help parties avoid future disputes and costly litigation over FRAND royalties. But if, outside litigation, parties rarely calculate royalties as a share of the price

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[185] Nos. 2:07-CV-565-TJW-CE, 2:08-CV-478-TJW, 2011 WL 2417367, at *3 (E.D. Tex. June 14, 2011).

[186] Microsoft Corp. v. Motorola, Inc., 904 F. Supp. 2d 1109, 1119 (W.D. Wash. 2012) (citing Boeing Co. v. United States, 86 Fed. Cl. 303, 319–20 (2009); Mondis Tech., Ltd. v. LG Elecs., Inc., 2011 WL 2417367, at *3 (E.D. Tex. June 14, 2011)).

of the smallest salable patent-practicing component, then how helpful to the resolution of real-world disputes over the determination of FRAND royalties are the court decisions which, pursuant to the Federal Circuit's mandate, compel the parties as a matter of course to use the price of the smallest salable patent-practicing component as the royalty base? Court opinions that calculate royalties using instead the price of the downstream product as the royalty base, as parties routinely do in voluntary license negotiations, would provide greater guidance to courts, patent holders, and patent implementers in clarifying the meaning of a FRAND royalty.

C. The Federal Circuit's *De Facto* Theory of Cognitive Bias Concerning a Royalty Base Consisting the Value of the Downstream Product

A patented technology creates only a finite amount of value over a given interval of time. If there is no computational error or cognitive bias in the calculation of the royalty for use of the patent in suit, and assuming that one can accurately measure the value of all complementarity effects and network effects, then calculating a royalty as 10 percent of $30 rather than 1 percent of $300 should not make any difference to the magnitude of the royalty that the licensee ultimately pays.[187] An analytically correct calculation that adjusts the royalty rate compensates for the change in the appropriate royalty base. However, due to the presence of cognitive bias, computational error, and incomplete information, this neutral result may be unlikely to arise in practice.

Underlying the Federal Circuit's jurisprudence on the EMVR seems to be an underdeveloped theory that the selection of a "small" royalty base (as in the case of the value of the smallest salable patent-practicing component) or a "large" royalty base (as in the case of the value of the downstream product) will have substantially different implications for the ultimate magnitude of the damages award. The Federal Circuit's reasoning in *Uniloc* reveals that the Federal Circuit worries that juries manifest a cognitive bias resulting in a tendency to award excessive reasonable-royalty damages when presented with a damages estimate predicated on a small royalty rate multiplied by a large royalty base.[188] As discussed above, the Federal Circuit rejected the patent holder's use of the revenues for infringing products (a $19 billion figure) as the

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[187] By analogy, William Landes and Judge Richard Posner showed, in the most intellectually significant article published on antitrust law, that with respect to defining markets and calculating market shares, given the market elasticity, it does not matter to the outcome of assessing market power whether a market is narrowly or broadly defined, because there is only a finite amount of market power that a firm possesses. William M. Landes & Richard A. Posner, *Market Power in Antitrust Cases*, 94 HARV. L. REV. 937, 962–63 (1981). An analytically correct calculation that adjusts the relevant price elasticities of supply and demand compensates for the change in scope of the definition of the relevant market and the resulting calculation of market shares.

[188] Uniloc USA, Inc. v. Microsoft Corp. (*Uniloc I*), 632 F.3d 1292, 1320–21 (Fed. Cir. 2011).

royalty base,[189] even though the patent holder's damages expert witness called that figure merely a "check" and the trial judge instructed the jury not to use the $19 billion figure to calculate reasonable-royalty damages.[190] The Federal Circuit held that the mere presence of a large number as a royalty base—in this case, Microsoft's total revenue from the accused products, Microsoft Office and Windows—would incline the jury to render an erroneously large damages award.

In Part II.B, I explained the computational errors that result from a failure to measure the influence of complementarity effects and network effects in determining a patent royalty. The computational error associated with cognitive bias presents a different challenge because it distorts the fairness and accuracy of adjudications and is difficult to detect. Finders of law and finders of fact must be free from bias. The adjudicatory system provides rules to exclude a biased finder of law or fact.[191] Through *voir dire* and juror removal, the adjudicatory system also provides safeguards for mitigating jury bias before and after the impaneling of a jury.[192] Unlike the jury bias that these safeguards address, cognitive bias on the part of jurors is neither overt nor intentional; it is implicit in the mental process of the finder of law or fact.[193] Although cognitive bias is difficult to detect, if present, it has a real effect on outcomes and distorts the fairness and accuracy of adjudications.

The Federal Circuit has not clearly articulated its theory of cognitive bias among jurors in cases concerning reasonable-royalty damages for the infringement of patented technologies implemented in multi-component products. The court has not expressed the process by which cognitive bias manifests itself, nor has it rigorously questioned the likelihood of the bias occurring in the award of reasonable-royalty damages. In fact, the theories in behavioral economics do not necessarily support the Federal Circuit's concern. Rather, research in behavioral economics finds that individuals are typically averse to

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[189] *Id.* at 1321.

[190] *Id.*

[191] The Judicial Code requires "[a]ny justice, judge, or magistrate judge of the United States [to] disqualify himself in any proceeding in which his impartiality might reasonably be questioned." 28 U.S.C. § 455(a); *see also* Liteky v. United States, 510 U.S. 540, 558 (1994) (Kennedy, Blackmun, Stevens & Souter, J.J., concurring) ("One of the very objects of law is the impartiality of its judges in fact and appearance."); Martin H. Malin & Monica Biernat, *Do Cognitive Biases Infect Adjudication? A Study of Labor Arbitrators*, 11 U. Pa. J. Bus. L. 175, 175 (2008) ("One of the most fundamental requirements of due process [in arbitration] is that the adjudicators be free from bias.") (citing Aetna Life Ins. Co. v. Lavoie, 475 U.S. 813, 821–25 (1986); Ward v. Vill. of Monroeville, 409 U.S. 57 (1972)).

[192] *See, e.g.*, Lauren A. Rousseau, *Privacy and Jury Selection: Does the Constitution Protect Prospective Jurors from Personally Intrusive Voir Dire Questions?*, 3 Rutgers J. L. & Urb. Pol'y 287, 288 (2006); Barbara A. Babcock, *Voir Dire: Preserving "Its Wonderful Power,"* 27 Stan. L. Rev. 545, 551 (1975).

[193] *See, e.g.*, Malin & Biernat, *supra* note 191, at 175–76.

extreme results,[194] which would include awarding extreme damages. It is therefore equally plausible that juries would adopt a cautious approach when awarding damages for patent infringement and thus undercompensate the patent holder. In the absence of further evidence, there is no intellectually rigorous justification for the Federal Circuit's concern that using the entire market value of the downstream product as the royalty base would cause the patent holder to receive excessive compensation.

The technique used by the patent holder's counsel during cross-examination in *Uniloc*—comparing his expert's damage estimate to a much larger number corresponding to Microsoft's total sales of Office and Windows—is the quotidian stuff of trial practice. The tactic is not unique to patent litigation. It is overkill for a court to try to eradicate this problem by changing the substantive law of damages in a given field of law. A federal district court judge already has the power to punish attorney misconduct of this sort by excluding such evidence on a case-by-case basis or even by declaring a mistrial or granting a motion for a directed verdict (in which case, the client will surely take care of punishing its trial lawyer). Federal Rule of Evidence 403 empowers a federal judge to exclude evidence of which the "probative value is substantially outweighed by a danger of . . . unfair prejudice [or] . . . misleading the jury."[195] In addition, the patent holder's attorney may find himself in contempt of court for misconduct before the jury,[196] for "[d]irect contempts that occur in the court's presence may be immediately adjudged and sanctioned summarily."[197] In short, it would have been more proportionate for the Federal Circuit to have relied on these evidentiary and judicial powers than to have rewritten, from 2009 to 2014, the law of patent damages, to have contradicted the established principle that a court's award of damages for patent infringement should mirror the outcome of real-word licensing negotiations, and as a consequence to jeopardize now the fulfillment of "Congress' overriding purpose of affording patent owners *complete* compensation."[198]

The Federal Circuit's EMVR jurisprudence is also difficult to reconcile with contemporaneous rulings by the same court expressing confidence in the jury's ability to weigh complex economic evidence on patent damages. In April 2014, the Federal Circuit found in *Apple, Inc. v. Motorola, Inc.* that Judge

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[194] Cass R. Sunstein, *Behavioral Law and Economics: A Progress Report*, 1 AM. L. & ECON. REV. 115, 135 (1999).

[195] Federal Rule of Evidence 403 provides: "The court may exclude relevant evidence if its probative value is substantially outweighed by a danger of one or more of the following: unfair prejudice, confusing the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence." FED. R. EVID. 403.

[196] *See generally* Judith A. McMorrow, Jackie A. Gardina & Salvatore Ricciardone, *Judicial Attitudes Toward Confronting Attorney Misconduct: A View From the Reported Decisions*, 32 HOFSTRA L. REV. 1425 (2004).

[197] International Union, United Mine Workers of Am. v. Bagwell, 512 U.S. 821, 827 n.2 (1994) (citations omitted).

[198] Gen. Motors Corp. v. Devex Corp., 461 U.S. 648, 655 (1983) (emphasis added).

Posner—sitting by designation for the District Court for the Northern District of Illinois—had overstepped his role as gatekeeper under *Daubert* by excluding almost entirely both parties' expert testimony on patent damages.[199] The Federal Circuit said that a judge should exclude expert testimony "if it is based upon unreliable principles or methods, or legally insufficient facts and data,"[200] but that a judge should not "weigh facts, evaluate the correctness of conclusions, [or] *impose its own preferred methodology.*"[201] Instead, "the jury must . . . be allowed to play its essential role as the arbiter of the weight and credibility of expert testimony,"[202] since "questions regarding which facts are most relevant or reliable to calculating a reasonable royalty are 'for the jury'" rather than the judge.[203] In short, the Federal Circuit expresses in *Apple v. Motorola* its confidence in the jury's ability to evaluate expert testimony, including expert economic testimony on damages, but in the EMVR cases (decided both before and after *Apple v. Motorola*) the Federal Circuit worries that a jury will suffer cognitive bias if merely hears the otherwise reliable testimony of an economic expert who computes damages using a particular royalty base.[204]

D. The Logic of Using a Larger Patent-Practicing Product Rather Than the Smallest Salable Patent-Practicing Component as the Royalty Base

The current discussion of the royalty base omits the possibility that a patent holder and a licensee in voluntary negotiations may agree on a larger royalty

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[199] Apple, Inc. v. Motorola, Inc., 757 F.3d 1286, 1313–1326 (Fed. Cir. 2014). The panel consisted of Judges Reyna, Rader and Prost. Judge Prost delivered the opinion. Judge Rader joined the opinion and dissented in part. Judge Prost concurred in part and dissented in part.

[200] *Id.* at 1314 (citing Smith v. Ford Motor Co., 215 F.3d 713, 718 (7th Cir. 2000); Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 595 (1993); i4i Ltd. Partnership v. Microsoft Corp., 598 F. 3d 831, 854 (Fed. Cir. 2010); Walker v. Soo Line R.R. Co., 208 F.3d 581, 587 (7th Circ. 2000)).

[201] *Id.* at 1314 (emphasis added).

[202] *Id.* (quoting Stollings v. Ryobi Techs., Inc., 725 F.3d 753, 765 (7th Cir.2013).

[203] *Id.* at 1315 (citing i4i Ltd. Partnership v. Microsoft Corp., 598 F.3d 831, 856 (Fed. Cir. 2010). In 2009, the Federal Circuit expressed a similar view in Monolithic Power Sys., Inc. v. O2 Micro Int'l Ltd., 558 F.3d 1341, 1346 (Fed. Cir. 2009), in which Judge Rader discouraged the appointment of court-neutral experts under Federal Rule of Evidence 706. He said that courts should confine the use of neutral experts to extraordinary circumstances. *Id.* (citing 4 JACK B. WEINSTEIN & MARGARET A. BERGER, WEINSTEIN'S FEDERAL EVIDENCE § 706.02[2] (2d ed. 2005); 29 CHARLES A. WRIGHT, ARTHUR MILLER, & KENNETH W. GRAHAM, JR., FEDERAL PRACTICE AND PROCEDURE § 6304 (2d ed. 2002)). Judge Rader's implication was that, in general, jurors are perfectly capable of properly weighing the testimony of expert witnesses. On the use of Rule 706 in patent litigation, see J. Gregory Sidak, *Court-Appointed Neutral Economic Experts*, 9 J. COMPETITION L. & ECON. 359 (2013).

[204] A related question exceeding the scope of this article is whether the Federal Circuit's EMVR jurisprudence so limits the jury's discretion to award what it otherwise would deem to be completely compensable damages for patent infringement as to violate the patent holder's Seventh Amendment right to a trial by jury on the question of damages.

base than the value of the downstream product. Parties can freely select any royalty base in their patent license agreement. For patented technologies implemented in telecommunication standards, for example, parties conventionally peg the royalty base to the value of the mobile handset. However, nothing prevents the parties from using a different, perhaps larger, royalty base than the value of the mobile handset.

For example, in negotiations involving smartphone technology, the parties could determine that the revenue generated by mobile network operators from wireless data transfer constitutes the royalty base for the technologies implemented in the smartphone. A smartphone component may generate complementarity effects not only within a smartphone, but also between a smartphone and the network provider. For example, providing faster network and Internet connections and faster access to data storage through cloud services creates synergies with photo-sharing platforms such as Facebook and Instagram, because the smartphone user has improved access to those platforms. As a result, the smartphone user might take more pictures, share them with more users, and consequently increase the use of mobile data. The patent holder could plausibly argue that it is entitled to a share of the value associated with the increase in data traffic stimulated by its technology, and thus the patent holder could suggest using the revenue generated by mobile network operators as a royalty base.

Courts have recognized that the patent holder may recover royalties calculated on the basis of the value of the "entire apparatus," rather than solely the value of the patented component.[205] The value of the entire apparatus is not necessarily limited to the value of the direct downstream product; in principle, it could include any complementary product or service for which the patent holder can prove that the customer's decision to buy results primarily from the existence and use of the patented component.[206] Of course, the patent holder still must provide reliable and tangible evidence of the portion of the infringer's profit that is attributable to the patented technology and the portion of the infringer's profit that is attributable to noninfringing features.[207] Why, then, does the debate over the proper royalty base for calculating damages for the infringement of patented technologies implemented in multi-component products, particularly the debate over FRAND-committed patents, consider only alternative definitions of the royalty base that are *smaller than* the retail price of the handset? Why does the debate over the proper royalty base for GSM-related SEPs ignore the obviously complementary revenue stream derived from subscription to, and usage of, mobile networks that use such SEPs?

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[205] *See, e.g.*, Fonar Corp. v. Gen. Elec. Co., 107 F.3d 1543, 1552 (Fed. Cir. 1997).
[206] LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 68 (Fed. Cir. 2012); Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 286 (N.D.N.Y. 2009).
[207] Garretson v. Clark, 111 U.S. 120, 121 (1884).

Ultimately, it is a factual question whether the best possible royalty base for patents essential to mobile network standards consists of the sum of revenues from sales of mobile devices and sales of mobile service subscriptions. Using the value of a product that is far removed from the patented technology in the chain of production may lead to inadmissible speculation concerning damages. Further, the absence of real-world licensing agreements that use such a royalty base would suggest that the choice of such a royalty base finds no efficiency basis as an industry norm. However, the choice of a larger royalty base than the value of the downstream product is a legitimate question for courts to consider. It is not evident as a matter of legal or economic reasoning why the debate over the proper size of the royalty base should produce a ratchet that only reduces the size of the base relative to the value of the downstream product, such as a handset. In light of those considerations, a court's selection of the value of the direct downstream product as the royalty base might be parsimonious.

IV. RISK AVERSION AND THE PROPER ROYALTY BASE

Separate from concerns about cognitive bias, and even after one has accounted for concerns about complementarity effects and network effects, a completely knowledgeable agent still may prefer the adjudicator to use one type of royalty structure rather than another to calculate an award, depending on that agent's preferences for certainty. (An "agent" is simply the economic term for an entity that makes an economic decision, and it does not carry any legal connotation concerning the law of agency.) If the royalty structure upon which the adjudicator relies to calculate a damages award affects the certainty of the award's overall value, and if firms are not risk neutral, then a firm will derive more value from one royalty structure than from another. This result contrasts with the usual model of a firm, in which economists describe the firm as an agent that does not consider the risk of an outcome, but only its expected value. However, as I will argue, in licensing negotiations firms reveal their preferences for one contract structure over another, demonstrating that a firm can be treated as a risk-averse agent. Therefore, many of the insights that apply to an individual person's response to risk can also be used to understand a firm's response to risk, which in this case correspond to a patent holder's response to risks associated with the award of patent damages.

A. The Economic Language of Risk and Uncertainty

Individuals and firms respond to risk in different ways, and economic analysis provides a standardized method for assessing those responses. Economics describes this method of assessment as revealing an agent's "risk preferences." These risk preferences determine the shape of an agent's utility function and provide insight into which contracts the agent will prefer and which the agent might pay to avoid.

In economics, risk is defined as a relative amount of uncertainty, the variation in potential outcomes from the expected value. For example, consider a bet that is made on a coin flip where each outcome—heads or tails—is equally likely. These outcomes can be used to create two lotteries with different payoffs. In the first, the bettor wins $10 if the coin comes up heads but loses $10 if it comes up tails. In the second, the bettor wins $100 if heads comes up but otherwise loses $100. The average outcome, or expected value, of the bet is the same (zero) in each lottery, but the second lottery is much riskier because the variation in the bettor's wealth is greater. A bettor who does not care about risk—that is, someone who is *risk neutral*—will be indifferent between the two bets because he has the same expected value for each bet. However, a bettor who dislikes risk—one who is *risk-averse*—will prefer the first bet, the outcome of which will have a smaller effect on the bettor's welfare.[208]

This example illustrates the basic concept underlying formalized definitions of risk preferences in economics. By building upon this basic scenario, these formalizations enable one to predict or explain how and why an agent might behave in a certain way when faced with particular probabilities and potential outcomes.

The formal language of economics, as in the example provided above, can express an uncertain outcome as a lottery. The outcomes of this lottery are different "states of the world," and in each state the agent receives a payout that either increases or decreases the agent's wealth. Because each state of the world occurs with a given probability, it is possible to calculate the expected value of the lottery—or the probability-weighted wealth of the agent—over all possible states of the world. By applying the agent's utility function, one can find the value to the agent of the expected outcome, which is known as the utility of the expected value.

However, the expected value may not be an outcome that actually occurs or that actually could occur. In the coin-flip example above, an agent may either win or lose money on any individual flip, but there is no chance that the agent will break even at zero, even though that is the expected value of the bet. By applying the agent's utility function to his situation in each possible state of the world, and then calculating the probabilities of each of these utilities occurring, one can calculate the expected value of the utilities, which is the weighted average of the agent's welfare across the different lottery outcomes. The important lesson to draw from this approach is that the utility of the expected value is equal to the expected value of the utilities only in very particular circumstances. Deviations from those particular circumstances determine the

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[208] *See, e.g.*, Louis Eeckhoudt & Harris Schlesinger, *Putting Risk in Its Proper Place*, 96 AM. ECON. REV. 280 (2006) (describing how an agent's utility function relates to that agent's risk preferences).
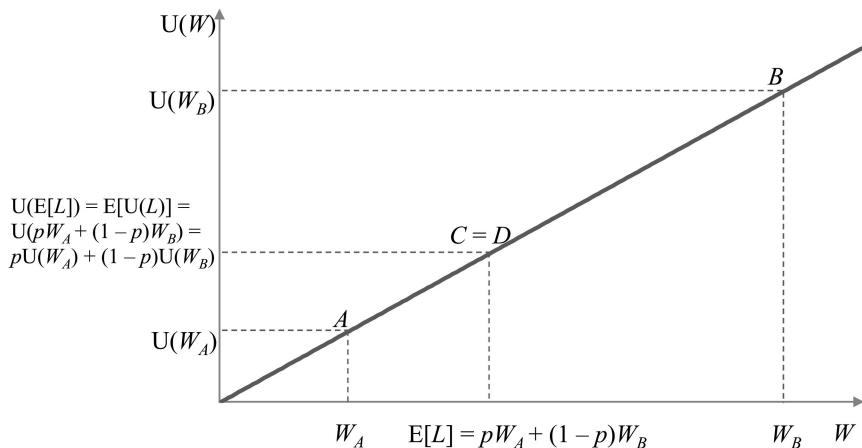
Figure 1. Utility versus wealth for a risk-neutral agent

agent's wellbeing when facing uncertainty.[209] Figures 1 and 2, and Table 1 illustrate the role of expected outcomes in describing risk preferences.

Figure 1 graphs a risk-neutral agent's utility (the vertical axis) at various levels of wealth (the horizontal axis). In this case, the agent's utility function takes the form $U(W) = SW$, where $U(W)$ is the agent's utility function, W is the agent's wealth, and S is some constant number. Figure 1 also illustrates a lottery with two potential outcomes, A and B. The two potential outcomes yield different wealth levels with different probabilities, described in Table 1 below.

The notable result is that, because the relationship between utility and wealth is linear, the utility of the expected value equals the expected value of the utilities. Such an agent will be completely indifferent to the amount of risk he bears—the distance between W_A and W_B—because the agent cares only about the expected outcome of the lottery and whether his bet is likely to be profitable.

Figure 2 shows a different case, that of a risk-averse agent who is made worse off by uncertainty. The value of the expected utility (labeled as point D on the straight line connecting points A and B) is below the utility of the expected value (labeled as point C). That is, when faced with the two disparate potential outcomes, the agent would rather have the average wealth for certain, than take a gamble, even if the expected outcome of the gamble is the average wealth. This relationship means that the agent would rather be certain to receive the expected value of the lottery than take a bet with the same expected payout. It is not the level of wealth after the lottery that the agent dislikes, but

[209] *See, e.g.*, Kenneth J. Arrow, *Alternative Approaches to the Theory of Choice in Risk-Taking Situations, in* Essays in the Theory of Risk- Bearing 1 (North-Holland Pub. Co. 1971) (giving an early description of this way of modeling risk).
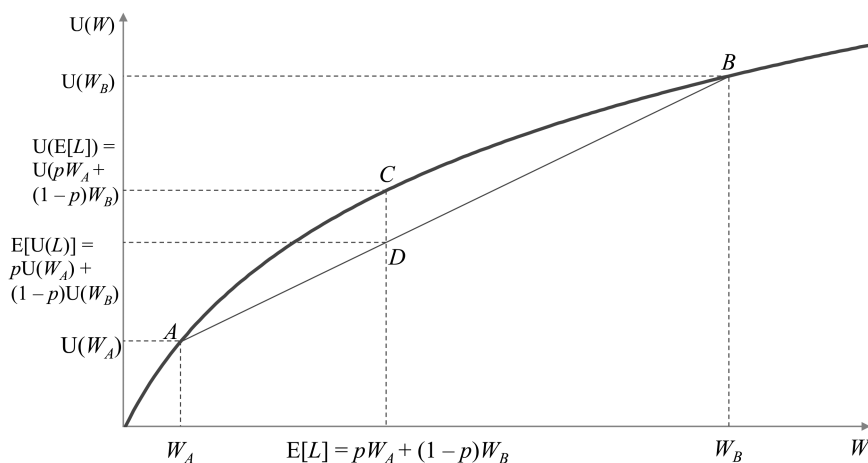
Figure 2. Utility versus wealth for a risk-averse agent

Table 1. Lottery outcomes for a risk-neutral agent

Outcome	Wealth	Utility	Probability
A	W_A	SW_A	P
B	W_B	SW_B	$(1-p)$

participation in the lottery itself. As this example shows, the agent's preference for a degree of certainty implies that the agent is not risk-neutral.

One can formalize these visual representations of the role of the utility function in determining risk preferences and use the same setup to derive several predictions about the likely behavior of an agent facing uncertainty. These predictions remain pertinent whether the agent in question is an individual person or a corporate entity such as a firm. What matters in assigning risk preferences is that the agent's behavior is consistent with the predictions derived from a given utility function. An individual's behavior may be described by risk-averse utility functions because individuals have declining marginal utility of wealth. That is, the next dollar gained is worth less to the individual than the previous dollar gained. Consequently, losses cause more harm than gains provide benefits. Firms, on the other hand, are not considered to have a declining marginal utility of wealth. Therefore, each additional dollar gained is equally valuable. However, under certain circumstances losses may cause more harm to a firm than gains will provide benefits, and these situations will lead a firm to adopt risk-averse behavior, just as an individual would. In the next part, I demonstrate how risk preferences tend to affect firms' decision making under conditions of uncertainty.

B. Award Uncertainty Under Risk Neutrality

In commercial litigation, firms face the basic risk that the jury will award an incorrect amount of damages. A simple model of this risk can yield insight into a firm's preferences. In this model, the royalty is determined by a royalty rate r applied to a royalty base B. One can structure the royalty calculation in either of two different ways: a high rate applied to a low base ($r_H B_L$), or a low rate applied to a high base ($r_L B_H$). Assuming that either of these structures produces the correct amount for the damages award, and that there is in fact only one correct amount of damages, the two structures must be equivalent, such that $r_H B_L = r_L B_H$.[210] The above formula would hold true if the jury had enough information to determine the correct amount of damages to award. Even if juries reach a correct decision on average, any given decision might deviate from the economically correct amount. This error could be greater for some award structures than others, and a risk-averse firm should prefer the structure that exposes it to less risk.

I now consider the role of juror error—that is, a deviation in the award from its true value. I model this error by introducing a "mean-preserving spread," defined as a random variable with a Gaussian distribution,[211] which I denote as k.[212] The expected value of k is one, meaning the expected value of any number multiplied by k will equal the original number, and the standard deviation of k is σ.[213] Figure 3 illustrates the effect of adding a mean-preserving spread to a random variable with a Gaussian distribution. Applied to the case of jury awards, the mean-preserving spread represents increased uncertainty in an award but maintains the same expected outcome (that is, the correct award amount) on average. The equivalence of jury awards with error can be expressed as $k r_H B_L = k r_L B_H$. Important assumptions here are that k is not

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[210] The proposition of equivalence implies a royalty based on the component's price and the downstream product's price taken at a given snapshot in time, and it assumes that those relative prices remain constant. However, the ratio of the prices of the smallest salable patent-practicing component and the downstream product will not necessarily remain constant over time. It is more realistic to assume that the price of either the component or the downstream product, or both, will change over time. In high-technology industries, the price of the downstream product generally is high upon the product's release and then declines, sometimes dramatically, over time. However, the price of the component—which often depends on raw material and production costs—varies depending on other factors, such that its price may change over time in different proportions than the price of the downstream product.

[211] *See, e.g.*, Jack Johnston & John Di Nardo, Econometric Methods 486–87 (McGraw-Hill 1997) (describing the Gaussian distribution and its properties). A Gaussian distribution is frequently called a normal distribution.

[212] *See, e.g.*, Andreu Mas-Colell, Michael Whinston & Jerry Green, Microeconomic Theory 197–98 (Oxford Univ. Press 1995) (describing a risk-averse agent's preference to avoid mean-preserving spreads).

[213] An equivalent proof can be done by treating k as a random variable with a mean of zero and a standard deviation of one and then adding this error term to the true value. The results are the same.
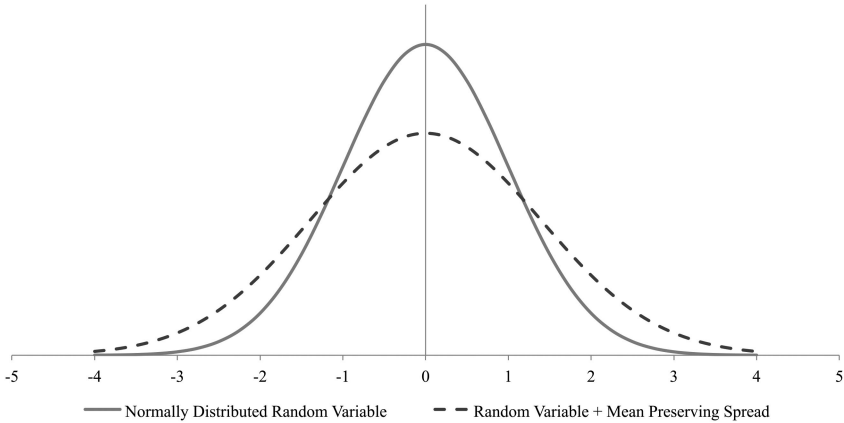
Figure 3. The effect of a mean-preserving spread on a Gaussian distribution

proportional to the rate or size of the award, on which I will expand later, and that k is independent of both the royalty rate and the royalty base.

Using the above notation, I now describe the preferred award structure of firms involved in a lawsuit. For a risk-neutral agent, the utility of the firm is the same whether or not there is error. This relationship is written:

$$U(r_H B_L) = U(kr_H B_L).$$

Because the utility of a risk-neutral agent is simply the expected value of the outcome, and because the utility function is linear, one can express the utility function explicitly and separate the expected values:

$$E[r_H B_L] = E[kr_H B_L]$$
$$E[r_H B_L] = E[r_H B_L] = E[kr_H B_L].$$

Because the expected value of k is one, this expression reduces to:

$$E[r_H B_L] = E[r_H B_L].$$

This result shows that a risk-neutral agent is indifferent between a certain award and an uncertain award as long as the award is expected to be correct in either case on average. This analysis is applied to the case of a high royalty with a low base, but the proof is equivalent in the case of a low royalty with a high base. When one observes that a firm prefers one type of royalty structure to the other, one can infer with confidence that the firm is not behaving in a risk-neutral manner.

One can now work through an equivalent analysis for a risk-averse agent. The setup is the same as above:

$$\text{Certain Damages}: r_H B_L = r_L B_H$$
$$\text{Uncertain Damages}: k r_H B_L = k r_L B_H.$$

When one examines the utility functions, one can observe that there are two distinctive damages scenarios for the risk-averse agent—one with correct damages and one with incorrect damages—where the two scenarios are no longer equivalent. This outcome results from applying Jensen's Inequality, which states simply that the utility of the expected value exceeds the expected value of the utilities for a concave curve.[214] To derive the "correct" award when agents are risk-neutral, the expectations operator can be moved inside the utility function because it is known for certain. The same cannot be done for the uncertain value:

$$E[U(r_H B_L)]?E[U(k r_H B_L)]$$
$$U(E[r_H B_L])?E[U(k r_H B_L)]$$
$$U(E[r_H B_L]) \geq E[U(k r_H B_L)].$$

One can perform an equivalent calculation for the scenario of a low royalty rate and high royalty base. However, examining the equality of the two certain, correct values produces an interesting result:

$$U(E[r_L B_H]) = U(E[k r_H B_L])$$
$$U(E[r_L B_H]) = U(E[r_H B_L]) \geq E[U(k r_L B_H)].$$

The two certain values provide the risk-averse agent the same utility, and the risk-averse agent prefers either certain value to either uncertain value. *The uncertainty itself is more undesirable to the agent than the structure of the royalty payment.* Uncertainty cannot be avoided in a real trial, but this conclusion implies that, if one royalty structure is more uncertain than the other, it should be less preferred, especially when there is no reward for bearing the additional risk.

I previously defined k by assuming that it had the same distribution across all royalty rates. Essentially, an error of one percentage point was as likely on a royalty rate of 5 percent as on a royalty rate of 25 percent. In reality, this distribution might not be the case. If k actually varies according to r, then a risk-averse agent may prefer one royalty structure to another. Consider the case where a jury is more likely to mistakenly award a 26-percent royalty when the true value is 25 percent than it is to mistakenly award a 6-percent royalty

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[214] *See, e.g.,* MAS-COLELL, WHINSTON & GREEN, *supra* note 212, at 185 (discussing implications for economic theory of J.L.W.V. Jensen, *Sur les Fonctions Convexes et les Inégalités Entre les Valeurs Moyennes*, 30 ACTA MATHEMATICA 175 (1905)).

when the true value is 5 percent. This situation implies that k increases as r increases, and it yields the inequality:

$$E[U(kr_L B_H)] \geq E[U(kr_H B_L)].$$

That is, if a jury is more accurate when assigning low royalty rates than when assigning high royalty rates, a firm will sensibly prefer the royalty structure that uses a more accurate low rate and a high base. This analysis is symmetric for licensees and licensors—a firm prefers a certain loss to an uncertain loss and a certain gain to an uncertain gain, regardless of whether it is a patent holder or a patent licensee.

C. The Effects of Risk Aversion on the Choice of Royalty Base and Royalty Rate

I provide an example below to clarify how risk aversion can create preferences for certain types of payouts when damages awards are subject to error. In this scenario, the firm has a product that produces revenue of $10 million, and the correct damages award is assumed to be $500,000, but the amount can be awarded in one of two ways: either as a 5-percent royalty on the entire $10 million base, or as a 25-percent royalty on a $2 million base. In the second scenario, the firm has $8 million of revenue that is excluded from consideration in the lawsuit. I introduce potential judgment error into the royalty rate by adding error equal to 10 percent of the royalty rate squared, or $k = 0.1 \times r^2$. This value is then added or subtracted from the correct royalty rates to produce the incorrect royalty rates. That is, for the too-high award, I add 0.025 percentage points to the 5-percent rate and 0.625 percentage points to the 25-percent royalty. This method introduces a larger deviation from the correct value in the larger-rate scenario than in the smaller-rate scenario.

First, I calculate the three scenarios of too-low, correct, and too-high awards for each potential royalty structure. Next, I calculate the licensee's wealth w, for which I use the royalty base (as a proxy for wealth gained from sales revenue of the infringing product) minus the damages award (as a proxy for wealth lost from patent infringement). I then calculate the firm's utility using the following utility function where γ is assigned a value of 0.4:[215]

$$U(w) = \frac{w^{1-\gamma} - 1}{1 - \gamma}.$$

Here, γ affects how curved the function is, and as γ increases, so does the firm's risk aversion. Consistent with common sense, utility decreases as the infringer's wealth is reduced. By assigning equal probabilities to the two error

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[215] This utility function is known as the isoelastic utility function (or the power utility function). A comprehensive discussion of the power utility function appears in Peter P. Wakker, *Explaining the Characteristics of the Power (CRRA) Utility Family*, 17 HEALTH ECON. 1329 (2008).

states (excessively high royalties and excessively low royalties), I calculate the firm's expected utility. Because the firm behaves in a risk-averse manner, the expected utility is lower than the utility in the certain scenario. I then find the amount of wealth that the licensee could have with certainty that would make the licensee just as well off as having the expected utility in the case where the damages award is uncertain (the "Certainty Equivalent Wealth").[216] The difference between the licensee's Certainty Equivalent Wealth and its wealth in the case with certainty is the maximum premium that the licensee would be willing to pay to avoid bearing the risk of an uncertain award. In essence, this difference is the premium for an insurance contract that would protect the company from an uncertain damages award. As expected, I find that the licensee facing the greater risk—in other words, the company with the larger royalty rate—would need to pay the higher premium even though the royalty base is lower. If the licensee faces a situation where the court-determined royalty rate could be incorrectly calculated, then the licensee would prefer the scenario with the lower rate and the larger royalty base.

In Table 2, I provide a numerical example to show the licensee's wealth and utility in each state of the world. I highlight the expected utility under uncertainty to show that it is below the certain, correct utility, though this difference only shows up in the third decimal point.

The proof in Part IV.B demonstrates that a risk-neutral firm should not be concerned with the potential for an erroneous award as long as k has an expected value of one, and the expected error does not change the average value of the award. That is, as long as there is no systematic bias (in one direction or the other) in the damages that a jury awards, a risk-neutral firm should not prefer one type of award to another. However, when a firm is risk-averse, the royalty structure does matter. A firm then will seek to minimize the risk it faces, even if the firm might have to accept a lower damages award to avoid that risk.

The fact that firms engaged in patent litigation frequently argue for certain types of royalty structures to be used in the calculation of a damages award suggests that these firms do not behave as risk-neutral organizations, but instead have risk preferences that economists can describe as curved utility functions. The revealed preferences of a firm indicate that a firm can be treated as a risk-averse agent. Consequently, many of the same insights that apply to individual persons can also apply to a firm. This proof builds on the research into the risk preferences of firms that shows that the "demand for liability insurance may be explained by risk aversion of customers, suppliers, managers or employees."[217]

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[216] *See, e.g.*, MAS-COLELL, WHINSTON & GREEN, *supra* note 212, at 185.

[217] Jan M. Ambrose, Anne M. Carroll & Laureen Regan, *The Economics of Liability Insurance*, *in* HANDBOOK OF INSURANCE 315, 320 n.14 (Georges Dionne ed., Springer 2013).

Table 2. Example of a risk-averse firm facing royalty rates made with error

| Gamma | 0.4 | | | | | |
| Damages Award | $500,000 | | | | | |

| Licensee | Small Royalty Rate, Large Base | | | Large Royalty Rate, Small Base | | |
| Royalty Base: | $10,000,000 | | | $2,000,000 | | |
	Minus 1% Error	Correct Rate	Plus 1% Error	Minus 1% Error	Correct Rate	Plus 1% Error
Royalty Rate	4.975%	5.00%	5.025%	24.375%	25.00%	25.625%
Wealth	$9,502,500	$9,500,000	$9,497,500	$9,512,500	$9,500,000	$9,487,500
Utility	25,616.702	25,612.658	25,608.614	25,632.875	25,612.658	25,592.431
Expected Utility Under Uncertainty		25,612.658			25,612.653	
Certainty Equivalent Wealth		$9,498,969.65			$9,498,966.49	
Premium		$1,030.35			$1,033.51	

D. Implications of Risk Aversion for the Choice of Royalty Base Used to Calculate Damages for Patent Infringement

Two ways of describing an individual's response to uncertainty are absolute risk aversion (ARA) and relative risk aversion (RRA). ARA describes how much an agent dislikes risk in general. RRA describes how much an agent dislikes risk relative to that agent's starting amount of wealth. Those two measures can increase, remain constant, or decrease as an agent's wealth changes.

The type of utility function that most closely aligns with observed behavior manifests constant relative risk aversion (CRRA) and decreasing absolute risk aversion (DARA). The way in which an agent responds to changes in wealth can illustrate the meaning of these terms. DARA implies that, as an agent's wealth increases, the agent is willing to buy a greater amount (in nominal terms) of the risky asset. CRRA implies that, as wealth increases, the agent continues to invest the same fraction of his portfolio in the asset. A young investor who has only $1,000 might put $500, or 50 percent, of his portfolio in stocks. As the investor's wealth grows to $1,000,000, he may increase the nominal amount of his investment in stocks to $500,000 (manifesting DARA), while still maintaining the share of his total portfolio in stocks at 50 percent (manifesting CRRA). Alternatively, if the investor practices constant absolute risk aversion (CARA), then he will invest only $500 in stocks, whether his total portfolio totals $1,000 or $1,000,000. An investor with decreasing relative risk aversion (DRRA) will increase the percentage of his portfolio in stocks as his wealth grows.

The common risk preference assumptions of DARA and CRRA utility functions indicate that a larger firm could find it easier to bear the risk of an uncertain judgment than a smaller firm could, because the larger firm would be willing to risk a higher nominal dollar amount (although not a larger percentage of its total portfolio) relative to the smaller firm. Similarly, if a firm's business portfolio depends less on the value of a particular patent, it would be more willing to risk an adverse judgment than would a firm with a less diversified and more highly patent-dependent portfolio. If the nominal amount of the damages award at stake varies with the varying size of the royalty base for the patent, the risk preferences of the parties involved could lead one firm to be less willing to risk an uncertain judgment than the other.

This analysis shows that when a firm is risk-averse, it will prefer a royalty structure that minimizes the effects of that risk. Depending on the firm's situation relative to that of other firms, such as the size of each firm and the importance of the patent to each firm's business, one of the firms involved might be more willing than the other to tolerate uncertainty. The actual preferences of the firms under consideration would likely need to be empirically determined on a case-by-case basis, although understanding the effects of risk aversion can help a court structure an award to minimize the risk to the firms involved or to compensate appropriately a firm that does bear risk.

The different royalty structures—a high rate paired with a low base or a low rate paired with a high base—can have differing effects on firms. Even though the two structures in theory may have the same arithmetic value, in the actual market their economic effects can be quite different. Changing market conditions, potential data errors, or the varying ability of juries to estimate proper values are a few examples of how variation in the level of sensitivity to risk offered by different royalty structures can have real effects. A firm's managers understand these issues and gravitate toward royalty structures that they believe will maximize their utilities, as well as their firm's profits. This understanding may manifest itself in industry norms, as I discussed in Part II.C. The extant case law and scholarly commentary on patent damages has ignored information on risk preferences revealed by a firm's behavior. But courts should understand and consider these effects. An industry norm by which the licensor and licensee willingly choose to use the value of the downstream product as the royalty base in their voluntary agreement shows a preference for a larger royalty base. When the royalty base is estimated more accurately than the appropriate royalty rate, courts should prefer a high base and a low rate to a low base and a high rate. To increase economic welfare, a court should prefer to predicate its damages award on the economic variable that industry participants have found to be more accurate.

V. CONCLUSION

The royalty base for calculating patent damages generally should be no smaller than the value of the downstream product if the patented technology interacts with other components of that downstream product to create value. A royalty payment based on the value of the smallest salable patent-practicing component ignores the creation of additional value derived from complementarity effects and network effects. Although each implemented patent component has value by itself, a court should consider the interaction among multiple components that generates additional value for the downstream product. The need to consider complementarity effects and network effects when determining patent damages is particularly important in the context of standard-essential patents, for which the complementarity effects and network effects typically are significant. The entire market value rule most appropriately compensates the SEP holder for the value that its SEPs contribute to the downstream product resulting from the standard. The EMVR also most closely approximates real-world licensing agreements, in which willing licensors and licensees use the value of the downstream product as their royalty base. Conversely, using the value of the smallest salable patent-practicing component as the royalty base for calculating damages for the infringement of patented technologies implemented in multi-component products carries the substantial risk of undercompensating the patent holder, reducing the returns to investment in innovation, and, in the case of SEPs, compromising the commercial success of open standards.