



Misconceptions Concerning the Use  
of Hedonic Prices to Determine FRAND  
or RAND Royalties for Standard-Essential Patents

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Hedonic price analysis is an econometric methodology that enables one to isolate the value attributable to each component of a multicomponent product. The implicit price of each of the product's characteristics is statistically determined from observed prices and features in the market. By regressing a product's total price on the product's characteristics, hedonic price analysis enables one to determine how much consumers are willing to pay for individual components of a multicomponent product. The best candidates for hedonic price analysis are goods for which changes in the components are frequent, observable, measurable, and relatively easy to identify and quantify. For example, for a multicomponent product like a smartphone, hedonic price analysis can quantify consumers' demonstrated willingness to pay for features such as screen size, battery life, memory, or even the smartphone's brand.<sup>1</sup>

In a 2017 article, *Hedonic Prices and Patent Royalties*, Dr. Jeremy Skog and I developed a hedonic price model for memory modules used in enterprise servers to estimate the incremental value attributable to the DDR4 LRDIMM standard above and beyond the next-best technology standard (which was the RDIMM standard promulgated by the same standard-setting organization (SSO)).<sup>2</sup> After estimating the incremental value of the DDR4 LRDIMM standard using the hedonic price model, we apportioned that

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<sup>1</sup> See J. Gregory Sidak & Jeremy O. Skog, *Hedonic Prices for Multicomponent Products*, 4 CRITERION J. ON INNOVATION 301 (2019).

<sup>2</sup> J. Gregory Sidak & Jeremy O. Skog, *Hedonic Prices and Patent Royalties*, 2 CRITERION J. ON INNOVATION 601 (2017). RDIMM is the previous memory module standard defined by the Joint Electron Device Engineering Council (JEDEC) SSO, which has also defined the LRDIMM standard. Skog and I emphasize the difference between "competing standards," such as the simultaneous competition between VHS and Betamax, and "successive standards" whereby a later standard builds on and supersedes the technology in a previous standard to solve the same technological question in a more advanced manner.

value across holders of patents essential to the DDR<sub>4</sub> LRDIMM standard on the basis of a forward-citation weighting methodology to calculate the value attributable to each standard-essential patent (SEP).<sup>3</sup> We then used that information to determine a royalty range that would be reasonable and nondiscriminatory (RAND) for a given SEP holder to charge to license its SEPs on the basis of the value that it contributed to the standard.

To be clear, our hedonic price analysis can assess whether a given offer to license an SEP (or a portfolio of SEPs) pursuant to a RAND obligation is reasonable. Similarly, hedonic price analysis can assess whether an offer to license an SEP (or a portfolio of SEPs) is reasonable under an obligation to offer to license SEPs on fair, reasonable, and nondiscriminatory (FRAND) terms. The methodology, however, does not speak to the question of whether that offer is nondiscriminatory within the meaning of the same FRAND or RAND obligation, or whether the offer is fair (under a FRAND obligation). A hedonic price analysis is likely to be particularly helpful in cases where there are no comparable licenses and, therefore, the nondiscrimination requirement is not likely to be an issue. (Indeed, the existence of a comparable license is a prerequisite to asking whether the implementer in question is similarly situated to the first licensee.) A situation in which there are no comparable licenses arises in particular for a new standard or an SEP holder without any licensees (including smaller patent holders, startups, and recent entrants).

Only two months after Skog and I published *Hedonic Prices and Patent Royalties* in August 2017, Dr. Allan Shampine of the CompassLexecon economic consultancy published a review of that article<sup>4</sup> arguing that the Sidak-Skog hedonic price model for LRDIMMs does not comply with the Federal Circuit's decision in *Ericsson Inc. v. D-Link Systems, Inc.*<sup>5</sup> Shampine argues that the Sidak-Skog model does not separate the value of a patented technology used in LRDIMMs from the value attributable to that patent's inclusion in the LRDIMM standard.<sup>6</sup> According to Shampine, to calculate the value of the patented technology separately from the value that a patent receives merely from being included in the standard, one must use an "ex ante incremental value approach," pursuant to which a FRAND or RAND royalty for the patent in suit equals the increment by which the value created by the

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<sup>3</sup> On the use of alternative citation-weighting methodologies, see J. Gregory Sidak & Jeremy O. Skog, *Citation Weighting, Patent Ranking, and Apportionment of Value for Standard-Essential Patents*, 3 CRITERION J. ON INNOVATION 201 (2018).

<sup>4</sup> Allan L. Shampine, *Paper Trail: Working Paper and Recent Scholarship*, ANTITRUST SOURCE, Oct. 2017, at 1 (review of Sidak & Skog, *Hedonic Prices and Patent Royalties*, *supra* note 2) [hereinafter Shampine, *Review*]. The *Antitrust Source* is an online publication of the Antitrust Section of the American Bar Association. Its lead economics editor is John Woodbury of the Charles River Associates economic consultancy (also known as CRA International). Shampine also edits the *Antitrust Source*. See Curriculum Vitae of Allan Shampine, at 1 (Mar. 2019), <https://www.compasslexecon.com/wp-content/uploads/2018/04/Allan-Shampine-CV-March-2019.pdf>.

<sup>5</sup> 773 F.3d 1201 (Fed. Cir. 2014).

<sup>6</sup> Shampine, *Review*, *supra* note 4, at 2.

patent in suit exceeded the value created by the next-best substitute that the SSO considered (but rejected) for inclusion into the standard.<sup>7</sup>

Shampine's criticism is incorrect. The Federal Circuit has never endorsed the *ex ante* incremental value approach for the calculation of a FRAND or RAND royalty. Instead, it has merely reiterated the long-recognized principle that damages for patent infringement must be apportioned to the value of the patented technology.<sup>8</sup> The Federal Circuit has emphasized that, in the context of SEPs, such apportionment requires the exclusion of any value attributable to standardization.<sup>9</sup> Although the Sidak-Skog hedonic price analysis appropriately separates the value of the patented technology included in the LRDIMM standard from the value of standardization according to the revealed preferences of consumers, and thus the Sidak-Skog analysis in fact faithfully complies with the Federal Circuit's ruling in *Ericsson v. D-Link*.

In a larger sense, Shampine's criticisms epitomize the fallacies that continue to infect the opinions of many economic experts in FRAND or RAND disputes. Shampine critiques a new empirical method for determining a RAND royalty, but his criticisms are not econometric ones. Rather, they concern three questions.

First, what is the proper definition of the legal question to be answered when valuing an SEP? Shampine argues that hedonic price analysis does not comply with a normative principle that he would like to impose on the law—that one must use the *ex ante* incremental value approach to determine a FRAND or RAND royalty. Thus, our disagreement rests on epistemological grounds. However, the principle that Shampine prefers and advocates is impossible to effectuate in the real world. It would send the finder of fact on a wild goose chase of nonfalsifiable speculation.

Second, what is the plausibility, as a matter of first principles, of a key assumption in the hedonic model regarding the value over time of having a standard? As I will explain, my 2017 article with Skog carries the burden to show that the assumption that the value of standardization does not change between iterations of a standard is economically sound and reasonable. Shampine disagrees, but he does not explain why, much less provide any empirical evidence to support his contrary opinion.

Third, what is the hedonic methodology's susceptibility to *Daubert*?<sup>10</sup> In that decision, the Supreme Court explained that “the [Federal] Rules of Evidence—especially Rule 702—do assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand.”<sup>11</sup> Therefore, it is important to read Shampine's criticisms of the Sidak-Skog model in light of the fact that the use of hedonic price analysis to calculate SEP royalties has survived at least one *Daubert*

<sup>7</sup> *Id.* at 3.

<sup>8</sup> *Ericsson v. D-Link*, 773 F.3d at 1232 (citing *Garretson v. Clark*, 111 U.S. 120, 121 (1884)).

<sup>9</sup> *Id.*

<sup>10</sup> *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993).

<sup>11</sup> *Id.* at 597.

challenge in federal district court.<sup>12</sup> In addition, and more generally, the Supreme Court has specifically observed that a scientific methodology is not inadmissible merely because it is novel.<sup>13</sup>

In Part I of this article, I explain why the *ex ante* incremental value approach that Shampine endorses misapplies the standard *ex ante* hypothetical negotiation framework used in non-SEP patent-infringement cases, and that courts do not in fact rely on the *ex ante* incremental value approach to calculate a FRAND or RAND royalty in disputes concerning SEPs. Furthermore, I explain that an economic expert's reliance on the *ex ante* incremental value approach in federal court in the United States would likely make that expert's testimony inadmissible under the Federal Rules of Evidence because it would require so much speculation based on so little hard data as to be unreliable. In Part II, I explain why Shampine's criticisms of the Sidak-Skog hedonic price model are incorrect, and why, to the contrary, that model properly disaggregates the value of the patented technology from the value of standardization. In addition, I analyze why the use of a hedonic price model to determine a FRAND or RAND royalty does not improperly rely on the "Book of Wisdom." In Part III, I explain why, contrary to Shampine's intimation otherwise, the 2017 Sidak-Skog hedonic price model was indeed a novel contribution to the economic literature on FRAND and RAND royalties. In Part IV, I remark on Shampine's curious assertions of nonpublic facts when he praises a particular portion of the Sidak-Skog article.

#### I. USING AN *EX ANTE* INCREMENTAL VALUE APPROACH TO CALCULATE A FRAND OR RAND ROYALTY

Shampine asks whether "hedonic pricing [can] fit into the *ex ante* framework at all."<sup>14</sup> For most of his commentary, he strongly suggests that the answer is no, and that the hedonic price analysis in the 2017 Sidak-Skog article should be considered an unreliable methodology for expert economic testimony. However, the *ex ante* incremental value approach that Shampine advocates is a problematic methodology for determining a FRAND or RAND royalty for both theoretical and practical reasons. First, the methodology rests on an incorrect economic understanding of standard setting, and, if used, the methodology would systemically bias the FRAND or RAND royalty in favor

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<sup>12</sup> Memorandum Opinion and Order at 2, *Huawei Techs. Co. Ltd. v. T-Mobile US, Inc.*, No. 2:16-CV-00052-JRG-RSP (E.D. Tex. Sept. 10, 2017) ("Dr. Vander Veen isolates the portion of that total revenue attributable to LTE technology using price regression analysis, which is a method Dr. Vander Veen uses to determine how the price of a mobile carrier plan is dependent on LTE coverage. In other words, Dr. Vander Veen estimates the price a customer would pay for LTE technology."); *id.* at 8 ("Dr. Vander Veen's damages opinion satisfies *Daubert* and Rule 702 [of the Federal Rules of Evidence].").

<sup>13</sup> *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 151 (1999) (Breyer, J.) ("*Daubert* made clear that its list of factors was meant to be helpful, not definitive. Indeed, those factors do not all necessarily apply even in every instance in which the reliability of scientific testimony is challenged. It might not be surprising in a particular case, for example, that a claim made by a scientific witness has never been the subject of peer review, for the particular application at issue may never previously have interested any scientist.").

<sup>14</sup> Shampine, *Review*, *supra* note 4, at 3.

of the implementer (over the SEP holder). Second, implementing the *ex ante* incremental value approach would require using hypothetical data that do not exist. It should therefore come as no surprise that, in practice, it appears as of August 2019 that no court has ever used an *ex ante* incremental value approach to determine a FRAND or RAND royalty for SEPs.

*A. Reasonable Royalties and the Hypothetical Negotiation Theory*

Under section 284 of the Patent Act, if a claimant successfully proves the infringement of a patent, “the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer.”<sup>15</sup> In determining damages for patent infringement, courts often rely on the hypothetical negotiation framework, which “attempts to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before the infringement began.”<sup>16</sup> In *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, the U.S. District Court for the Southern District of New York identified fifteen factors comprising “[a] comprehensive list of evidentiary facts relevant . . . to the determination of the amount of a reasonable royalty for a patent license.”<sup>17</sup> The Federal Circuit subsequently endorsed the framework, stating: “A reasonable royalty can be calculated from . . . a hypothetical negotiation between the patentee and infringer based on the factors in *Georgia-Pacific*.”<sup>18</sup> In other words, in a typical patent-infringement case, the court will use an *ex ante* hypothetical negotiation framework to determine a reasonable royalty upon which the parties would have agreed at the moment immediately before the defendant first infringed the patent.

*B. Why the Ex Ante Incremental Value Approach for Patent-Infringement Cases Involving SEPs Misapplies the Standard Hypothetical Negotiation Framework*

The *ex ante* incremental value approach that Champine advocates in his article modifies the hypothetical negotiation framework used in a typical patent-infringement case—that is, a case concerning non-SEPs (also known as implementation patents)—by moving the date of the hypothetical negotiation from the moment immediately before first infringement to the moment immediately before standard adoption. SEPs are complements—not substitutes. One cannot examine the next-best noninfringing alternative to an

<sup>15</sup> 35 U.S.C. § 284.

<sup>16</sup> *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1324 (Fed. Cir. 2009) (citing *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970); *Rite Hite Corp. v. Kelley Co.*, 56 F.3d 1538, 1554 n.13 (Fed. Cir. 1995); *Radio Steel & Mfg. Co. v. MTD Prods., Inc.*, 788 F.2d 1554, 1557 (Fed. Cir. 1986)); *see also* *Aqua Shield v. Inter Pool Cover Team*, 774 F.3d 766, 770 (Fed. Cir. 2014); *Uniloc USA, Inc. v. Microsoft Corp.*, 632 F.3d 1292, 1312 (Fed. Cir. 2011).

<sup>17</sup> 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970), *modified and aff'd*, 446 F.2d 295 (2d Cir. 1971).

<sup>18</sup> *Wordtech Sys., Inc. v. Integrated Networks Solutions, Inc.*, 609 F.3d 1308, 1319 (Fed. Cir. 2010) (citing *Lucent Tech., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1324 (Fed. Cir. 2009); *Minks v. Polaris Indus., Inc.*, 546 F.3d 1364, 1372 (Fed. Cir. 2008)); *see also* *Elbit Sys. Land and C4I Ltd. v. Hughes Network Sys., LLC*, 927 F.3d 1292, 1299–1300 (Fed. Cir. 2019) (Taranto, J.).



SEP unless one backdates the hypothetical negotiation between the patent holder and the implementer (who is notionally represented by the SSO, acting collectively) to the moment of standard adoption. The *ex ante* incremental value method does so and then, critically but implicitly, makes the economist's *ceteris paribus* assumption—that all other factors remain the same as one factor is changed. But do all other factors really remain the same in the real world? Certainly not. The need to undertake a hypothetical bargaining analysis is not authority to include dispositive assumptions, either explicit or implicit, that are unworldly.

Beyond the practical limitations to determining a FRAND or RAND royalty through an *ex ante* incremental value approach in an economically rigorous manner, upon which I will elaborate in Part I.B.3, that approach itself rests on incorrect theoretical propositions about economic behavior. The *ex ante* incremental value approach sets an arbitrary point in time at which to consider the hypothetical negotiation, and it neglects the implementer's costs of lawfully acquiring the next-best noninfringing alternative. Moreover, the model upon which the *ex ante* incremental value approach is predicated—a static Bertrand pricing game without capacity constraints<sup>19</sup>—inaccurately portrays how technology becomes incorporated into a standard; rather, that process more closely resembles the structured rivalry observed in a tournament. Yet, to my knowledge, Shampine and the other proponents of the *ex ante* incremental value approach have never explained why the economic literature on tournaments is less instructive than their inapt attempt to use a static Bertrand pricing model to explain the manifestly dynamic phenomenon of competition through innovation.

1. *The Mistaken Timing of the Hypothetical Negotiation in the Ex Ante Incremental Value Approach*

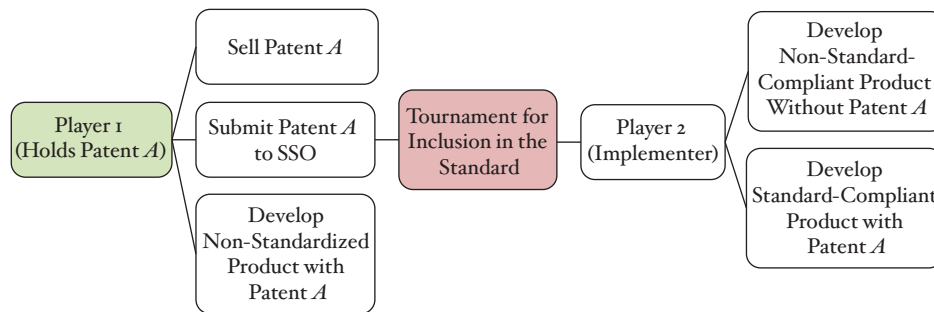
From an economic perspective, the *ex ante* incremental value approach is specious because it is “not *ex ante* enough.”<sup>20</sup> To be unbiased and intellectually

<sup>19</sup> Bertrand competition describes a (static) situation in which each competing firm's strategy consists of its choice of the price at which to sell its output. See, e.g., MICHAEL L. KATZ & HARVEY S. ROSEN, MICROECONOMICS 504–08 (McGraw-Hill 3d ed. 1998); DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 171–72 (Pearson 4th ed. 2005). Formally, one can view the degree of product differentiation in a Bertrand pricing game as measuring the incremental value of a technology. As technologies become more differentiated, the incremental value of the best technology over the next-best technology increases, and the Bertrand-equilibrium price approaches the monopolist's price. As technologies become less differentiated, the incremental value of the best technology over the next-best technology decreases, and the Bertrand-equilibrium price approaches the perfectly competitive price. See CARLTON & PERLOFF, *supra*, at 172–74; JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 210–12 (MIT Press 2002) (1988).

<sup>20</sup> I have made this argument repeatedly in the scholarly literature since at least 2013. See J. Gregory Sidak, *The Meaning of FRAND, Part I: Royalties*, 9 J. COMPETITION L. & ECON. 931, 983 (2013); J. Gregory Sidak, *Is Patent Holdup a Hoax?*, 3 CRITERION J. ON INNOVATION 401, 452 (2018). Proponents of the *ex ante* incremental value approach, including Shampine, continue to ignore my argument. See, e.g., PATENT REMEDIES AND COMPLEX PRODUCTS: TOWARD A GLOBAL CONSENSUS (C. Bradford Biddle, Jorge L. Contreras, Brian J. Love & Norman V. Siebrasse eds., Cambridge Univ. Press 2019); Timothy S. Simcoe & Allan L. Shampine, *Economics of Patents and Standardization: Network Effects, Hold-Up, Hold-Out, Stacking*, in THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND

rigorous, the chosen moment of the hypothetical negotiation between the willing licensor and the willing licensee of an SEP must be pushed back in time not merely from the eve of first infringement to the eve of the SSO's standard adoption, but rather all the way back to the moment just before the patent holder decided to monetize his invention within the open standard of the SSO in question by declaring his patent essential rather than outside the SSO through a proprietary standard or some other business strategy predicated on exclusion rather than open access, as shown in Figure 1.<sup>21</sup>

Figure 1. The Process by Which a Patent Holder Can Monetize Proprietary Technology



As Figure 1 shows, the *ex ante* incremental value approach considers the value of the patent holder's technology after the patent holder has already decided to monetize its technology through a standard (shaded in red). In contrast, at the earlier moment (shaded in green), both the patent holder and the implementer still have outside options to the hypothetical negotiation. Both the seller and the buyer of innovative inputs intended for the downstream product still have substitution opportunities. Neither party at that anterior moment is subject to lock in or holdup. That moment more closely resembles the Rawlsian original position, in which the patent holder and implementer are both still veiled in ignorance of the commercial potential of the technology before them.

In contrast, the *ex ante* incremental value approach is selective, asymmetric, and therefore inherently biased: it sets a FRAND rate so as to restore the implementer—but not the patent holder—to his original position. The

PATENTS 100 (Jorge L. Contreras ed., Cambridge Univ. Press 2017); Mark A. Lemley & Timothy Simcoe, *How Essential Are Standard-Essential Patents?*, 104 CORNELL L. REV. 607 (2019); A. Douglas Melamed & Carl Shapiro, *How Antitrust Law Can Make FRAND Commitments More Effective*, 127 YALE L.J. 2110, 2113 (2018); William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385, 392 (2016).

<sup>21</sup> For a general discussion of the strategic options available to innovators generally (not merely SEP holders), see the classic analysis in David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RESEARCH POL'Y 285 (1986). If there is a competing standard, another outside option for the patent holder is to commit its patented technology to a different SSO. Figure 1 does not include that possible option.

implementer in the hypothetical negotiation would still have substitution opportunities, but the patent holder would not.

2. *The Neglected Costs of Acquiring the Next-Best Noninfringing Alternative*

The *ex ante* incremental value approach ignores the implementer's acquisition cost of the next-best noninfringing substitute, and thus it mischaracterizes what a FRAND or RAND royalty commitment represents. So long as the *ex ante* incremental value exceeds the difference in the licensing price for two competing patented technologies, the licensees will purchase the rights to the higher-valued technology at a price up to the incremental value of that patent *plus* the price of lawfully acquiring the right to use the less valuable patent. So, even under these relatively weak assumptions, the price for the patent must exceed the *ex ante* incremental value.

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

A second example might help proponents of the *ex ante* incremental value approach to grasp this argument with greater immediacy. Suppose that in a FRAND lawsuit the alleged infringer has the choice of retaining as its expert economic witness a Stanford professor for \$1,200 per hour or a Harvard professor for \$1,400 per hour. Assume that both economists possess the prerequisites to perform the engagement competently, but that the Harvard professor is more famous. Would a reasonable price for the services of the Harvard professor be \$200 per hour, since that amount is the extent of his incremental value to the client over the value of the next-best alternative not chosen—namely, the equally competent but less famous Stanford professor? The fact that patent litigators do not observe Harvard professors charging \$200 per hour for their time answers that question.

Granted, in some cases, it might be possible for the implementer to acquire the rights to the next-best noninfringing substitute at zero additional expense, such as if the technology exists in the public domain. But one cannot generalize this condition, and it is fallacious economic reasoning simply to assume (as expert economic witnesses often do) that the next-best alternative is free. The cost of acquiring the next-best alternative is a fact-specific inquiry that courts would need to determine on a case-by-case basis. Thus, the *ex ante* incremental value approach provides no assurance that the licensee's incremental profit from using the patent in suit rather than the next-best noninfringing substitute will translate into a high enough royalty to enable the patent holder to recover the sunk costs of developing the patented technology.



3. *The Inapplicability to Standard Setting of a Static Bertrand Pricing Game Without Capacity Constraints*

According to the *ex ante* incremental value approach, if two inventors each develop a similar substitute technology, and the two technologies would generate an equal amount of value to a manufacturer, then the manufacturer would need to pay only a nominal FRAND royalty for the technology chosen for adoption into the standard, because the two inventors would compete to sell their respective technologies and thus would enable the manufacturer to bid down the FRAND royalty to nearly zero. The argument that a FRAND royalty is effectively zero implicitly depends on modeling competition between the technologies in standards development and standards setting process as a static Bertrand pricing game without capacity restraints. However, the argument that a price war between SEP holders would drive down a FRAND royalty nearly to zero requires one to make at least three heroic assumptions: (1) that there is no differentiation between the competing (substitute) technologies, (2) that the inventors lack any outside option for monetizing their technologies, and (3) that each inventor has some ancillary revenue stream generating a positive return to its participation in the SSO, such that the inventor can cover the costs of that participation without licensing its patents. When assumptions (1) and (2) are met, the SEP holder cannot receive a positive payoff from any use of its SEPs, including participation in the SSO. However, unless the costs of participation in the SSO are zero, the SEP holder still will not participate, absent some ancillary revenue stream. The ancillary revenue source could arise from vertical integration or from some other form of multiproduct output that enables the SEP holder to internalize some of the benefit arising from the standard by offering an SEP at a zero royalty. In any case, this ancillary revenue stream is a significant deviation from the traditional assumptions underlying Bertrand competition.

What empirical evidence indicates that an SSO could simultaneously choose from *many* substitute technologies for each and every facet of a standard, and that those substitute technologies are all homogeneous in terms of price and quality? None. If all substitute technologies were homogeneous, then standard setting would essentially be a lottery—and a most peculiar lottery at that, with a winner who receives only a penny for his troubles. The *ex ante* incremental value approach ignores the need to ensure the continued participation of inventors in the current standard and in future standards.

Compared with a static Bertrand pricing game without capacity constraints, a more appropriate model for determining a FRAND royalty is a tournament.<sup>22</sup> Economists have long studied the effects of tournament structures and prizes on effort levels.<sup>23</sup> All things being equal, higher prize levels

<sup>22</sup> See J. Gregory Sidak, *Tournaments and FRAND Royalties*, 1 CRITERION J. ON INNOVATION 101 (2016).

<sup>23</sup> See, e.g., Edward P. Lazear & Sherwin Rosen, *Rank-Order Tournaments as Optimum Labor Contracts*, 89 J. POL. ECON. 841 (1981); H. Lorne Carmichael, *The Agents-Agents Problem: Payment by Relative Output*, 1 J. LAB. ECON. 50 (1983); Clive Bull, Andrew Schotter & Keith Weigelt, *Tournaments and Piece Rates: An Experimental Study*, 95 J. POL. ECON. 1 (1987).

lead to better performances by the participants, and higher marginal returns to effort cause participants to exert greater effort.<sup>24</sup>

In standard setting, firms invest not only in developing patents, but also in competing to have their technologies adopted into a standard. This form of rivalry exemplifies dynamic competition, in which firms compete not *within* the market but *for* the market.<sup>25</sup> If the winner of that tournament—whose patented technology the SSO adopts into the standard—is not compensated for that additional investment, how can one expect patent holders to invest in participation in the collective development and setting of open standards? Investment in innovation would flow instead into proprietary standards—of precisely the sort that, if they proved to be commercially successful, fuel titanic disputes over monopolization or abuse of dominance.

The “winner-take-all” nature of standard setting increases the risk to inventors and their investors. Using the *ex ante* incremental value approach and other rent-shifting proposals that view low prices for intellectual property as the sole objective of standard setting fails to compensate inventors and their investors for their risk bearing. A royalty that excludes all value associated with the patent’s contribution to the standard will deter investments in contributions to the standard. In contrast, a tournament-based model would consider that the expected payoff for each participant must satisfy each participant’s individual-rationality constraint. Consequently, the aggregate payoff—which in this case equals the FRAND royalty itself—must exceed the sum of the costs of participation *for each participant*.

C. *Is It Common or Feasible for Economists or Judges to Use an Ex Ante Incremental Value Approach to Determine a FRAND or RAND Royalty?*

Although U.S. courts have discussed the *ex ante* incremental value approach in the context of FRAND and RAND disputes, in practice, no U.S. court has ever used that methodology to determine a FRAND or RAND royalty. The most common methodologies for determining a FRAND or RAND royalty—a comparable-license analysis or a top-down analysis—do not purport to synchronize the royalty analysis to the moment immediately before standard adoption. Furthermore, an expert’s use of an *ex ante* incremental value approach to determine a FRAND or RAND royalty would likely be too unreliable to meet the standards in the Federal Rules of Evidence for the admissibility of expert testimony.

<sup>24</sup> See Ronald G. Ehrenberg & Michael L. Bognanno, *Do Tournaments Have Incentive Effects?*, 98 J. POL. ECON. 1307, 1322 (1990); see also Ronald G. Ehrenberg & Michael L. Bognanno, *The Incentive Effects of Tournaments Revisited: Evidence from the European PGA Tour*, 43 INDUS. & LAB. REL. REV. 74-S (1990).

<sup>25</sup> See Harold Demsetz, *Why Regulate Utilities?*, 11 J.L. & ECON. 55, 57 & n.7 (1968); see also J. Gregory Sidak & David J. Teece, *Dynamic Competition in Antitrust Law*, 5 J. COMPETITION L. & ECON. 581 (2009). For a related explanation of the static versus dynamic benefits of standardization, see Jonathan D. Putnam, *Economic Determinations in “Frاند Rate”-Setting: A Guide for the Perplexed*, 41 FORDHAM INT’L L.J. 953 (2018).

*I. What the Case Law Says*

Discussion of the *ex ante* incremental value approach appears as dicta in some U.S. case law.<sup>26</sup> However, as of August 2019, I am not aware of a single case in the United States in which a judge or jury purported to *compute* a FRAND or RAND royalty using the *ex ante* incremental value approach that Shampine describes and endorses. Moreover, it should be noted that the European Union and the United Kingdom do not require that the value of the standard be excluded when calculating a FRAND or RAND royalty, thus mooting any alleged issues arising from an *ex post* approach to determining a FRAND or RAND royalty.<sup>27</sup> Many disputes over SEPs are global in scope, and the controlling law in SEP disputes (even if they are litigated in the United States) often is that of a country other than the United States.

Like Shampine, some economists, academics, government agencies, and other commentators misstate that U.S. law *requires* that patent damages be calculated on the basis of an *ex ante* hypothetical negotiation occurring immediately before the standard is adopted.<sup>28</sup> That proposition is simply incorrect.

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<sup>26</sup> See, e.g., *In re Innovatio IP Ventures, LLC Patent Litigation*, No. 11 C 9308, 2013 WL 5593609, at \*37, \*40 (N.D. Ill. Oct. 3, 2013) (Holderman, J.); *Microsoft Corp. v. Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217, at \*18–20 (W.D. Wash. Apr. 25, 2013) (Robart, J.).

<sup>27</sup> See, e.g., *Unwired Planet Int'l Ltd v. Huawei Techs. Co.* [2017] EWHC (Pat) 2988 [97] (Eng.) (“When talking about FRAND economists refer to the idea that the FRAND rate represents the rate which would be agreed ‘ex ante’, in other words before the patented invention is adopted into the standard. . . . In the concurrent evidence session Prof [Damien] Neven [of CompassLexecon] explained that he did not regard FRAND as a scheme which meant the patentee could not appropriate some of the value that is associated with the inclusion of his technology into the standard and the value of the products that are using those standards. Dr [Gunnar] Niels [of Oxera] agreed with that. Neither side disputed this and to the extent it is a matter for the economists, I accept their evidence. The economists’ opinions show that it is not necessary to deprive the patentee of its fair share of those two sources of value in order to eliminate hold up and fulfil the purpose of FRAND.”).

<sup>28</sup> See Shampine, *Review*, *supra* note 4, at 1–2; Oral Argument at 33:29–40, TCL Comm’n Tech. v. Telefonaktiebolaget LM, No. 2018-1363 (Fed. Cir. Aug. 7, 2019) (“The test . . . for FRAND is to look at what is the value that’s added to the product over other alternatives prior to the establishment of the standard.”) (argument of Stephen Korniczky of Sheppard Mullin on behalf of TCL), <http://oralarguments.cafc.uscourts.gov/default.aspx?fl=2018-1363.mp3>; Gregory K. Leonard & Mario A. Lopez, *Determining RAND Royalty Rates for Standard-Essential Patents*, 29 ANTITRUST, Fall 2014, at 86, 87 (“The definition of RAND can be further refined to be the *ex ante* incremental value of the SEP, which is the additional value provided by the SEP over the next-best substitute technology.”); see also Gregory K. Leonard, *Reflections on the Debates Surrounding Standard-Essential Patents*, 14 ANTITRUST SOURCE, Aug. 2015, at 1, 5 (“One element of the SEP debates is whether a ‘reasonable’ royalty for an SEP under a RAND commitment should be based on a valuation of the SEP before the standard was set, often termed to be an ‘*ex ante*’ valuation. Some have pointed out that such a valuation is *ex ante* only with respect to the implementer’s sunk cost investments in developing their products; it is *ex post* with respect to the inventor’s sunk cost investments in developing the patented invention. However, the framework of the U.S. patent system calls for patents to be valued in the *ex ante* sense defined above.”); Mark Lemley & Carl Shapiro, *A Simple Approach to Setting Reasonable Royalties for Standard-Essential Patents*, 28 BERKELEY TECH. L.J. 1135, 1148 (2013) (“The hypothetical negotiation needs to take place under conditions where the alternative specifications have been identified, so that the parties are well informed about the best potential non-infringing alternatives to the proposed standard. . . . The key idea here is that a reasonable royalty should reflect what would happen as a result of well-informed *ex ante* technology competition. The incremental value of the patented technology over and above the next-best alternative serves as an upper bound to the reasonable royalties. To this end, SSO best practice includes maintaining records, such as minutes from SSO meetings, that will inform subsequent negotiators and arbitrators of the *ex ante* technical alternatives that were feasible or considered, along with their pros and cons.”).

That misrepresentation of the controlling law has appeared in the literature at least since 2007 and has been exhaustively rebutted.<sup>29</sup>

Shampine specifically argues that the Sidak-Skog hedonic price analysis violates *Ericsson v. D-Link* because it supposedly violates his vision of the *ex ante* incremental value approach. He contends that “[a]pplying a hedonic regression to data reflecting current usage of a standard is, by definition, an *ex post* approach, and, by definition, it seems that the value that is estimated for a SEP will reflect the ‘increased value the patented feature gains from its inclusion in the standard.’”<sup>30</sup> Shampine is misinformed. He implies a false equivalence between the Federal Circuit’s holding in *Ericsson v. D-Link* and the *ex ante* incremental value approach that he advocates. As an evidentiary matter, whether or not the *ex ante* incremental value approach is one of several permissible methodologies for satisfying *Ericsson v. D-Link* in no way proves that *Ericsson v. D-Link* mandates that every other permissible methodology must satisfy the *ex ante* approach. Shampine’s article obscures the fact that in *Ericsson v. D-Link* the Federal Circuit affirmed the district court’s analysis of comparable licenses to determine a RAND royalty, which, as I explain in Part I.B.2, is not an *ex ante* methodology.<sup>31</sup> Furthermore, the fact that in 2011 the Federal Trade Commission (FTC) advocated a particular theory for calculating a FRAND or RAND royalty obviously does not bind the Federal Circuit or any other court with respect to how it construes a FRAND or RAND obligation.<sup>32</sup> Nor can the FTC’s policy advocacy alter the fact that the FRAND contract and the RAND contract are both a voluntary modification by contract of the rights and duties arising under the public law embodied in a nation’s patent statutes and the court decisions interpreting those statutes.<sup>33</sup>

Shampine falls prey here to a common error of economists who testify or consult in litigation: he fails to distinguish normative propositions about what one thinks the law *ought to be* from positive statements about what the law *is*. Shampine assumes that the controlling law that defines the question on which it might be helpful and relevant, as a matter of the law of evidence, for him to opine coincides with the normative rule that he would prefer the courts to announce. To the contrary, the controlling principle for relevant and helpful expert economic testimony is the positive rule that courts actually use to decide cases.

<sup>29</sup> See, e.g., Sidak, *Is Patent Holdup a Hoax?*, *supra* note 20, at 448–55; Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 20, at 968–86.

<sup>30</sup> Shampine, *Review*, *supra* note 4, at 3 (quoting *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1235 (Fed. Cir. 2014)).

<sup>31</sup> *Ericsson v. D-Link*, 773 F.3d at 1225–28.

<sup>32</sup> See Shampine, *Review*, *supra* note 4, at 2 (quoting FED. TRADE COMM’N, *THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION* 23 (2011)).

<sup>33</sup> See J. Gregory Sidak, *The FRAND Contract*, 3 CRITERION J. ON INNOVATION 1, 10–11 (2018); Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 20, at 969 (“[O]ne can view the FRAND commitment as a form of private contracting around a default rule supplied by either statute or case law.”).

2. *Do Courts Even Explain the Relevance of the Ex Ante Incremental Value Approach to the Actual Calculation of a FRAND or RAND Royalty?*

Shampine's fidelity to the theoretical *ex ante* incremental value approach between patent holder and implementer on the eve of standard adoption leads him to dispute the reliability of hedonic price analysis on the grounds that it is not an *ex ante* methodology.<sup>34</sup> But Shampine's argument, if valid, would prove too much.

Another methodology that courts have unquestionably recognized as reliable for calculating a FRAND or RAND royalty is the "top-down" approach, which first assumes that an aggregate level of royalties for the SEPs to a given standard is knowable and known and then divides that aggregate royalty among SEP holders on the basis of the worthiness of the SEP holder in question, which is approximated by indirect evidence such as portfolio quality in a technical sense, forward patent citations, participation in the standard development process, approved contributions to the standard, or some other indicator of technological leadership with respect to the standard in question. But does a court applying the top-down approach really synchronize *anything at all* to the moment immediately before standard adoption? (And, as an aside, when is a standard "set," since many standards go through continual updates?)

There are many different patents (and even more claims identified in those patents) relevant to many different aspects of a given standard. They are not all adopted into the standard simultaneously, and they do not all face the same extent or absence of competition from alternative technologies. It is common for judicial opinions in the United States that report the use of the top-down methodology by the finder of fact to have a prelude extolling the virtue of the *ex ante* incremental value methodology. Yet, it is rare—in the same sense that unicorn sightings are rare—to find a judicial opinion that walks through the mechanics of the top-down calculation and pinpoints precisely where in the arithmetic that calculation is synchronized to the moment immediately before standard adoption. Put differently, the anterior discussion of the *ex ante* incremental value methodology does no heavy lifting, if it does any lifting at all. Such discussions by courts are therefore necessarily dicta rather than the holding of the case.

If this *non sequitur* does not elicit a bit of intellectual embarrassment, consider now the same question with respect to comparable licenses, the analysis of which is clearly the preferred methodology of courts in setting FRAND or RAND royalties or determining whether an offered royalty for

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<sup>34</sup> Shampine, *Review*, *supra* note 4, at 3 ("Applying a hedonic regression to data reflecting current usage of a standard is, by definition, an *ex post* approach, and, by definition, it seems that the value that is estimated for a SEP will reflect the 'increased value the patented feature gains from its inclusion in the standard.'") (quoting *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1235 (Fed. Cir. 2014)); *id.* ("[M]any of the academics, practitioners, and government officials cited by Sidak & Skog favor the *ex ante* approach and disagree with the *ex post* approach, as do I.").



the licensing of an SEP is FRAND or RAND.<sup>35</sup> Again, in what precise manner does a comparable license into which the SEP holder has entered with a similarly situated third party (in the recent past, but necessarily *after* standard adoption) shed any light on an *ex ante* hypothetical negotiation between the SEP holder and the implementer in question that would notionally transpire on the eve of standard adoption? Again, the analysis of comparable licenses that the finder of fact actually uses to calculate a royalty in a FRAND or RAND dispute does not rely in the least on an *ex ante* hypothetical negotiation before standard adoption. And, of course, the practice of analyzing comparable licenses contains a heavy dose of autocorrelation. It is certainly not a typical practice for courts to trace (much less for courts to instruct juries to trace) back to the earliest comparable licenses to confirm that their terms were indeed predicated on what the parties agreed they would have found to be mutually acceptable terms on the eve of standard adoption.

Given that the two most common methodologies that courts have used so far in SEP disputes to calculate a FRAND or RAND royalty do not use any analytics from the theory motivating the *ex ante* incremental value approach, it is specious for Shampine to criticize the Sidak-Skog hedonic price analysis on the grounds that it also does not use any analytics from the *ex ante* incremental value theory.

3. *Would Using the Ex Ante Incremental Value Approach Comply with the Requirements for Expert Testimony Under the Federal Rules of Evidence?*

Implementing the *ex ante* incremental value approach would typically require using hypothetical data that do not exist. At best, the *ex ante* incremental value approach would need to rely on data produced before the standard was set—such as data collected by conjoint analysis surveys, sales predictions, or other methods that all would be limited in their reliability by the issues common to any prediction. Thus, Shampine’s preferred approach would require conjecturing about what competing technologies *might have been* available at the time of standard adoption; his approach would then require evaluating the degree to which the chosen technology was superior to the (conjectured) next-best competing technology (if any existed) that the SSO did not adopt.<sup>36</sup> Expert economic testimony of that nature would likely be

<sup>35</sup> See, e.g., *Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc.*, 809 F.3d 1295, 1303–04 (Fed. Cir. 2015); *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1227–28 (Fed. Cir. 2014); *Apple Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1325 (Fed. Cir. 2014); *Unwired Planet Int’l Ltd v. Huawei Techs. Co.* [2017] EWHC (Pat) 2988 [169]–[170] (Eng.).

<sup>36</sup> See Alexander Galetovic, *Hedonic Prices, Patent Royalties, and the Theory of Value and Distribution: A Comment on Sidak and Skog*, 3 CRITERION J. ON INNOVATION 59, 64–65 (2018) (“It would be difficult to exaggerate the difference between, on the one hand, Sidak’s and Skog’s approach, which deduces the value of a technology from observed market transactions, and, on the other hand, valuation approaches that are based on unobserved hypotheticals.”); *id.* at 70 (“Sidak and Skog make an important contribution, because they link technology valuation with actual and observable market transactions and prices. This sets them apart from authors that argue that courts should compare the new technology with a hypothetical technology that never existed and was seemingly discarded by the standard-setting organization.”).



impractical and unreliable. It would contain little serious economic analysis and a good deal of unverifiable prognostication by industry “futurists.”

It is not clear how Shampine himself envisions using an *ex ante* incremental value approach to determine a FRAND or RAND royalty. In a 2013 article co-authored with Professor Dennis Carlton, Shampine advocates the use of an *ex ante* incremental value approach,<sup>37</sup> yet he acknowledges that “[e]x ante analyses based on the ‘reasonable’ principle can potentially eliminate hold-up, but, as a practical matter, may be costly, difficult to perform, and error-prone.”<sup>38</sup> Later in the same article, Shampine concedes that “[t]here may be circumstances in which performing an *ex ante* analysis is uncertain, making application of the reasonable principle difficult.”<sup>39</sup>

It is telling that in the same year Shampine conspicuously declined to use an *ex ante* incremental value approach in expert economic testimony in a publicly reported decision in a FRAND dispute—the remand of the 613 Investigation before the International Trade Commission (ITC) in 2015, in which he testified on behalf of the alleged infringer (Nokia). The initial determination on remand in that investigation found:

Dr. Allan Shampine testified that he did not reach the conclusion that IDC [InterDigital Communications] had violated a FRAND commitment in this case; that he had concerns that there is holdup, and that if an exclusion order were granted that holdup was a grave concern. He goes on to admit he did not attempt to determine the value of the patents based on the method he would prefer, an “ex ante” value, and stated he did not attempt to assign a specific FRAND rate to them. He did not attempt to determine a specific ex ante FRAND rate for any IDC patent.<sup>40</sup>

In his cross-examination testimony at the remand hearing in the 613 Investigation, Shampine confirmed that he did not calculate the *ex ante* incremental value of the SEPs in suit:

Q. [Mr. Levin, Counsel to Complainant, InterDigital] Your witness statement discusses the concept of ex ante analysis of royalties; is that correct?

A. Yes.

Q. And you believe that an ex ante analysis is the proper way to determine if a royalty offer is consistent with FRAND; correct?

A. I think a FRAND rate should not include holdup, and that involves looking at the value—the incremental value of the patents prior to the standard being set. Then that’s what an ex ante analysis is about.

<sup>37</sup> Dennis W. Carlton & Allan L. Shampine, *An Economic Interpretation of FRAND*, 9 J. COMPETITION L. & ECON. 531, 545 (2013).

<sup>38</sup> *Id.* at 531.

<sup>39</sup> *Id.* at 547.

<sup>40</sup> Initial Determination on Remand at 44–45, *Certain 3G Mobile Handsets and Components Thereof*, Inv. No. 337-TA-613 (USITC Apr. 27, 2015) (internal citations omitted).

Q. But you have not attempted to determine what the ex ante value is of the two asserted patents in this investigation; correct?

A. I've not attempted to assign a specific FRAND rate to them, no.

Q. And you've not attempted to determine a specific ex ante FRAND rate for any InterDigital patent, correct?

A. That's correct.

Q. Nor have you attempted to determine what an ex ante collective set of royalties would be for all of InterDigital's essential patents; correct?

A. That is correct.<sup>41</sup>

Upon further cross examination by the ITC's staff attorney, Shampine again confirmed that he did not actually implement the *ex ante* incremental value approach, notwithstanding his testimony that it is the methodology that one should use to confirm that a royalty offer is legitimately FRAND:

Q. [Lisa Murray, Office of Unfair Import Investigation] You testified earlier that you favor an ex ante framework in which a reasonable royalty can be defined as no more than the ex ante royalty that would have been negotiated before the patented technology was implemented in the standard; is that right?

A. That's correct.

Q. Now, if a technology is adopted into a standard, that tends to indicate that there was some consensus that that technology was better than any alternatives in some way or another; correct?

A. That's a frequent inference made, yes.

Q. So then wouldn't the ex ante value of such a patent be relatively high in any event?

A. No, that doesn't follow.

Q. It doesn't follow that if the patent was—or the technology in the patent was better than the alternatives, that the value of the patent would be high?

A. No, it doesn't. As an example, some standards specify a particular head for an attachment that has to be used, and that's often essentially [an] arbitrary decision, doesn't make any real difference. Now, they can pick one and maybe it's marginally better. But the fact that something is included doesn't mean that it has any great economic significance. . . . Sometimes there may be no incremental value. I'd agree as a general proposition the fact that it gets included probably means it's at least marginally better

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<sup>41</sup> Open Sessions Hearing Transcript at 532:18–533:14, Certain 3G Mobile Handsets and Components Thereof, Inv. No. 337-TA-613 (USITC Jan. 28, 2015) (testimony of Dr. Allan Shampine) [hereinafter Shampine 613 Investigation Testimony]. The attorney tendering Shampine for cross examination was David C. Giardina of Sidley Austin, counsel for Nokia, who subsequently was counsel to SK hynix in the 1023 Investigation, in which I gave expert testimony relying on the hedonic price model that Skog and I subsequently discussed in *Hedonic Prices and Patent Royalties*, *supra* note 2. Giardina took my deposition in the 1023 Investigation in April 2017 and cross examined me about hedonic price analysis in July 2019 during the hearing in the 1089 Investigation, which resulted from a second complaint that Netlist filed against SK hynix.

than the alternatives. But my experience is that frequently it's a very small differential.

Q. So is it your testimony, then, that there could be some patents adopted in the standard for some reason that had an *ex ante* value of zero?

A. Sure, it's possible. Again, my expectation is that usually you'd expect there to have [sic] at least some positive marginal value. And it's certainly possible that some of them are really fundamental. It is absolutely possible that there just aren't any good alternatives and that the patent is for something that's truly fundamental, that you really need in the standard, that does something really important. And if that's the case, then the *ex ante* value is going to be really high, there's no real concern about holdup then because there weren't any alternatives. So it can go both ways.<sup>42</sup>

If Shampine does not undertake the *ex ante* incremental value approach *when actually testifying about a FRAND or RAND royalty*, then his discussion of the *ex ante* hypothetical negotiation is merely window dressing for a methodology that necessarily relies on information that postdates the moment of standard adoption.

Rule 403 of the Federal Rules of Evidence authorizes a federal judge to exclude evidence "if its probative value is substantially outweighed by a danger of . . . unfair prejudice, confusing the issues, [or] misleading the jury."<sup>43</sup> Expert economic testimony that does not satisfy basic standards of intellectual rigor could fall within this general exception to admissibility. Hypothetical conjectures about hypothetical data would not constitute useful economic evidence for the court and could very conceivably confuse the jury. In contrast, the Sidak-Skog hedonic analysis will be more useful, reliable, and probative for the finder of fact. It should not be a close call under Rule 403 for a court to favor one expert's use of actual data that postdate the standard's adoption over the opposing expert's use of hypothetical, nonexistent data that supposedly predate the standard's adoption. Adopting Shampine's recommendation would produce a less reliable evidentiary basis because it would fundamentally compromise the epistemological inquiry by ceding to noneconomists the task of conjecturing about consumer demand.

## II. USING HEDONIC PRICE ANALYSIS TO CALCULATE A FRAND OR RAND ROYALTY

An empirically robust hedonic price model requires the use of *ex post* sales data. However, as I explained in my 2017 article with Skog, and as I explain below, even using *ex post* data, the Sidak-Skog hedonic price model still manages to separate the incremental value of the patented technology from the underlying value of standardization. Thus, the model complies faithfully with the Federal Circuit's ruling in *Ericsson v. D-Link* that a FRAND

<sup>42</sup> Shampine 613 Investigation Testimony, *supra* note 41, at 573:6–575:5.

<sup>43</sup> FED. R. EVID. 403.

or RAND royalty for an SEP (or for a portfolio of SEPs) cannot include the portion of value attributable to the patented technology solely by virtue of its inclusion into the standard. To my knowledge, my use of a hedonic price model to compute a RAND royalty in expert economic testimony in the ITC's 1023 Investigation in 2017 (on which my 2017 article with Skog is based) was the first reported application of hedonic price modeling to the calculation of a FRAND or RAND royalty.

*A. Is It Epistemologically Feasible to Use Hedonic Price Analysis to Simulate an Ex Ante Hypothetical Negotiation of a FRAND or RAND Royalty?*

Although Shampine stops short of saying it explicitly, his intimation to any sophisticated reader is that hedonic price analysis should fail a *Daubert* challenge in a FRAND or RAND dispute tried before a jury. “The bottom line,” he contends, “seems to be that hedonic price analyses can certainly be used under a variety of frameworks, but practitioners should be particularly cautious about how they implement them in RAND cases, as following the Sidak & Skog approach may open the practitioner to charges that the particular implementation (e.g., using *ex post* data that include the value from standardization) is fundamentally inconsistent with the *ex ante* framework.”<sup>44</sup> If the subtlety is not obvious enough, the penultimate sentence of Shampine’s article presents the opinion that any counsel seeking to exclude hedonic price analysis on a *Daubert* motion in a FRAND or RAND dispute tried before a jury will quote:

Although Sidak & Skog should be applauded for grappling with how to apply hedonic analysis in light of *Ericsson v. D-Link*, they do not address how it might be used in the commonly advocated *ex ante* framework, and their claims that they have resolved the problem of isolating the value of the standard in their *ex post* framework are not persuasive to this reviewer.<sup>45</sup>

Shampine’s two major conclusions are wrong, if not also irrelevant. The possibility that good-faith differences of opinion will arise on complex and consequential evidentiary questions is merely one reason why the courts resort to evidentiary burdens of proof, as well as rules limiting the admissibility of evidence lacking probative value. In this case, it is irrelevant (for the reasons already explained in Part I) that the Sidak-Skog hedonic price analysis does not seek to implement the *ex ante* hypothetical negotiation approach, since that approach is not actually a “test” or “rule” that courts apply in practice to identify a FRAND or RAND royalty. That narrative is at most a hortatory *amuse-bouche* before the court gets down to the nitty gritty of making sense of the more limited universe of hard evidence that actually exists and that must

<sup>44</sup> Shampine, *Review*, *supra* note 4, at 3–4.

<sup>45</sup> *Id.* at 6.

in all its imperfections form the basis for the court's conclusions of fact and law in the real world.

Shampine implies that it would indeed be possible to conduct a hedonic price analysis on an *ex ante* basis. He seems to believe that one could find reliable price data necessary for hedonic regression analysis as of the eve of standard adoption, before the product practicing the standard had even come into existence and, therefore, before there were any market transactions to observe.<sup>46</sup> Shampine is wrong. Actual prices with which to perform hedonic price analysis do not exist *ex ante*. He suggests that “a practitioner could look at how people valued particular characteristics prior to the standard being set, and then evaluate the incremental contribution of the patented technology to those characteristics relative to alternatives that might have been included in the standard.”<sup>47</sup> According to Shampine, to perform such analysis, one could use “actual sales data (hedonic analysis) or survey data (conjoint analysis, which Sidak & Skog mention is also used in patent litigation and which relies on similar statistical techniques to hedonic analysis).”<sup>48</sup> To the contrary, the “actual sales data” that Shampine describes are nonexistent, such that this portion of his critique and recommendations is a dead end.

Shampine's recommendation to rely on conjoint analysis to infer consumer valuations of product features before standard adoption is misguided. It is in my opinion so speculative as to be devoid of probative value. A consumer's answer to hypothetical survey questions intended to elicit a revealed preference is not remotely a substitute for actual price data arising from consumption decisions that occurred in fact. The epistemological difference between Shampine's conjoint analysis proposal and the Sidak-Skog hedonic price analysis is captured in a familiar adage: “Put your money where your mouth is.” Hedonic price analysis does so, because it is predicated on prices observed in actual market transactions; conjoint analysis does not, and it would become only more tenuous if conducted, as Shampine recommends, before the standard is adopted.

Shampine's belief that *ex ante* conjoint analysis is feasible recalls a much deeper question in economic theory concerning innovation and consumer demand: do consumers or producers decide, in the first instance, which goods producers shall supply? In 1921, Frank Knight, the great University of

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<sup>46</sup> *Id.* at 5 (“In the RAND context, . . . use of an explicitly *ex post* approach to hedonic analysis raises tricky questions as to how the value of standardization can be separated out, since that value is part of the total value being estimated. Applying hedonic analysis in an *ex ante* framework can address this problem, but practitioners should exercise caution when applying hedonic analysis in an *ex post* framework and be prepared to defend their approach.”).

<sup>47</sup> *Id.* at 3.

<sup>48</sup> *Id.* I do not understand why Shampine would say that the statistical techniques used to analyze data from conjoint surveys are similar to the econometric techniques used to perform hedonic price analysis. The fact that the two methodologies both use multiple regression analysis is not saying much. In any event, Skog and I have shown how the analysis in our 2017 article can be enhanced through the use of machine-learning techniques. See J. Gregory Sidak & Jeremy O. Skog, *Hedonic Prices and Patent Royalties: Epilogue*, 4 CRITERION J. ON INNOVATION 401 (2019) (examining whether the specification of the 2017 Sidak-Skog hedonic price model for memory modules is robust to an objective variable-selection methodology based on a machine-learning algorithm—the least absolute shrinkage and selection operator (LASSO) regression).

Chicago price theorist, argued that producers are better able than consumers to anticipate future consumer preferences. He posed the problem of revelation of consumer preferences as follows: “The essence of organized economic activity is the production by certain persons of goods which will be used to satisfy the wants of other persons. The first question which arises then is, which of these groups in any particular case, producers or consumers, shall do the foreseeing as to the future wants to be satisfied.”<sup>49</sup> Knight did not believe that consumers communicate their preferences clearly to producers. Rather, he reasoned that, “[a]t first sight it would appear that the consumer should be in a better position to anticipate his own wants than the producer to anticipate them for him, but we notice at once that this is not what takes place. The primary phase of economic organization is the production of goods for a general market, not upon direct order of the consumer.”<sup>50</sup> If one accepts Knight’s reasoning, then consumers answering a conjoint survey cannot be expected to know the value of product features that do not yet exist and are not yet consumed. Nor can one expect those consumers to understand (and make tradeoffs about) the relative merits of different technologies that might enable those product features.

There is a commonsense confirmation of this conclusion in the very practical way that courts and other tribunals try patent disputes. It is routine in patent-infringement investigations at the ITC for the administrative law judge (if not also a judge in federal district court) to review a tutorial from the parties on the disputed technology.<sup>51</sup> In federal district court, the judge—not a lay jury of consumers—decides claim construction in a *Markman* hearing.<sup>52</sup> If so much close study is required for a judge to preside competently over an SEP dispute, it is fanciful for Shampine to argue that hedonic price analysis would be reliable *if* it used data derived from subjecting consumers on the eve of standard adoption to a conjoint analysis survey designed to reveal their preferences for the various features of a product that does not yet exist.

Moreover, the reliability of consumer valuations of a product’s features on the eve of standard adoption is likely to be inversely related to the magnitude of the technological contribution of the new standard over its predecessor. The more revolutionary the innovation enabled by the standard, the harder it would be for consumers to know *ex ante*, on the eve of standard adoption, how much they would value the features that the revolutionary technology will enable. One would expect that SSOs aspire to achieve revolutionary advances in product functionalities, not trifling ones. Consequently, we should expect it to be the rule rather than the exception under Shampine’s proposal that the data from a conjoint survey conducted on the eve of standard adoption

<sup>49</sup> FRANK KNIGHT, RISK, UNCERTAINTY AND PROFIT 240 (Houghton Mifflin 1921).

<sup>50</sup> *Id.* I was first struck by this insightful passage by Knight when I was critiquing an antitrust rule to constrain software integration that Lawrence Lessig had proposed during the *Microsoft* case. See J. Gregory Sidak, *An Antitrust Rule for Software Integration*, 18 YALE J. ON REG. 1, 65–66 (2001).

<sup>51</sup> See, e.g., Open Session Hearing Transcript at 14:14–23:4, Certain Memory Modules and Components Thereof and Products Containing the Same, Inv. No. 337-TA-1023 (USITC May 8, 2017).

<sup>52</sup> See, e.g., Memorandum Opinion and Order, *Wi-LAN, Inc. v. HTC Corp.*, No. 2:11-cv-68-JRG (E.D. Tex. Mar. 25, 2013).



will be an unreliable basis on which to predicate expert economic opinions about the value of a given standard or the value of the patented features of a multicomponent product that practices that standard.

*B. Does the Sidak-Skog Hedonic Price Model for LRDIMMs Successfully Exclude the Value from Standardization?*

Shampine contends that that Sidak-Skog hedonic price analysis does not necessarily separate the value of the patents from the value that they acquire from being included in the LRDIMM standard, or “the value of standardization.”<sup>53</sup> I disagree. The Federal Circuit emphasized in *Ericsson v. D-Link* that a FRAND royalty “must be premised on the value of the patented feature, not any value added by the standard’s adoption of the patented technology.”<sup>54</sup> Identifying and isolating the value of a product’s features is precisely the aim of hedonic price analysis.

*1. Isolating the Value of Standardization by Comparing Competing Standards*

To address Shampine’s contention, one must identify precisely what constitutes the value of standardization. As I have previously written, the value of standardization can be reduced to two components: (1) a reduction in transaction costs for implementers of the standard and for SEP holders and (2) the network effects generated by interoperability between standard-compliant products.<sup>55</sup> I isolate this increment of value by comparing the difference in value between competing (and evolving) standards. As Shampine observes, one must identify how the value of the standard is calculated, which will be a fact-intensive inquiry.<sup>56</sup>

Standardization enables a reduction in transaction costs by replacing a series of otherwise bilateral bargaining relationships with multilateral bargaining (regarding standardization, though not pricing), and it allows implementers of the standard to gain the benefits of cross-brand network effects. Shampine considers it unlikely that competing standards will typically be observable: “It is . . . not clear how a practitioner is to select the ‘next-best’ standard.”<sup>57</sup> He then elaborates: “Sidak & Skog note that correct selection of the ‘next-best’ standard is important to their methodology, but it is unclear what constitutes a ‘next-best’ standard or how the practitioner is to measure whatever metric is being used to make that decision.”<sup>58</sup> Such helplessness in the face of a down-to-earth empirical question would, if taken seriously, also doom Shampine’s prescription that we compare, under the *ex ante* hypothetical negotiation, the alternative technologies extant on

<sup>53</sup> Shampine, *Review*, *supra* note 4, at 4.

<sup>54</sup> *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1232 (Fed. Cir. 2014).

<sup>55</sup> J. Gregory Sidak, *The Value of a Standard Versus the Value of Standardization*, 68 BAYLOR L. REV. 59, 60 (2016).

<sup>56</sup> Shampine, *Review*, *supra* note 4, at 4.

<sup>57</sup> *Id.*

<sup>58</sup> *Id.* at 4 n.15.

the eve of standard adoption. Yet, Shampine expresses no concern that *that* question defies analysis. Why should it be nearly impossible to identify the next-best standard, yet thoroughly feasible to identify the next-best technology for a given portion of a given standard?

In short, I reject Shampine's opinion that it is too difficult to identify competing standards so as to implement the Federal Circuit's directive in *Ericsson v. D-Link*. Many of the standards currently practiced are next-generation versions of a previous standard. For example, many of the firms that participated in 4G standardization for mobile communication previously participated in 3G and 2G standardization.<sup>59</sup>

Although the value of standardization *could* vary as standards evolve, that need not be the case. For example, the network effects generated by standardized 3G mobile communication are likely similar to those generated by subsequent standards, as many countries in the world reached 100 percent or greater penetration of the mobile market with 3G devices.<sup>60</sup> Similarly, although 4G products enable more advanced device usage, that value can be attributed to the underlying technologies incorporated into the standard. The value of standardization is not the value of those technologies, but rather the cost savings to parties participating in incorporating those technologies into standardized products. The cost savings, realized through reduced transaction costs for implementers, are a function of the number of participants in the standardization process. In the absence of solid evidence that this number has increased from previous standards, it is sound on economic grounds for the finder of fact to presume that the value of standardization has not increased over time.

Furthermore, from the perspective of economic theory, the continual development of new standards for a given functionality most likely arises from the incentive to (1) incorporate new technological advancements that the original standard could not support or (2) resolve technological snags in the prior standard. Participants in standard setting that value only interoperability would have no incentive to create any new standard beyond the original standard that first achieved that interoperability. In other words, once the original standard for a given functionality is adopted, there is little additional benefit from interoperability that standard-setting participants can enable by developing a new iteration of that standard. Any increase in the value that firms and consumers derive from a new iteration of a standard is most likely driven by the advancement in technologies underlying the standard, not an increase in the value of standardization. Consequently, it is reasonable to believe that, by comparing the value of competing standards, a hedonic price analysis excludes the value of standardization from the value of the standardized technologies.

<sup>59</sup> See Sidak, *The Value of a Standard Versus the Value of Standardization*, *supra* note 55, at 68–69.

<sup>60</sup> See *Mobile Cellular Subscriptions (Per 100 People)*, WORLD BANK, <https://data.worldbank.org/indicator/IT.CEL.SETS.P2>.

Although Shampine questions the assumption that the value of standardization remains constant,<sup>61</sup> he does not present any evidence to support his skepticism. In other words, one should first ask: why, as a matter of first principles of economics, should we expect the value of standardization *not* to be constant as a first approximation? Second, one should advance theoretical and empirical argumentation that the value of the standard is constant over the period of time to be examined. Skog and I put forward such argumentation in our 2017 article, as I did above in this article. The burden of proof now properly shifts to those, including Shampine, who would dispute this proposition. Shampine fails to carry that burden. Instead, he calls the Sidak-Skog analysis “not persuasive to this reviewer.”<sup>62</sup> Thus, he obscures the question of who at this stage in the intellectual debate bears the burden of proving what to whom.

2. *Shampine’s Other Criticisms of the Sidak-Skog Hedonic Price Model Are Wrong*

Shampine further contends that “it is not so clear that the difference between what people are paying for [competing standards] is entirely attributable to the inherent value of the different technologies in the more highly valued standard.”<sup>63</sup> However, a hedonic regression does not measure what people pay for patented *technologies*. Instead, it measures what people pay for measurable *product features*, which, Shampine observes, often will not be *entirely* attributable to patented technologies. A product’s features could include value from unpatented technologies (including expired patents) or firm-specific implementation technologies, and an expert economic witness should account for that possibility. However, an effort to apportion the value of a feature to SEPs, non-SEPs, or potential public-domain technologies can be conducted *after* the value of that feature has been identified, as Skog and I did in our 2017 article.<sup>64</sup>

In general, it is not a legitimate criticism of the hedonic price model to quibble over which patents should or should not have been included among the universe of patents for the purpose of apportionment. That is a style of advocacy that would apply to any methodology for valuing patents (including the comparable license approach and the top-down approach). Because the hedonic price methodology is replicable, that kind of criticism is highly suspect. In litigation, the opposing party, which possesses access to both confidential and nonconfidential information, can replicate the results or produce variations on the results in an attempt to cast doubt on the reliability of the analysis. In my experience, when opposing counsel tries to impeach

<sup>61</sup> Shampine, *Review*, *supra* note 4, at 4 (“Why should the value of standardization be identical for the two standards?”).

<sup>62</sup> *Id.* at 6.

<sup>63</sup> *Id.* at 4.

<sup>64</sup> Sidak & Skog, *Hedonic Prices and Patent Royalties*, *supra* note 2, at 653–56.

the soundness of the hedonic price model by focusing on such nits and failing to respond substantively to the model, one must draw the sophisticated inference that the party lacked a substantive rebuttal, much less a dispositive one.

Shampine also contends that, “[a]fter [a technology for a standard] is selected, . . . competition [from other potential technologies] disappears, and a firm can charge more for the use of its patented technology than it could before, simply because of inclusion in the standard.”<sup>65</sup> He continues that “it is not obvious that the difference in payments for each standard sheds much, if any, light on the value of the patented technology absent its inclusion in the standard.”<sup>66</sup> This criticism is misplaced. As I explain above, the hedonic price model measures what end consumers have demonstrated they are willing to pay for a product’s *features*, not what implementers might pay for *patented technologies*. (Moreover, if a premium *is* being paid for technologies incorporated into a standard merely due to that incorporation, then that practice itself violates the Federal Circuit’s ruling in *Ericsson v. D-Link*.) The hedonic price model will measure what consumers pay for the standardized features of the product in question. A higher willingness to pay for a specific feature indicates that more valuable technologies are incorporated into that feature compared to a feature for which consumers have a lower willingness to pay.

Finally, Shampine contends that “Sidak & Skog also suggest that the value of the SEPs of interest can be separated from the incremental value of the standard by taking the willingness to pay for the standard and apportioning it among SEP holders based on patent counts.”<sup>67</sup> This statement is incorrect. Shampine evidently misunderstands the analysis in the 2017 Sidak-Skog article, because he misstates it. Skog and I do not claim that “patent counts,” conducted specifically through a forward-citation analysis, can separate the value of the standardized technology from the value of standardization. I agree with Shampine that, “if the amount that one starts with includes the value from standardization, then splitting that value up among multiple patented technologies does not address the *Ericsson v. D-Link* concern.”<sup>68</sup> Shampine’s remark is therefore not a legitimate criticism of hedonic price analysis or the 2017 Sidak-Skog article. To the contrary, the concern that he expresses is why Skog and I first identified the value of the patented technologies in the LRDIMM standard *before* apportioning that value across the different holders of SEPs in the LRDIMM standard. Skog and I used the forward-citation analysis of the patents declared essential to the standard to identify how much a specific SEP holder (in this case, Netlist) contributes to the LRDIMM standard.

In short, I agree with Shampine that practitioners must exercise caution and be prepared to defend the consistency of their analysis with the Federal Circuit’s decision in *Ericsson v. D-Link*. My 2017 article with Skog publicly presents that defense.

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<sup>65</sup> Shampine, *Review*, *supra* note 4, at 4.

<sup>66</sup> *Id.*

<sup>67</sup> *Id.* at 5.

<sup>68</sup> *Id.*

C. *Why a Hedonic Price Model to Determine a FRAND or RAND Royalty Does Not Improperly Rely on the “Book of Wisdom”*

In 2016, I criticized use of the “Book of Wisdom,” which uses information observed only after the formation of a contract to inform the calculation of expectations damages, as inappropriate when determining a reasonable royalty for patent infringement.<sup>69</sup> Specifically, I explained that relying on data unavailable at the time of a hypothetical negotiation can create a free option to infringe.<sup>70</sup> If one uses actual sales data to calculate damages, then the potential infringer faces little to no penalty for infringement by an unsuccessful product. Consequently, reliance on the “Book of Wisdom” for purposes of evaluating a hypothetical negotiation on the eve of first infringement will discourage licensing behavior, depress incentives to invest in the development of patentable innovations, and, ultimately, harm innovation.

However, it is manifestly not the law that one engages in a hypothetical negotiation to determine whether an offer that an SEP holder actually made at some specified prior point in time was FRAND (or RAND). In contrast to how one conducts the hypothetical-negotiation analysis, when answering whether an offer was FRAND (or RAND) on a specific date in the past, there is no impediment to examining information that became available only after the moment of first infringement. In fact, the analysis of whether an offer was FRAND (or RAND) specifically *should* rely on the data available at the time the offer was made, which typically occurs substantially after the moment of first infringement. Although the “Book of Wisdom” is potentially harmful—and, at best, unhelpful—for ascertaining the parties’ expectations at the time of a hypothetical negotiation, the most accurate source of data for determining whether a firm made a legitimately FRAND (or RAND) offer is the body of data available to that firm *when it made its offer*.

Importantly, whether the SEP holder’s offer was reasonable, and thus whether the SEP holder performed its duty to make a reasonable offer (pursuant to the FRAND or RAND contract), is a separate question from identifying a reasonable royalty upon which the parties would voluntarily have agreed in a hypothetical negotiation of the licensing of a patent that is not essential to any standard. Those two questions are separate, regardless of whether one fixes the hypothetical negotiation at the moment immediately before first infringement, at the moment of standard adoption, or even at the moment immediately before the SEP holder decided to monetize the patent in suit by declaring it to be essential to an industry standard and agreeing to offer to license it on FRAND (or RAND) terms. It is emphatically not the case that any U.S. court requires the hypothetical negotiation to be fixed at

<sup>69</sup> J. Gregory Sidak, *How Relevant Is Justice Cardozo’s “Book of Wisdom” to Patent Damages?*, 17 COLUM. SCI. & TECH. L. REV. 246 (2016).

<sup>70</sup> *Id.* at 282–84.

the time of standard adoption. Nor is it the case that the typical contractual overlay of a FRAND (or RAND) obligation requires the finder of fact to analyze whether a legitimately FRAND (or RAND) offer made at some point in time would also have been legitimately FRAND (or RAND) at the time of standard adoption or at some prior point in time.

Moreover, if the price data being examined for purposes of analyzing whether an offer was reasonable are contemporaneous with, or precede, the actual negotiations between the SEP holder and the implementer, then it might be the case that several years of data on consumer demand have been available to the parties, such that they could perform hedonic analysis to support or refute the reasonableness of the SEP holder's offer or offers at the point in time when the SEP holder made the offer or offers. Indeed, the Sidak-Skog hedonic model relied on publicly available industry data that De Dios & Associates, a market research firm, regularly compiles and publishes for firms that operate in the memory module industry.<sup>71</sup> Thus, contrary to what Shampine argues, it might actually be possible to use data for the hedonic analysis that predate the moment when the SEP holder made its ostensibly FRAND (or RAND) offer. Shampine cannot envision that possibility because he fixates on the *ex ante* incremental value approach at an earlier point in time, when no such price data are likely to exist.

### III. UNDERSTANDING THE NOVELTY OF THE 2017 SIDAK-SKOG ARTICLE WITHIN THE CONTEXT OF ACTUAL PATENT DISPUTES OVER SEPs

Citing his own article from 2010, Shampine states with a bit of puffery that “[t]he idea of using hedonic regressions to help estimate patent royalties is not novel.”<sup>72</sup> This statement, however, might give the false impression that the use of hedonic price regressions in patent litigation and litigation over FRAND or RAND royalties was commonplace by the time of the 2017 Sidak-Skog article. It was not. Although it is true that other economists had previously suggested “the idea of using hedonic regressions” in patent litigation, it is quite another matter actually to conduct the empirical analysis necessary to proffer expert economic testimony using this methodology and then to submit to cross examination on that methodology in deposition and at trial. To my knowledge, no expert economic witness had done so before the ITC's 1023 Investigation involving Netlist and SK hynix, which of course Skog and I discussed in our 2017 article.

In his article *Price Indexes, Hedonic Analysis, and Patent Damages*, Shampine presents an example concerning the demand for speed of an internet

<sup>71</sup> Sidak & Skog, *Hedonic Prices and Patent Royalties*, *supra* note 2, at 621 n.78.

<sup>72</sup> Shampine, *Review*, *supra* note 4, at 2 (citing Allan L. Shampine, *Price Indexes, Hedonic Analysis, and Patent Damages*, 5 J. INTELL. PROP. L. & PRAC. 84 (2010); Jesse David & Kara Gorski, *Economic Approaches to Royalty Calculations*, LAW360, May 25, 2010).



connection.<sup>73</sup> He presents a strictly *hypothetical* scenario concerning the pricing of broadband over power line (BPL), the speed of which is assumed to be enhanced by the invention taught in the patent in suit. It is important to recognize that Shampine is not discussing the valuation of a single product feature in a multicomponent product, such as a smartphone. The product he purports to examine is homogenous. Consumers, he assumes, do not care whether broadband internet access is provided by BPL, a cable television network, DSL, or optical fiber. They care only about the speed of the internet connection. Put differently, the product in question has only one attribute, feature, or dimension of quality: speed.

Moreover, Shampine's discussion is irrelevant to the fact pattern in a FRAND or RAND dispute over SEPs. As I explained earlier, in the stylized description of standard setting, there is competition *for* the market. Alternative technologies vie for adoption into the standard, but only one is chosen.<sup>74</sup> In contrast, Shampine's example of the demand for bandwidth lists four different technologies that simultaneously are used to provide high-speed internet connectivity (and that is without even considering wireless internet access, which might not have mattered in 2010, when Shampine published his article, but certainly matters today). Shampine argues that the internet-access services enabled by these other technologies give us actual market transactions from which to infer the demand for bandwidth. That information about the demand for this entirely homogenous product—internet speed—can then be used to infer how valuable the patent in suit concerning BPL technology is. An increase in 500 kbps has a market-determined value, and that value may then be used to determine how much the price of BPL (and, ultimately, the profit from providing BPL service) increases when the accused utility practices the patent in suit.

This is a strange discussion, given that Shampine says that the purpose of his article is to give “useful guidance in valuing patents’ contributions” in the face of “price changes associated with changes in product characteristics (referred to by economists as hedonic analysis for price indexes), particularly for complex, rapidly changing products such as computers.”<sup>75</sup> It is hard to see how anything that Shampine discusses in his article begins to tackle the challenge of modeling the incremental contribution of patents practiced by individual components of a multicomponent product, such as an Apple iPhone or the memory module for an enterprise server.

Shampine also cites to a *Law360* article by Dr. Jesse David and Dr. Kara Gorski, *Economic Approaches To Royalty Calculations*, to support his specific contention that “the idea of using hedonic regressions to help estimate patent royalties is not novel.”<sup>76</sup> Indeed, one such “general economic approach[]” to calculating a reasonable royalty that David and Gorski discuss is hedonic

<sup>73</sup> Shampine, *Price Indexes, Hedonic Analysis, and Patent Damages*, *supra* note 72, at 86–87.

<sup>74</sup> See Sidak, *Tournaments and FRAND Royalties*, *supra* note 22, at 105–07.

<sup>75</sup> Shampine, *Price Indexes, Hedonic Analysis, and Patent Damages*, *supra* note 72, at 84.

<sup>76</sup> Shampine, *Review*, *supra* note 4, at 2 (citing David & Gorski, *Economic Approaches to Royalty Calculations*, *supra* note 72).

price modeling.<sup>77</sup> Yet, the totality of what they say about hedonic price analysis is the following:

Hedonic regression is a statistical technique that may be used to decompose the value of a product based on its individual characteristics. Given sufficient information for a large number of sales, including price and multiple product characteristics, hedonic regression analysis may allow for an estimation of the average value of a patented feature, holding all other characteristics constant across sales. Because this type of analysis may require information that is difficult to obtain during the course of a litigation, instead, it may be useful to review hedonic analyses performed by third parties. For instance, government agencies perform hedonic analyses of certain products when constructing price indices.<sup>78</sup>

Certainly, these scant 106 words devoted to explaining the theory of hedonic price analysis, and how one could apply the theory to calculating a reasonable royalty in general, do not begin to compare to the thousands of hours invested to develop a hedonic price model to determine a RAND royalty for Netlist's LRDIMM SEP portfolio. If imitation is the sincerest form of flattery, then Skog and I should take pleasure in observing that Dr. Thomas Vander Veen, an opposing expert economic witness in the ITC's 1023 Investigation, shortly thereafter submitted a hedonic price analysis as expert economic testimony in a patent-infringement case before Magistrate Judge Roy Payne in the Eastern District of Texas, who denied a *Daubert* motion to exclude Dr. Vander Veen's testimony.<sup>79</sup>

Within academia, novelty in research is meritorious. Within litigation, novelty is dangerous. The difference lies in the fact that the epistemological tools that judges use rely heavily not on empirical assessment of testable hypotheses (that is, the scientific method) but on reasoning from authority. In common law jurisdictions, an important source of authority, apart from legislation, is precedent. Consequently, there is much effort in legal advocacy to shoehorn new methods of expert economic testimony into familiar taxa that courts have recognized and embraced. Put a bit more bluntly, there is an incentive to disguise novelty.

Justice Breyer, writing for the Supreme Court in *Kumho*,<sup>80</sup> recognized the tension between the two perspectives on novelty as they affect the admissibility of expert testimony, and he stressed that every idea having scientific merit was once novel, and thus lacking in the validation that comes from commentary in the scientific literature—which, incidentally, resembles the reliance of common law courts on precedent.<sup>81</sup> A new theory is not impermissible expert economic testimony simply because the Federal Circuit has

<sup>77</sup> David & Gorski, *Economic Approaches to Royalty Calculations*, *supra* note 72.

<sup>78</sup> *Id.* (citing Champagne, *Price Indexes, Hedonic Analysis, and Patent Damages*, *supra* note 72).

<sup>79</sup> See *supra* note 12.

<sup>80</sup> *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

<sup>81</sup> *Id.* at 151; see *supra* note 13.

not yet had the opportunity to rule upon the methodology and endorse it. As Chief Judge Rodney Gilstrap of the Eastern District of Texas wrote in 2018, “[t]hat the Federal Circuit may not have endorsed a damages theory does not make such a theory incorrect or unreliable—it simply means it’s untested by an appellate court.”<sup>82</sup> It is not the law of *Daubert* and *Kumho* that all that is not permitted is forbidden.

#### IV. FACTUAL ASSERTIONS CONCERNING NONPUBLIC INFORMATION

Shampine contends that, even “[a]ssuming [that] hedonic price analysis fits within the overall conceptual framework of the case, there is still the tricky question of getting the analysis itself right.”<sup>83</sup> “Hedonic price analyses can be very finicky,”<sup>84</sup> as he explains in these kind words:

This is where Sidak & Skog’s article shines. They walk through an example from litigation they participated in where they implemented a hedonic price analysis and describe why they made the choices they did. As they note, there are many choices to be made along the way. For example, the literature contains many different functional forms for a hedonic price model, and different forms may be more appropriate depending upon the specifics of the case. Sidak & Skog argue for a particular functional form given the specifics of their case, and, importantly, they explain why they believe the specifics of their case call for that particular functional form. *They also include discussions of areas of implementation where their choices were critiqued by the opposing economist and why they chose to do things in particular ways in spite of the criticisms.*<sup>85</sup>

As an example of these “choices” made in the face of criticism from “the opposing economist,” Shampine states that “Sidak & Skog choose an additive form for their model structure, and argue that alternative structures are not suitable in the RAND context, even though some practitioners claim other structures can better capture price dynamics in industries where prices are changing rapidly.”<sup>86</sup> Regrettably, Shampine does not identify any of these practitioners, nor does he cite any document in which these practitioners “claim” that “other structures” are more appropriate than the additive functional form that Skog and I used in the hedonic regression presented in our 2017 article.

Shampine correctly notes that, depending on the specific facts of the case, the testifying economic expert using hedonic price analysis might face

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<sup>82</sup> Memorandum Opinion and Order at 3–4, *Kaist IP US LLC v. Samsung Elecs. Co.*, No. 2:16-cv-01314-JRG (E.D. Tex. May 31, 2018).

<sup>83</sup> Shampine, *Review*, *supra* note 4, at 5.

<sup>84</sup> *Id.*

<sup>85</sup> *Id.* (emphasis added).

<sup>86</sup> *Id.*

a number of analytical choices. For example, Skog and I explained in detail in our 2017 article why the use of an additive functional form for a hedonic regression is preferable to a logarithmic or semi-logarithmic functional form when calculating the value that implementing a standardized technology adds to a multicomponent product.<sup>87</sup> Shampine says that the “step-by-step discussion” that Skog and I presented in our 2017 article “is very helpful in showing areas where particular implementation choices are likely to be criticized or should be checked for robustness”<sup>88</sup> and that the Sidak-Skog article “helps provide examples of areas the practitioner may wish to test.”<sup>89</sup>

However, Shampine curiously misspeaks when he says that Skog and I “include discussions of areas of implementation where [our] choices were critiqued by the opposing economist and why [we] chose to do things in particular ways in spite of the criticisms.”<sup>90</sup> Nowhere in our 2017 article did Skog and I say that any particular line of economic reasoning that we discussed there corresponded to a critique made by an opposing economist in litigation in which either of us had used a hedonic price model in an expert report or testimony. A search of the ITC’s EDIS docket portal confirms that no public record shows that Shampine executed a protective order in the 1023 Investigation. The public version of the hearing transcript for the ITC’s 1023 Investigation—released no earlier than May 10, 2017—does not discuss any methodological issue concerning hedonic price analysis, such as whether the functional form of the regression in the hedonic price model should be additive, logarithmic, or semi-logarithmic.<sup>91</sup> Public versions of the post-hearing briefs of the parties in the 1023 Investigation are not available. The public version of the final initial determination in the 1023 Investigation—which Chief Administrative Law Judge Charles Bullock issued on November 14, 2017, a month after Shampine published his critique—mentions hedonic price analysis only twice, and then only in passing when Chief Judge Bullock summarizes the arguments of the parties.<sup>92</sup> Chief Judge Bullock did not discuss the preferred functional form of the hedonic regression. In short, to my knowledge, nothing on the public record in any case discusses an

<sup>87</sup> Sidak & Skog, *Hedonic Prices and Patent Royalties*, *supra* note 2, at 614–17.

<sup>88</sup> Shampine, *Review*, *supra* note 4, at 5.

<sup>89</sup> *Id.* at 6.

<sup>90</sup> *Id.* at 5.

<sup>91</sup> The public version of the hearing transcript for my testimony in the 1023 Investigation does not contain any questions or answers discussing the choice between additive, logarithmic, and semi-logarithmic functional forms of the hedonic regression, nor does it even contain the words “additive,” “logarithmic,” or “semi-logarithmic.” Open Sessions Hearing Transcript at 488:19–544:16, 555:2–585:20, Certain Memory Modules and Components Thereof, and Products Containing Same, Inv. No. 337-TA-1023 (USITC May 9–10, 2017) (testimony of J. Gregory Sidak). These subjects and words also do not appear anywhere in the public version of the testimony of the opposing expert economic witness. *Id.* at 866:8–873:16 (USITC May 11, 2017) (testimony of Professor Fiona Scott Morton).

<sup>92</sup> Certain Memory Modules and Components Thereof, and Products Containing Same, Inv. No. 337-TA-1023, at 187 (USITC Nov. 14, 2017) (Final Initial Determination) (public version) (“Finally, Respondents criticize at length the hedonic regression analysis performed by Complainant’s expert, Mr. Sidak, which Netlist offers as evidence that its offers to SK hynix are reasonable.”); *id.* at 190 (Complainant “extrapolates the incremental value of the patented technology from the profits made by the infringing article[,] . . . [using] the hedonic regression analysis of its expert, Mr. Sidak . . . .”) (citations omitted).

“opposing economist” criticizing expert testimony of mine on the grounds that it used an additive functional form for the hedonic regression rather than a logarithmic or semi-logarithmic form.

So why did Shampine cast his remarks in terms of “criticisms” lodged against the hedonic price model by “the opposing economist” in “litigation”? How would Shampine know what was or was not said in confidential expert reports, which the parties exchanged but would not as a matter of course introduce into evidence at trial? The only persons who know such details are the parties, their law firms, and their expert witnesses. How would Shampine know what was or was not said in the deposition testimony of expert witnesses, which would be confidential and typically would not as a matter of course be disclosed at trial unless, and only to the extent that, it was being used to impeach a witness? Again, the only persons who know such details are the parties, their law firms, and their expert witnesses. How would Shampine know what was or was not said either in the prefiled direct testimony of expert witnesses filed under seal or in the live trial testimony of expert witnesses given on the confidential record? The only persons who know such details are the parties, their law firms, their expert witnesses, and the judge and staff of the adjudicatory body. The need to ask these questions reminds me of the dénouement in David Mamet’s screenplay for *House of Games*: “You see, in my trade this is called, what you did, you ‘cracked-out-of-turn.’”<sup>93</sup>

#### CONCLUSION

Dr. Allan Shampine’s criticisms of the Sidak-Skog hedonic price model rest on incorrect premises of law and economics. He criticizes the model for failing to apply the *ex ante* incremental value approach—a theory that contends that a FRAND or RAND royalty should not exceed the incremental value of the patented technology over the next-best alternative available at the time of standard adoption. Yet, like many economists, Shampine erroneously assumes that the *ex ante* incremental value approach is a positive principle of law, rather than merely a normative prescription that he happens to favor. He fails to recognize that the Sidak-Skog hedonic price model separates the value of the patented technology from the value of standardization, such that the model faithfully complies with the Federal Circuit’s apportionment requirement reiterated in *Ericsson v. D-Link*.

Shampine also criticizes the Sidak-Skog hedonic price model for relying on data that became available after the moment of standard adoption. He then proposes—as an alternative to the hedonic price model—reliance on *hypothetical* data concerning consumer demand that typically would not exist at the time of standard adoption. His suggested approach would fail *Daubert* because it is manifestly unreliable and unscientific. In contrast, the econometric methodology that the Sidak-Skog hedonic price model employs has

<sup>93</sup> DAVID MAMET, *HOUSE OF GAMES* 67 (Grove Press 1987).



passed muster under *Daubert* in at least one publicly reported federal district court case concerning SEPs.

In sum, Shampine's criticisms do not detract from the reliability and usefulness of hedonic price analysis in calculating a FRAND or RAND royalty for a given SEP or portfolio of SEPs. To the contrary, if embraced, Shampine's suggestions would reduce the intellectual rigor, replicability, and reliability of expert economic testimony concerning the calculation of a FRAND or RAND royalty.