THE
CRITERION
JOURNAL ON INNOVATION

VOL. 1 2016

# Tournaments and FRAND Royalties

*J. Gregory Sidak*[*]

From 1946 through 1957, the World Championship of Golf, held annually at the Tam O'Shanter Country Club in Niles, Illinois, awarded the highest first prize of any golf tournament.[1] The 1953 World Championship, whose first prize was $25,000—equivalent to $222,970 in 2016 dollars—became the first nationally televised golf tournament in the United States.[2] Approaching the eighteenth hole in the final round, Lew Worsham—a 35-year-old professional golfer from Pittsylvania County, Virginia—trailed the leader, Chandler Harper, by a single stroke.[3] Worsham needed to hole the ball in three strokes (one under par) to tie with Harper, or in two strokes to win. Worsham's drive left him more than one hundred yards from the hole. On his second stroke, he shot an approach. The gallery of spectators obscured his view of the green. He lost sight of the ball for a moment. The crowd's roar of amazement was the first indication of what Worsham's swing had wrought: an eagle. Worsham had won the 1953 World Championship of Golf and its $25,000 first prize.

The 1953 World Championship of Golf is an example of a tournament—a competition in which each participant's payoff depends on his relative perfor-

* Chairman, Criterion Economics, Washington, D.C. Email: jgsidak@criterioneconomics.com. For their helpful comments, I thank George Cary, Judge Theodore Essex, James Flynn, Alexander Galetovic, Kirti Gupta, Stephen Haber, Suzanne Harrison, Bowman Heiden, Daniel Hermele, Sir Robin Jacob, Jay Jurata, Ron Katznelson, Scott Kieff, Naomi Lamoreaux, Ron Laurie, Alice Li, Matthew Lynde, Justice Fidelma Macken, Paul Melin, Kayvan Noroozi, Irving Rappaport, Marc Richardson, James Rill, Shinji Ryu, Pekka Saaskilahti, Ed Sherry, Jeremy Skog, Henry Smith, Richard Sousa, Blount Stewart, Richard Taffett, Robert Taylor, Andrew Vassallo, John Veschi, Paul Zeineddin, and participants at the Hoover Institution's IP[2] Conference at Stanford University in May 2016, participants at the Global Competition Review 3rd Annual IP & Antitrust Conference in April 2016, and participants at the Second Conference on Patents in Telecoms organized by University College London and George Washington University in November 2015. The views expressed are solely my own. 

[1] Dave Anderson, *Sports of the Times; Holing a Wedge at 18 to Win*, N.Y. TIMES (Feb. 15, 1983), http://www.nytimes.com/1983/02/15/sports/sports-of-the-times-holing-a-wedge-at-18-to-win.html. At the time, other weekly tour events disbursed, on average, $3,500 to the first-place winner and had a total prize purse of $17,500. *Id.*

[2] *Id.*; *see also* KEN JANKE, FIRSTS, FACTS, FEATS & FAILURES IN THE WORLD OF GOLF 168 (John Wiley & Sons 2007); *History of Golf*, INT'L GOLF FED., http://www.igfgolf.org/about-golf/history.

[3] Anderson, *Sports of the Times*, *supra* note 1; JANKE, *supra* note 2, at 168.

mance.[4] Even though Worsham defeated Harper by the closest of margins, the difference between the size of Worsham's first-place prize and that of Harper's second-place prize was, to say the least, more than marginal.[5] In this essay, I explain how, in economic terms, collective standard setting resembles a tournament, and I show how the economic scholarship on tournaments can inform legal analysis of FRAND royalties.

## I. The Returns to Standard-Essential Patents

By developing standards, a standard-setting organization (SSO) encourages "agreements containing technical specifications or other criteria" and promotes "efficient resource allocation and production by facilitating interoperability among complementary products" in the advancement of the standard and associated technology within an industry.[6] An SSO typically requires one of its members to disclose or declare any patent that the member believes is potentially essential to a proposed standard. A patent that claims an invention that is necessary to practice a technical standard is called a standard-essential patent (SEP). The declarant agrees to offer to license its SEPs to willing third parties on fair, reasonable, and nondiscriminatory (FRAND) terms. However, scholars in law and economics sedulously debate what constitutes FRAND licensing terms.[7]

[4] *See* Robert Gibbons & John Roberts, The Handbook of Organization Economics 67 (Princeton Univ. Press 2013). Ronald Ehrenberg and Michael Bognanno examined data from the 1984 men's PGA tour and found that, all things being equal, higher prize levels lead to better performances by the participants and that higher marginal returns to effort cause participants to exert greater effort. 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). Economists have long studied the effects of tournament structures and prizes on effort levels. *See, e.g.*, Edward P. Lazear & Sherwin Rosen, *Rank-Order Tournaments as Optimum Labor Contracts*, 89 J. Pol. Econ. 841 (1981); 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). Tournaments might motivate participants to exert effort more efficiently than piece rates if workers are risk-averse and if their outputs are affected by a common shock. *See* Gary Charness & Peter Kuhn, *Lab Labor: What Can Labor Economists Learn from the Lab?*, *in* 4A Handbook of Labor Economics 229, 257 (Orley Ashenfelter & David Card eds., Elsevier 2011).

[5] To put Worsham's $25,000 first-place prize in perspective, Harper's total winnings in 1953 were only $19,938, which was enough to make him golf's fourth-highest earner that year. Worsham was the highest earner in 1953 with $34,002 in total winnings. *Worsham Top Money Winner*, St. Petersburg Times, Dec. 27, 1953, at 4-C.

[6] United States Department of Justice & United States Patent & Trademark Office, Policy Statement on Remedies for Standards-Essential Patents Subject to Voluntary F/RAND Commitments 2–3 (Jan. 8, 2013), http://www.uspto.gov/about/offices/ogc/Final_DOJ-PTO_Policy_Statement_on_FRAND_SEPs_1-8-13.pdf.

[7] *See, e.g.*, Joseph Farrell, John Hayes, Carl Shapiro & Theresa Sullivan, *Standard Setting, Patents, and Hold-Up*, 74 Antitrust L.J. 603 (2007); John M. Golden, *"Patent Trolls" and Patent Remedies*, 85 Tex. L. Rev. 2111, 2116 (2007); Anne Layne-Farrar, A. Jorge Padilla & Richard Schmalensee, *Pricing Patents for Licensing in Standard Setting Organizations: Making Sense of FRAND Commitments*, 74 Antitrust L.J. 671, 693 (2007); Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 Tex. L. Rev. 1991, 2043 (2007); J. Gregory Sidak, *Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro*, 92 Minn. L. Rev. 714, 714–15 (2008); J. Gregory Sidak, *The Meaning of FRAND, Part I:*

Some economists testify in litigation over FRAND royalties that, if two inventors each develop a similar substitute technology, and the two technologies would generate an equal amount of value to a manufacturer, 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 would enable the manufacturer to bid down the FRAND royalty to nearly zero. For example, in *Innovatio*, Judge James Holderman wrote in 2013 that a respected economist, Dr. Gregory Leonard, "testified that . . . if two patented and equally effective alternatives both cost the same amount, . . . the two patent holders would negotiate the price down to effectively zero."[8] Economists testifying to this effect next assert—on the basis of the theoretical arguments that Carl Shapiro, Joseph Farrell, Mark Lemley, and others advanced in 2007[9]—that any increment of royalty that the SEP holder receives beyond that near-zero amount constitutes "holdup value," which Shapiro, Farrell, Lemley, and others argue the SEP holder has wrongly extracted from the implementer solely by virtue of the SSO's having chosen the SEP holder's technology for the standard.

We cannot know the full extent to which other reputed economists have made this "effectively zero" argument about FRAND royalties in litigation. The reason we cannot know is that, in practice, an economic expert witness typically files his written report and gives his oral testimony at deposition and trial subject to a protective order, which conveniently denies the public any means to keep the testifying economist intellectually accountable for the expert opinions that he gives confidentially to the litigants and to the judge and jury. (Similarly, expert economic testimony in international commercial arbitration—an increasingly popular forum for resolving FRAND licensing disputes—is typically subject to a confidentiality agreement.) It is telling that, despite the many articles that proponents of the patent-holdup conjecture have published about what constitutes a FRAND royalty as a matter of economic theory, there appears to be not one academic article arguing that competition among patent holders compels the holder of the chosen technology to settle for a FRAND royalty of "effectively zero."[10] It is easy to understand why economists are loath to defend that proposition publicly. It is facially absurd. It

*Royalties*, 9 J. Competition L. & Econ. 931, 988–1025 (2013); Damien Geradin, *The European Commission Policy Towards the Licensing of Standard-Essential Patents: Where Do We Stand?*, 9 J. Competition L. & Econ. 1125, 1127 (2013); J. Gregory Sidak, *The Meaning of FRAND, Part II: Injunctions*, 11 J. Competition L. & Econ. 201, 208–18 (2015). As of May 2016, the law in the U.S. Court of Appeals for the Federal Circuit was that a royalty for an SEP, regardless of whether the SEP is subject to a FRAND commitment, "must be premised on the value of the patented feature, not any value added by the standard's adoption of the patented technology." Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1233 (Fed. Cir. 2014); *see also* Commonwealth Sci. & Indus. Res. Org. v. Cisco Sys., Inc., 809 F.3d 1295, 1303-05 (Fed. Cir. 2015).

[8] *In re* Innovatio IP Ventures, LLC, No. 11-cv-09308, 2013 WL 5593609, at *20 (N.D. Ill. Oct. 3, 2013).

[9] *See* Farrell, Hayes, Shapiro & Sullivan, *supra* note 7; Lemley & Shapiro, *supra* note 7.

[10] Leonard declined to defend the "effectively zero" argument in a subsequent article, which goes only so far as to say that, "[i]n competitive markets, the price for a product tends to be lower the greater the number

forces the wrong economic model on collective standard setting to contrive a silly but expedient result.

The argument that a FRAND royalty is "effectively zero" implicitly depends on modeling competition between the technologies in standard setting as a static Bertrand pricing game without capacity restraints.[11] However, the argument that a price war between SEP holders would drive down a FRAND royalty nearly to zero requires assuming (1) that there is no differentiation between the competing (substitute) technologies, and (2) that the inventors lack any outside option for monetizing their technologies, and (3) that the inventor has some ancillary revenue stream generating a positive return to participation in the SSO, at least sufficient to cover the costs of participation.[12] What empirical evidence exists that an SSO could 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.

If an inventor could receive only a pittance for his investment in developing his technology and in contributing it to a standard, he would cease contributing proprietary technologies to collective standards and instead pursue more profitable outside options. That reasoning is even more compelling if the inventor is a publicly traded firm, answerable to its shareholders. Therefore, modeling standard setting as a static Bertrand pricing game without any differentiation among the competing technologies and without any outside option for the inventors would predict that every inventor loses—that is, no inventor could possibly recoup his investment in innovation and therefore would quickly exit the market. Standard setting would be a sucker's game for inventors. As Nobel laureate Milton Friedman famously wrote, "Viewed as a body of substantive hypotheses, theory is to be judged by its predictive power for the class of phenomena which it is intended to 'explain.'"[13] The observed fact that many SSOs continue to set standards and that many innovators continue to contrib-

of substitutes for the product, all else equal." Gregory K. Leonard & Mario A. Lopez, *Determining RAND Royalty Rates for Standard-Essential Patents*, 29 Antitrust, no. 1, 2014, at 86, 87.

[11] 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.*, Dennis W. Carlton & Jeffrey M. Perloff, Modern Industrial Organization 171–72 (Pearson 4th ed. 2005); Michael L. Katz & Harvey S. Rosen, Microeconomics 504–08 (McGraw-Hill 3d ed. 1998).

[12] When conditions (1) and (2) are met, the SEP holder cannot receive a positive payoff from any use of its SEP, including participation in the SSO. However, unless the costs of participation are zero, the SEP holder still will not participate, absent some ancillary revenue stream. The ancillary revenue source could be vertical integration or some other form of multi-product production that allows the SEP holder to internalize some of the benefit to the standard from offering an SEP at a zero royalty. In any case, this is a significant deviation from the traditional Bertrand competition assumptions.

[13] Milton Friedman, *The Methodology of Positive Economics*, *in* Essays in Positive Economics 3, 8 (Univ. of Chicago Press 1953).

ute their technologies to those collective standards strongly suggests that a different economic model than static Bertrand competition would better predict how standard setting works in the real world.

## II. Standard Setting and Tournaments

A successful golf tournament will attract a wide field of qualified players, including all of the top players, and its incentive structure will ensure that each participant employs maximum effort to try to win. Few spectators would watch a golf tournament whose participants do not try to win. A successful golf tournament will also continue to attract high-quality participants who vigorously compete to win in future tournaments. If the cost of entering the tournament exceeds the expected benefit from doing so, most players would choose not to return in future years.

An SSO's goals resemble those of an organizer of a golf tournament. First, just as a successful golf tournament seeks to attract all of the top golfers, an SSO seeks to elicit participation from all of the top patent holders. Indeed, securing the top participants is even more important in collective standard setting than in a golf tournament. A golf tournament can still succeed if it is missing one of the top golfers. However, developing a standard without the participation of one of the top patent holders would require designing around that firm's patents or licensing them for non-FRAND royalties, which would increase uncertainty among implementers and jeopardize the standard's success.

Second, just as the organizer of a golf tournament seeks to ensure that all contestants exert maximum effort to win the tournament, so as to ensure a competitive and entertaining tournament, the SSO must give each participant the incentive to offer the SSO its best technologies.

Third, like a tournament organizer, an SSO needs to ensure that its contestants continue to participate in the future. The SSO must develop policies that ensure long-term success in standard setting. Those policies are not necessarily the same policies for ensuring immediate or short-term success.

Fourth, a sports tournament identifies a champion, but in doing so it supplies entertainment that consumers highly value. It would be uninteresting simply to name the year's best golfer and forgo witnessing the contest substantiating that decision. It is the *process* of selecting a winner—not the leapfrogging to the act of crowning a given contestant as the winner—that creates the value that consumers derive from watching professional golf. Here, the analogy of standard setting to a tournament breaks down somewhat, but in a way that breakdown is still highly instructive. It is, of course, unnecessary for society to crown an annual champion of golf. In contrast, society does find it necessary for the common good to identify the best technology to enable

mobile devices to communicate with base stations so that consumers can use their cell phones. The rivalrous process—the tournament—by which an SSO identifies and then adopts a particular technology for the standard incidentally produces something else of profound value, something which the economists who invoke static Bertrand competition to model a FRAND royalty manage to obscure. The high level of inventor participation that a standard-setting tournament is able to elicit by virtue of its payoff structure reveals valuable information about both the inventors and the technologies that might make subsequent rounds of innovation far more socially productive (for example, by identifying dead ends that future inventors need not invest time and money in exploring). In contrast, the alternative portrayal of standard setting as static Bertrand competition among technologies leads, as I previously explained, to the dismal prediction that standard setting is essentially a lottery. The alternative technologies are assumed to be unlimited in number and undifferentiated in quality. All are equally mediocre. If the standard were instead a motion picture and the competing inventions were instead actors, there would be no movie stars—only extras from central casting, all equally suitable to play the leading role.[14] In short, a model of competition for adoption of a technology into the standard that, in practical effect, randomly selects its winner and therefore does not aggregate and reveal information is a model of price formation that ignores what Nobel laureate Friedrich Hayek long ago argued is the quintessential virtue of a market mechanism.[15]

The economic literature finds that a tournament is efficient when the cost of measuring the absolute output of each participant sufficiently exceeds the cost of measuring the *relative* output of each participant compared with the other participants.[16] That condition obtains in the context of SEPs and SSOs. Modeling competition between technologies as a static Bertrand pricing game would determine a royalty for a technology chosen for inclusion in the standard on the basis of that technology's incremental value over the next-best alternative.[17] Measuring the actual output or value of each competing technology for a standard is notoriously difficult.[18] However, it is much easier to

[14] One distinguished economics professor at a world-famous research university argues that, even if no alternatives to the chosen technology existed when the SSO adopted the standard, the SEP holder still should receive only a modest FRAND royalty because somebody else would have invented the very same technology sooner or later. A similar conjecture has been made about monkeys, typewriters, and the complete works of William Shakespeare.

[15] *See* F. A. Hayek, *The Use of Knowledge in Society*, 35 Am. Econ. Rev. 519 (1945).

[16] Lazear & Rosen, *supra* note 4, at 841.

[17] 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 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* note 11, at 172–74; Jean Tirole, The Theory of Industrial Organization 533 (MIT Press 1988).

[18] *See* Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 7, at 1034–35.

ascertain the relative value of each technology.[19] SEP holders and implementers routinely make these ordinal comparisons in FRAND royalty disputes. If the SSO needs to quantify in cardinal terms the amount by which one technology surpasses another in value creation, the SSO would need information that it does not possess (and which might not exist until each technology is incorporated in competing products in the market). That is, modeling competition between technologies as a static Bertrand pricing game would predict (implausibly) that the SSOs would pay the exorbitant cost of quantifying in cardinal terms the value that each technology creates, which could even exceed the aggregate FRAND royalties that the Bertrand model estimates. Consequently, it is highly unlikely that the static Bertrand model accurately represents the intentions of the parties to the FRAND contract at the time of contract formation. Given the similarities between tournaments and collective standard setting, and given the fact that it is far easier to measure the relative value of an SEP than its absolute value, it is productive to analyze the standard-setting process as if it were a tournament.[20]

## III. Some Insights into FRAND Royalties from the Economic Analysis of Tournaments

A tournament can take many different forms, each with different prize structures. Without a prize, there would be no incentive for anyone to participate in the tournament given the cost of participating. Because the tournament's organizer must create such an incentive, the tournament's prize necessarily must be nonzero.[21] The expected payoff for a participant must exceed the cost of participation. Otherwise, the potential player will not join the tournament. Put differently, participation in the tournament must satisfy an individual-ra-

[19] *See id.* at 945; *see also* David J. Teece & Peter C. Grindley, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 Cal. Mgmt. Rev., no. 2, Winter 1997, at 8, *reprinted in* David J. Teece, Essays in Technology Management and Policy: Selected Papers of David J. Teece 204, 216–17 (World Scientific 2003).

[20] I do not suggest that I am proposing a perfect tournament model for standard setting. Future research into this model, whose outline I merely sketch here, could examine features of standard setting that are not obviously compatible with a tournament model. For an example of a next-generation economic model for standard setting, see Josh Lerner & Jean Tirole, *Standard-Essential Patents*, 123 J. Pol. Econ. 547, 551–53 (2015).

[21] Lazear & Rosen, *supra* note 4, at 841. Economists often analyze tournaments in the context of labor contracts, which by their very nature require a nonzero wage rate. Analogously, a nonzero prize is necessary to create an incentive for a firm to participate in the tournament to "win" the standard—that is, to have the SSO incorporate the firm's technology into the standard. There is an obvious parallel here to the concept in antitrust law that, "[o]nce a product or standard achieves wide acceptance, it becomes more or less entrenched[, and] [c]ompetition in such industries is 'for the field' rather than 'within the field.'" United States v. Microsoft Corp., 253 F.3d 34, 49 (D.C. Cir. 2001) (en banc) (quoting Harold Demsetz, *Why Regulate Utilities?*, 11 J.L. & Econ. 55, 57 & n.7 (1968) (emphasis omitted)). "In technologically dynamic markets, . . . . [r]apid technological change leads to markets in which 'firms compete through innovation for temporary market dominance, from which they may be displaced by the next wave of product advancements.'" *Id.* at 49–50 (quoting Howard A. Shelanski & J. Gregory Sidak, *Antitrust Divestiture in Network Industries*, 68 U. Chi. L. Rev. 1, 11–12 (2001)).

tionality constraint.[22] Similarly, in standard setting the expected FRAND royalty necessarily must exceed the SSO member's expected cost of entering the FRAND tournament—that is, the transactions costs associated with standardization. Otherwise, an SSO member will cease to have an incentive to contribute its technologies to the standard. In a repeat-play setting,[23] the FRAND royalty must be high enough to cover the direct and indirect costs of participating in an SSO, such as the original research and development costs, particularly those related to a particular standard.[24]

Further, in addition to guaranteeing participation, the prize structure must provide a sufficient incentive to encourage participants to exert a high level of effort. In a standard-setting context, a "high level of effort" means investing significant capital and other scarce resources to develop new technologies that have commercial value. The economic literature, starting with the seminal work by Edward Lazear and Sherwin Rosen, suggests that the level of effort that a participant exerts depends on the spread, or difference, between the prize for winning the tournament and the next-best prize.[25] Furthermore, as Lazear and Rosen observed, "as the spread increases, the incentive to devote additional resources to improving one's probability of winning increases."[26] That result implies that the first-place prize must exceed the second-place prize and that, the greater the disparity between those two prizes, the greater the incentive that participants have to invest in developing new and innovative technologies.

One can observe in the prize distribution of sports competitions how actual tournament prize structures provide tournament participants with the incentives to exert a high level of effort. I compare below the prize distribution of four tournaments: the 2015 PGA Championship, the 2015 U.S. Open Tennis Championships, the 2015 World Series of Poker (WSOP) Main Event, and the 2014 Major League Baseball (MLB) playoffs. I normalize the size of the prize awarded to each participant in a tournament by expressing it as a percentage of the first-place prize. Figure 1 shows the normalized prize awarded to the ten highest finishers in each of the four competitions.

---

[22] *See* Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 7, at 989–92; J. Gregory Sidak, *Bargaining Power and Patent Damages*, 19 Stan. Tech. L. Rev. 1, 10–15 (2015).

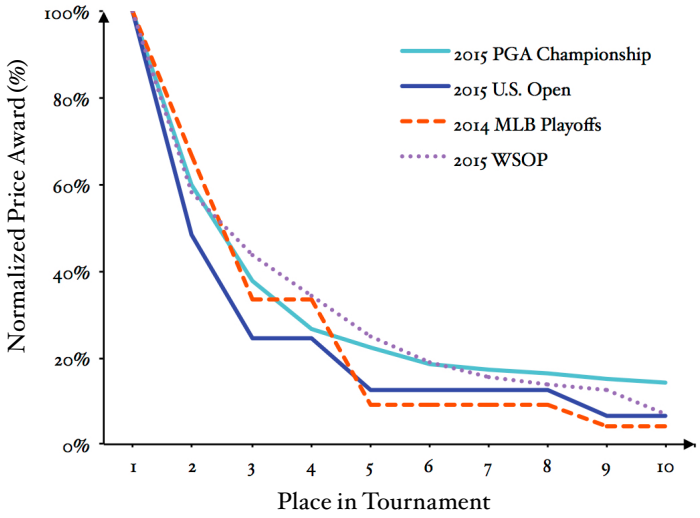
[23] Standard setting is typically a continuously repeated game. That is, updating an existing standard seamlessly moves to developing a new standard, with many of the same innovators participating in both. *See, e.g.*, Signals Research Group, The Essentials of Intellectual Property, from 3G Through LTE Release 12, at 5 (May 2015), http://www.ericsson.com/res/docs/2015/ericsson-3gpp-submission-study-whitepaper-may-2015.pdf.

[24] To satisfy a participant's individual-rationality constraint, the FRAND royalty must also exceed the value of the participant's outside option, which might include developing the patented technology outside the standard in question. *See*Sidak, *Bargaining Power and Patent Damages*, *supra* note 22, at 13.

[25] Lazear & Rosen, *supra* note 4, at 849.

[26] *Id.*

Figure 1. Normalized Prize Awarded
to the Top-Ten Finishers in Four Competitions




*Sources*: Robby Kalland, *2015 PGA Championship Prize Money: Every Golfer's Payout from $10M Pool*, CBSSPORTS (Aug. 16, 2015), http://www.cbssports.com/golf/eye-on-golf/25270785/pga-championship-complete-list-of-payouts-and-prize-money; E.J. Crawford, *US Open Prize Money to Top $40 Million in 2015*, U.S. OPEN (Aug. 11, 2015), http://www.usopen.org/en_US/news/articles/2015-08-11/us_open_prize_money_to_top_40_million_in_2015.html; Mike Axisa, *MLB Announces Playoff Shares; Giants Get $388K Each for World Series Win*, CBSSPORTS (Nov. 24, 2014), http://www.cbssports.com/mlb/eye-on-baseball/24837777/mlb-announces-playoff-shares-giants-get-388k-each-for-world-series-win; Seth Palansky, *WSOP Announces 2015 Main Event Payout Change*, WSOP (Feb. 1, 2015), http://www.wsop.com/news/2015/Feb/5172/WSOP-Announces-2015-Main-Event-Payout-Change.html.

In all four competitions, the prize awarded to each participant declines rapidly as a participant's place in the tournament gets farther away from first place. That observation comports with the economic insight that the spread between the prize for winning and the consolation prize for finishing second determines the participants' effort levels. Table 1 below shows the average normalized prize for each place in the tournament across the four competitions.

Table 1. Average Normalized Prize Awarded to Each Place in the Tournament

| Place in the Tournament | Normalized Prize |
|---|---|
| 1 | 100% |
| 2 | 58% |
| 3 | 35% |
| 4 | 30% |
| 5 | 17% |
| 6 | 15% |
| 7 | 14% |
| 8 | 13% |
| 9 | 10% |
| 10 | 8% |

Across the four competitions, the second-place finisher receives a prize worth 58 percent of the first-place prize, the third-place finisher receives a prize worth 35 percent, the fourth-place finisher receives a prize worth 30 percent, and the fifth-place finisher receives a prize worth 17 percent.[27] Put differently, the tournament prize structure rewards a participant handsomely for improving his tournament standing by one place (that is, finishing third instead of fourth, for example). However, that effect is weaker as a participant's place in the tournament gets farther away from first place, partly because elimination tournaments (such as the U.S. Open Tennis Championships and the MLB playoffs) generally award the same prize to participants who are eliminated in the same round. That is, all losers of quarterfinal matches (fifth- to eighth-place finishers), for example, might receive the same consolation prize.

With a relatively small number of participants competing to have their technologies included in the standard, the optimal payoff to the first-place winner could even constitute the entire payoff pool, leaving no prize for lower-ranked participants.[28] In other words, the winner of the standard-set-

[27] The function $y = x^{-1} + c$ (where $y$ represents the normalized prize awarded, $x$ represents the place in tournament, and $c$ represents a constant) approximates the four competitions' prize structures. That function has a very strong predictive power over the shares that participants in the four competitions receive. The $R^2$ of the function $y = x^{-1} + c$, which measures the proportion of the variation in the data that the function is able to explain, is 0.9908 for the PGA Championship, 0.9895 for the U.S. Open Tennis Championships, 0.9450 for the MLB playoffs, and 0.9755 for the WSOP Main Event. For an explanation of $R^2$, see James H. Stock & Mark W. Watson, Introduction to Econometrics 119–20 (Addison-Wesley 3d ed. 2011).

[28] *See* Vijay Krishna & John Morgan, *The Winner-Take-All Principle in Small Tournaments*, *in* 7 Advances in Applied Microeconomics 61, 62 (Michael Baye & John Maxwell eds., 1998). Krishna and Morgan show that, in tournaments with either two or three participants, the optimal prize structure is winner-take-all.

ting tournament would receive a significant prize in the form of a significant FRAND royalty, and the runners-up—that is, the holders of patented technologies that the SSO chose not to include in the standard—would receive no prize.[29]

Thus, the salient insight of the economic literature on tournaments that is relevant to determining a FRAND royalty is that, when there are relatively few alternative technologies competing for inclusion in the standard, the optimal prize structure might be for the runners-up to receive no prize and for the tournament winner to receive a handsome FRAND royalty. In that case, 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*.[30]

Selecting a technology for each facet of a standard is a miniature winner-take-all tournament. Each participant in standard setting might win a number of such mini-tournaments. It bears emphasis that selecting a technology for each facet of a standard differs from competition between standards in the market. One example of two standards competing in the market is the competition between the Long-Term Evolution (LTE) standard and the Worldwide Interoperability for Microwave Access (WiMAX) standard.[31]

There is also a difference between standards setting and standards development. In the standard-setting process, alternative technologies might already exist for different portions of the standard. If so, the cost of participation in the tournament is limited to the marginal costs of participation for each participant, exclusive of research and development costs. However, standards development differs in that some authority (the government or customers perhaps) might set technical requirements that future products must meet. Inventors then must convene and collectively work to define the standard sufficient to meet those technical requirements. Then these same inventors might compete against one another to invent the technology that will satisfy those requirements. In this case, the cost of participating in the

*Id.* Under certain conditions, particularly when the players are risk-neutral, the optimal prize structure in tournaments with four participants is also winner-take-all. *Id.*

[29] Winner-take-all tournaments are rare in sports. One example is The Basketball Tournament, which in 2015 awarded a $1-million prize to the winning team and nothing to the rest of the participants. A total of 97 teams entered the tournament in 2015. *See* Jack Tien-Dana, *Hoop Dreams: Winner Take All at The Basketball Tournament's $1 Million Game*, Rolling Stone (Aug. 3, 2015), http://www.rollingstone.com/sports/features/hoop-dreams-winner-take-all-at-the-basketball-tournaments-1-million-game-20150803.

[30] The optimal FRAND royalty will need to be determined given the optimal number of contestants in the standard-setting tournament. The answer to that question exceeds the modest ambitions of this short essay and must be left to others better suited to the task.

[31] *See* J. Gregory Sidak, *The Value of a Standard Versus the Value of Standardization*, 68 Baylor L. Rev. (forthcoming 2016); *see also* Steven J. Vaughan-Nichols, *Mobile WiMax: The Next Wireless Battleground?*, 41 Computer, June 2008, at 16, 16 (2008); Matt Hamblen, *WiMax vs. Long Term Evolution: Let the Battle Begin*, Computerworld (May 14, 2008), http://www.computerworld.com/article/2535716/mobile-wireless/wimax-vs--long-term-evolution--let-the-battle-begin.html.

tournament will necessarily include the research and development costs associated with developing a potential technical solution. In either standards setting or standards development, the process by which the SSO incorporates technologies into the standard will more closely resemble a tournament than Bertrand competition. For the standards-development setting, the participation costs that the FRAND royalty must cover are even greater than in the simpler standard-setting context. Applying a tournament model to the standards-development process suggests that a FRAND royalty must be great enough to cover the direct and indirect costs of contributing to the standard, including transactions costs and the costs of research and development, so as to give incentives for the SSO's members to continue investing in innovation and participating in collective standard setting.

## Conclusion

Proponents of the patent-holdup conjecture implicitly model competition among different technologies for inclusion in a standard as a static Bertrand pricing game without (1) any capacity restraints, (2) any product differentiation, and (3) any outside option for the inventors. On the basis of those improbable assumptions, proponents of the patent-holdup conjecture suppose that the FRAND royalty for the technology chosen for inclusion in the standard will approach zero.

That conclusion is wrong. It violates the predictions and real-world observations of the economics of tournaments. No firm would enter a tournament whose first-place prize is "effectively zero" if it cannot recoup its participation costs. Further, SSO members would not invest in developing a technology that might win the standard-setting tournament if the difference between the payoff from winning and the payoff from losing were negligible. Instead, modeling standard setting as a tournament whose winner receives a substantial first-place prize—that is, a significant FRAND royalty—is more likely to lead to legal rules for licensing disputes over standard-essential patents that encourage continued investment in innovation and continued participation in collective standard setting.