Standard-Setting, Competition, and Innovation

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ABSTRACT
This paper uses fairly standard models to investigate several competition policy questions related to standard-setting organizations (SSOs). Are compatibility standards agreed upon by competitors generally in the public interest? Should antitrust favor patent-holders who practice their patents against innovation specialists who do not? Should SSOs be encouraged – or even required – to employ competition among patent-holders before standards are set to determine post-standard patent royalty rates? Alternatively, should antitrust policy allow or encourage collective negotiation of royalty rates? Some recent policy developments are discussed.

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I. INTRODUCTION

This essay is concerned with several antitrust policy questions related to standard-setting organizations (SSOs), in which industry participants, perhaps with some customer representation, voluntarily come together and attempt to produce consensus standards for mutual benefit. SSOs have a long history. The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA), for instance, grew out of standard-setting activity that began in 1890.\(^2\) As the closely coupled information technology and telecommunications sectors have advanced both technically and in economic importance, SSOs have played an increasingly important role in that advance. Chiao et al [2007] have identified 59 SSOs operating in this arena, and they do not claim to have found them all. As of 2001, the IEEE-SA alone had 866 active standards and 526 projects in hand, with over 450 technical working groups and committees.\(^3\)

At first blush, there are (at least) two surprising aspects of voluntary standard-setting. The first is that antitrust authorities generally approve, particularly when compatibility standards are involved,\(^4\) despite the authorities’ hostility toward collaboration among competitors. Section II provides a rationale for this stance and illustrates with a simple model employed in later analysis. A compatibility standard reduces differentiation by definition and thus enhances price competition. If it nonetheless expands the market enough to be profitable for producers, it also generally makes consumers better off, even they value produce diversity.

A second surprising aspect of voluntary standard-setting is that it works as well as it apparently does.\(^5\) Standard-setting processes often involve diverse interests, including innovation specialists that only produce intellectual property, manufacturers that do not innovate, and integrated firms that both innovate and manufacture. Decisions made by SSOs can have significant and divergent implications for the value of intellectual property and other assets held by SSO participants. Moreover, modern standards are often quite complex and

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\(^3\) Ibid.  
\(^4\) As Shapiro [2001b] notes, quality, design, or performance standards can be more easily used as collusive or exclusionary devices than the compatibility standards that are most common in the IT/communications sector.  
cannot be used without licenses to many patents held by many firms. The MPEG-2 standard, for instance, involves 425 patents with 28 owners.\textsuperscript{6} Not only do most standard-setting processes nonetheless seem to produce socially valuable standards, there is evidence to suggest that they tend to select particularly promising technologies and thereby to enhance their impact.\textsuperscript{7} And, while standard-setting has recently been involved in a few high profile antitrust and other legal proceedings in the US and the EU, their number seems tiny relative to the total volume of standard-setting activity.\textsuperscript{8}

Two reasons are frequently given for the generally good performance of voluntary standard-setting. First, large integrated firms, which produce both innovations and final products, traditionally dominate standard-setting processes. These firms typically have large patent portfolios that could potentially be used in mutually destructive infringement litigation. To avoid this outcome, it is argued, integrated firms typically engage in mutual forbearance and charge low royalty rates to each other.\textsuperscript{9} Second, in technology-based industries the same firms tend to interact with each other repeatedly over time. This means that “bad” behavior by any firm – integrated or not – in any one standard-setting process can be punished by others in subsequent processes; see DeLacey et al [2006].

In recent years, however, two developments seem to have made standard-setting both more difficult and more contentious. Many observers have argued that the U.S. Patent Office has been awarding patents too easily and that courts have been too willing to uphold the validity of dubious patents.\textsuperscript{10} The U.S. Federal Trade Commission [2003] and the U.S.

\textsuperscript{6} Lévêque and Ménière [2008].
\textsuperscript{7} See Tirole et al [2003] and Rysman and Simcoe [2008a].
\textsuperscript{8} For discussions of US proceedings, see Farrell et al [2007] and Oliver [2008]. In April 2008 the Court of Appeals decision in \textit{Rambus, Inc. v. Federal Trade Commission}, available at \url{http://pacer.cadc.uscourts.gov/docs/common/opinions/200804/07-1086-1112217.pdf}, reversed the Federal Trade Commission’s decision that Rambus had monopolized by deceptive behavior in standard setting. The European Commission sent a Statement of Objections to Rambus in August 2007, expressing the preliminary view that Rambus had abused a dominant position by charging high royalties subsequent to engaging in deceptive behavior; see \url{http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/330&form}. (For an economic discussion of high price as an abuse of dominance in the EU, see Evans and Padilla [2005].) In October, 2007, the EU announced initiation of a formal Article 82 investigation of Qualcomm; see \url{http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/389&format=HTML&aged=0&language=EN&guiLanguage=en}.
\textsuperscript{9} This strategy, which involves accumulation of large patent portfolios for strategic reasons, has been colorfully described as “Mutually Assured Destruction” by the U.S. Federal Trade Commission [2003, ch. 2, pp. 30-31].
\textsuperscript{10} For critiques, see Jaffe and Lerner [2004] and Scherer [2006]. Harhoff [2006] has argued that these problems may be cropping up in Europe as well.
National Academy of Science [2004] have echoed these arguments and made recommendations for reform. To the extent that patent policy inflates the number of patents that must be licensed in order to practice a standard, thus creating what has been called a “patent thicket” through which standard-setting must pass, it clearly complicates standard-setting and may make standards less socially valuable once set.\textsuperscript{11} My concern is with antitrust policy, however, and it seems logical that if the patent thicket should be thinned, this should be done by reforming the patent system. Trying to compensate for distortions in the patent system by creating offsetting distortions in antitrust policy is, to say the least, a delicate and risky business.

The second complicating development, and the one with which this essay is primarily concerned, is the rise of innovation specialists, firms that produce intellectual property but not tangible products. The growth of such firms has been one of the most important developments since around 1990 in industries in which intellectual property is important.\textsuperscript{12} Separation of innovation from manufacturing permits individual firms to focus on what they do best and is thus potentially efficiency-enhancing. Moreover, such vertical dis-integration should reduce the competition policy concerns traditionally posed by vertical integration. The disruptive complication is that innovation specialists are much less vulnerable to infringement suits than manufacturers and thus have less incentive to engage in the sort of mutual forbearance that is generally thought to restrain the royalty rates charged by integrated firms to each other. It is thus perhaps not surprising that the defendant in the most visible set of SSO-related proceedings is (primarily) an innovation specialist, Qualcomm.\textsuperscript{13}

There has in fact emerged a fairly pervasive hostility toward innovation specialists within at least parts of the policy community. In his concurring opinion to the 2006 U.S.

\textsuperscript{11} For discussions of this issue, see Shapiro [2001a] and Padilla and Teece [2007].
\textsuperscript{12} For discussions see Geradin et al [2008c], Padilla and Teece [2007] and the references they cite. Simcoe [2006] attributes the rapid increase in intellectual property disclosure in a sample of standard-setting organizations in the early 1990s to the rise of small innovation specialist firms. This development would have been impossible without strong intellectual property rights. For example, Hall and Ziedonis [2001] argue that the strengthening of patent rights in the 1980s contributed to the rise of “fabless” semiconductor design firms. Strong intellectual property rights also contribute to the patent thicket problem, of course, and thus potentially to royalty-stacking.
\textsuperscript{13} See Farrell et al 2007, pp. 605-06 and the references cited in footnote 8.
Supreme Court decision in the *eBay* case, for instance, which made injunctive relief less certain in patent infringement cases, Justice Kennedy observed

An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees.

For these firms, an injunction … can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.\(^{14}\)

He does not mention that firms that also produce and sell goods could also use injunctions for this purpose, as well as for other socially undesirable purposes.\(^{15}\)

Innovation specialists have been accused of three forms of behavior that adversely affect social welfare. Perhaps the most common accusation is that they are *patent trolls*.\(^{16}\)

Trolls in folk tales hide under bridges and emerge suddenly to demand tolls from unsuspecting travelers, and patent trolls hide their intellectual property until an opportune time and then emerge to extract royalties.\(^{17}\) In the standard-setting context, the opportune time is typically after the intellectual property has been embodied in a standard and, perhaps, additional standard-specific costs have been sunk. This term has sometimes been applied to all innovation specialists, but most clearly do not engage in troll-like deceptive behavior, while some integrated firms have apparently done so.\(^{18}\) It seems generally agreed that if such deception can be shown to have yielded either a monopoly (in the US) or the ability to charge very high royalties (in the EU) it should be unlawful, though proving the deception was the main cause may be difficult in practice.\(^{19}\)

SSOs commonly attempt to prevent troll-like

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\(^{14}\) *eBay, Inc. v. MercExchange, LLC*, 126 S. Ct. 1837 (2006), at 122. The discussions of “non-practicing entities” by the U.S. Federal Trade Commission [2003; ch. 2, pp. 30-31; ch. 3, pp. 38-41] provide additional evidence of pervasive hostility; see also the references cited by Layne-Farrar et al [2008].

\(^{15}\) Lemley and Shapiro [2007] would go beyond *eBay* and generally deny injunctive relief to innovation specialists in infringement cases. While one can debate whether some limitation on injunctive relief is desirable in situations in which reasonable damages are much smaller than the losses that would be imposed by an injunction, it does not seem justifiable to conclude that injunctive relief should be denied to innovation specialists regardless of the balance between damages and losses. (For alternative views on injunctive relief in infringement cases, see Denicolò et al [2007], Geradin and Rato [2007], and Sidak [2008].)

\(^{16}\) See the references cited in note 8, above.

\(^{17}\) See Lemley [2008, n. 2] on the origin of this term.

\(^{18}\) For discussions of alternative definitions, see Gerardin et al [2008c], Lemley [2008], and the references they cite.

\(^{19}\) On this and related issues, see Farrrell et al [2007, pp. 647-59] and Villarejo and Banasevic [2008].
behavior by various sorts of rules requiring participants to disclose their intellectual property, though there are limits to what can be accomplished by this device.\footnote{Large technology-based firms may have portfolios of thousands of patents, each with multiple claims. To require a single complete search would be sufficiently burdensome as to discourage participation in standard-setting, and multiple searches might be required as a standard-setting process shifts direction over time and patent portfolios change. (See Miller [2007] on this latter point.) Thus few SSOs require even a single complete search, but without a complete search, individuals participating in standard-setting may be unaware of relevant patents held by their employers and thus fail to disclose them. Further complications are the incentive to over-disclose to avoid litigation and the offsetting incentive to make only vague disclosures in order not to reveal R&D strategies. For relevant discussions, see Chiao et al [2007], Farrell et al [2007], Lemley [2002], and Simcoe [2006].}

The other two accusations, with which this essay is primarily concerned, involve charges of excessive or abusive royalties. The mechanisms involved are commonly lumped together, but they are analytically quite distinct. The first of these accusations is patent hold-up. When technology covered by a patent is included in a standard, the ex ante value of that patent is sometimes (but not always, as we discuss further below) increased substantially ex post. It seems broadly consistent with most of the literature to say that patent hold-up occurs when a patent-holder demands royalties ex post that are above the reasonable ex ante expectations of potential licensees, expectations that presumably reflect the patent’s ex ante value rather than its ex post value. Thus defined, patent hold-up does not necessarily involve hiding the existence of intellectual property, but it generally does involve at least some deception (perhaps only misleading silence) regarding the corresponding royalty rate. If there is no surprise, if ex post royalties are in line with ex ante expectations, there is no hold-up.\footnote{Reducing or eliminating the risk of hold-up by all potential licensors may benefit licensors as well as consumers by encouraging the entry of manufacturing specialists; see Lévêque and Ménière [2007] for a formal analysis.}

Over the years, many SSOs have attempted to deal with the hold-up problem by requiring participants to commit ex ante to charge only royalty rates that are reasonable and non-discriminatory (RAND) or, particularly in Europe, fair, reasonable, and non-discriminatory (FRAND). These commitments at least oblige patent-holders to negotiate non-exclusive licenses in good faith; some have argued that they carry with them additional obligations.\footnote{See Chiao et al [2007] and Lemley [2002]. In what follows I will use FRAND to refer to both sorts of commitment for simplicity.} Despite this ambiguity, FRAND commitments seem to have worked well. The IEEE-SA [2002], for instance, testified that “[w]ith very few exceptions, this approach has worked very successfully for at least the past twenty years…” But as we discuss in Section
V, below, the IEEE-SA has recently sought and received approval of the U.S. Department of Justice to supplement this approach.

Upstream innovation specialists are also commonly accused of royalty-stacking. In a classic analysis, Cournot [1838] showed that in a static, one-shot model, unaffiliated firms with market power selling complementary products would set higher prices than a single firm formed from a merger among them. In the standard-setting context this analysis implies that if the patents essential to a standard are in multiple hands, total royalty rates will be at least somewhat higher than if all essential patents had a single owner. Because Cournot’s model assumes away important aspects of reality, including repeated interactions among participants in SSOs, the importance of this effect in general or in any particular standardization process must be an empirical question. The available evidence, such as it is, seems to suggest that royalty-stacking is not a generally important effect.23

Section III, below, contrasts royalty rate determination by innovation specialists and by integrated firms under imperfect competition in the absence of hold-up. We show first that both sorts of firms have parallel incentives to engage in royalty-stacking. And, while upstream innovation specialists sometimes have incentives to charge higher royalties than integrated firms would, we show that the latter may have the ability and incentive to use patent portfolios either to cartelize manufacturing or to exclude competition. This analysis provides no basis for what seems to be a growing presumption that the licensing behavior of innovation specialists is so clearly less socially desirable than that of integrated firms that a policy tilt against specialists is in order even though such a policy would necessarily put at risk gains from specialization.

Sections IV-VI considers possible antitrust responses to the hold-up problem. In an influential paper, Swanson and Baumol [2005, esp. pp. 16-18] argued that royalty rates that would emerge from ex ante competition among intellectual property owners for inclusion in a standard should be considered FRAND.24 They advocated the use of formal ex ante

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23 Compare Shapiro [2006], Lemley and Shapiro [2007], Geradin et al [2008a], Denicolò et al [2007], and Padilla and Teece [2007].
24 Thus, for instance, the U.S. Federal Trade Commission recently found that a reasonable royalty is “the amount the industry participants would have been willing to pay to use a technology over its next best alternative prior to the incorporation of the technology into a standard” (Opinion of the Commission on Remedy, In re Rambus, Inc., FTC Docket 9302, at 17, February 5, 2007). However, Geradin et al [2008b] and Geradin and Rato [2007]
competition, which they suggested might be implemented via an auction, to determine actual royalty rates. If formal ex ante competition were a workable mechanism, antitrust authorities might either require or actively encourage SSOs to employ it, possibly in order to obtain antitrust immunity for involving competitors in standard-setting. However, Section IV shows that formal ex ante competition is unlikely to be workable in practice, in important part because it is difficult to evaluate competing bids by innovation specialists and integrated firms. I also argue that ex ante competition has only slightly more potential as a standard for evaluating whether observed royalty rates are consistent with FRAND commitments.

Section V considers the alternative of allowing potential licensees operating in SSOs to engage in collective negotiation of royalty terms ex ante. The basic idea here is reminiscent of Galbraith’s [1952] endorsement of an economy with widespread “countervailing power” between upstream and downstream firms with market power. As Section V notes, both the US and the EU have recently moved significantly in the direction of allowing collective negotiation. Skitol [2005, p 729] would go farther, arguing that SSOs should have an antitrust duty to implement ex ante mechanisms to avoid hold-up that could include “collective negotiation of the license agreement.” While collective negotiation may be workable, in the sense that some sort of deal may well emerge when all interested parties come together behind closed doors, Section V shows that this process has significant shortcomings. Once again the different strategic incentives of innovation specialists and integrated firms cause problems. Perhaps more important, I argue that the emerging permissive policies toward collective negotiation in the US and the EU may impose

reject this standard and argue that FRAND simply implies a commitment to negotiated in good faith. Miller [2006] argues that signatories to FRAND commitments have given up the right to obtain injunctive relief; Garadin and Rato [2007] disagree. As Layne-Farrar et al [2007] discuss, some have argued that FRAND implies “numerical proportionality”: all essential patents would receive equal royalty rates. Lemley [2002] argues that FRAND is a commitment to license, with a court to determine whether the offered rates are reasonable. Layne-Farrar et al [2008] argue that because of small numbers bargaining, plausible ex ante compensation will tend to under-compensate innovators. Finally, Rysman and Simcoe [2008b] argue that FRAND is inherently unworkably ambiguous and propose an alternative commitment.

It is perhaps worth noting that Swanson and Baumol [2005, pp. 13-14] argue that royalty rates obtained by buyers acting collectively are not FRAND, and they oppose collective negotiation.


See also Lemley [2007].
considerable costs on society by condoning cartel behavior that inefficiently reduces incentives to innovate and thereby slows technical progress.

Based on the preceding analyses, Section VI discusses what I believe to be appropriate antitrust policy responses toward the difficulties that seem to beset standard-setting organizations and processes. While it is not sensible to make consideration of royalty rates within such processes an automatic offense, I believe it is also not sensible simply to permit collective negotiation of rates or to try to impose some sort of ex ante auction mechanism. At our current state of knowledge, it makes sense to experiment with processes that provide ex ante information about ex post royalty rates and licensing terms but stop short of enabling collective negotiation.

II. THE DECISION TO STANDARDIZE

This section uses a fairly standard oligopoly model, employed further in Sections III and V, to illustrate a simple point about the benefits of voluntary standardization. When standardization does not facilitate collusion or exclusion, it reduces differentiation to at least some extent and thus intensifies price competition. If that were all it did, competitors would never voluntarily agree to standardize. When they do agree to standardize, it is usually if not always because they believe that standardization will expand the market enough that profits will increase despite more intense price competition. If that belief is correct, consumers are also better off.

To illustrate, consider a simple economy with N producers and the following quasi-linear representative consumer utility function:

(1) \[ U = X_0 + \alpha \sum_i X_i - \frac{1}{2} \sum_i (X_i + \gamma \sum_{j \neq i} X_j). \]

Here \( X_0 \) is consumption of the numeraire good, produced competitively at constant unit cost and price of 1, \( \alpha > 0 \) and \( \gamma \in [0,1] \) are constants, all summations are from 1 to N, and the \( X_i \) are the outputs of Cournot oligopolists with constant unit cost C. When \( \gamma = 0 \) goods 1 through N are independent in demand, while when \( \gamma = 1 \) they are perfect substitutes. Standardization is modeled here simply as an agreement by all firms to increase \( \gamma \), assuming for simplicity here
that the intellectual property necessary to practice the new standards, if any, is available royalty-free to both firms. For this to be in the firms’ interest, $\alpha$ must increase as well.

If $P_i$ is the price of good $i$, equation (1) implies the following inverse demand functions:

$$P_i = \alpha - X_i - \gamma \sum_{j \neq i} X_j, \quad i = 1, \ldots, N. \quad (2)$$

Substituting the aggregate budget constraint into (1) and using (2), one obtains

$$U = I + (1/2) \sum_i X_i (X_i + \gamma \sum_{j \neq i} X_j) \equiv I + U^*, \quad (3)$$

where one can think of $U^*$ as the increment to consumer utility produced by this market.

Suppose there are $K$ upstream innovation specialists, and let $S_k$ be the royalty charged per unit of final output by specialist $k$. Similarly, let $R_i$ be the per-unit royalty charged by manufacturer $i$. (If firm $i$ is a manufacturing specialist, $R_i = 0$.) Let $S$ be the sum of the $S_k$ and $R$ be the sum of the $R_i$. Then firm $i$’s profits are given by

$$\Pi_i = X_i [\alpha - X_i - \gamma \sum_{j \neq i} X_j - \sum_{j \neq i} R_j - S - C] + R \sum_{j \neq i} X_j, \quad i = 1, \ldots, N. \quad (4)$$

In Sections III – V we consider two stage games in which royalty rates are selected in the first stage and outputs are selected in the second, taking royalty rates as given. Here we focus on the second stage only. Differentiating (4) with respect to $X_i$ and adding across $i$ yields

$$\sum_i X_i = \left[ N(\alpha - S - C) - (N - 1)R \right] / [2 + \gamma (N - 1)], \quad (5)$$

And substitution into (4) yields

$$X_i = \left[ (\alpha - S - C)(2 - \gamma) + \gamma (N - 1)R_i - 2 \sum_{j \neq i} R_j \right] / [(2 - \gamma)(2 + \gamma (N - 1))], \quad i = 1, \ldots, N. \quad (6)$$

For the purposes of this section, it suffices to consider (6) with zero royalties. Then substituting (6) into (4) yields,

$$\sum_i \Pi_i = N(\alpha - C)^2 / (2 + \gamma (N - 1))^2, \quad (7)$$

and substitution of (6) into (3) and simplifying yields

$$U^* = \left[ 1 + \gamma (N - 1) \right] \sum_i \Pi_i / 2. \quad (8)$$

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28 Kim [2004] and Schmidt [2006] analyze this same two-stage model with $\gamma = 1$ and consider some of the questions addressed below.
It can easily be shown that $\partial U^*/\partial \gamma < 0$: taking into account output responses, standardization that does not increase $\alpha$ makes consumers worse off.

The main result of this section follows immediately from (7) and (8). If standardization that raises both $\alpha$ and $\gamma$ increases firms’ profits, it also increases consumer utility and thus total economic welfare. It follows also from these equations that there are unility-increasing standardization options of this sort that would not be voluntarily adopted because they would not increase profits. In the absence of symmetry, welfare-enhancing standards can fail to be adopted because they would only increase the profits of some firms, perhaps resulting in a standards war. Intellectual property and other assets, including technology-specific know-how, specialized manufacturing facilities, and distribution channels can be sources of important asymmetries in this context.

### III. STRATEGIC ROYALTY-SETTING

Using the model just introduced, and assuming away complications related to hold-up and the ex ante/ex post distinction (on which the following three sections focus), let us first examine royalty-stacking behavior. Suppose the intellectual property that is essential for some standard is divided among $K$ upstream innovation specialists. From (5), the stage 1 objective of the $k^{th}$ such firm is

$$\Pi_k = S_k [N(\alpha - \sum S_l - C)]/[2 + \gamma (N - 1)],$$

where the summation is over all $k$. The one-shot Nash equilibrium royalty rate for each firm is easily seen to be

$$S_k = (\alpha - C)/(K + 1), \quad k = 1, \ldots, K.$$  

The total per-unit royalty paid by each downstream firm is $K$ times $S_k$. This latter quantity is easily seen to be increasing in $K$ and to tend to $(\alpha - C)$ in the limit as $K$ increases. In this limit, total downstream output tends to zero. Royalty-stacking in this model eliminated all output in the limit.

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29 Suppose initially $\alpha = 1$ and $\gamma = 0$ and that a proposed standardization would raise $\alpha$ to 5/4 and $\gamma$ to 1. It is easy to show that this change would benefit consumers but not producers and would thus not be voluntarily adopted by the latter.
The same royalty-stacking effect also appears in this model when there are no innovation specialists. Suppose that there are N manufacturing firms, as above, and firms 1, …, K, where K ≤ N, have essential intellectual property. Substituting (5) and (6) into (4) to obtain the stage 1 objective function of a typical integrated firm:

\[
\Pi_i = \left\{ \frac{[(2-\gamma)(\alpha-C) + \gamma(N-1)R_i - 2\sum_{j \neq i} R_j]}{[(2-\gamma)(2 + \gamma(N-1))]^2} \right. \\
+ R_i \left\{ \frac{[(N-1)(2-\gamma)(\alpha-C) - 2(N-1)R_i + (4+\gamma N-2N-\gamma)\sum_{j \neq i} R_j]}{[(2-\gamma)(2 + \gamma(N-1))]^2} \right\}. 
\]

Suppose firm i has essential intellectual property so that one can differentiate (11) with respect to \( R_i \) and, to examine the symmetric equilibrium, set \( \sum_{j \neq i} R_j = (K-1)R_i \).

The resulting expression for \( R_i \) is quite complex, but consideration of the special case of perfect downstream substitutes (\( \gamma = 1 \)) will serve to illustrate the main point:

\[
R_i = (\alpha - C)(N + 3)(N - 1)/[(K - 1)(N^2 + 2N - 7) + (N - 1)(6 + 2N)].
\]

Integrated firms pay total per-unit royalties equal to (K-1) times this quantity, while firms K+1, …, N pay K times this quantity. It is easy to show that both total royalty rates rise with K. If K = N, so that all firms have intellectual property, the total royalty rate paid by each is given by

\[
R - R_i = (\alpha - C)(N^2 + 2N - 3)/(N^2 + 4N - 1), \quad I = 1, \ldots, N.
\]

The right-hand side of (13) is increasing in N and in the limit approaches (\( \alpha - C \)), the aggregate royalty rate that drives downstream output to zero – exactly as above.

Upstream firms’ only concern is royalty income, but their ability to extract profit is limited by the problem of vertical double marginalization: downstream manufacturers add markups to the royalty costs they pay, thus tending to raise final prices too high for maximization of total profit. Each integrated firm avoids this problem with respect to its own output, but its competitors mark up the royalties it charges them. In addition, the payoff to each integrated firm individually from raising rivals’ costs, thus reducing their output and increasing the first term on the right of (4) leads to aggressive royalty-setting. The pattern that emerges from these strategic considerations in any particular case will depend on details of demand and costs.
In this model when \( \gamma = 1 \), it is straightforward to compare the case in which \( N \) innovation specialists set royalties for \( N \) manufacturing firms with the case in which \( N \) integrated firms non-cooperatively set royalties for each other. Because of the raising-rivals-cost effect, it is not surprising that the equilibrium royalty charged by each integrated firm, \((\alpha - C)(N - 3)/(N^2 + 4N - 1)\), is higher than the rate charged by each innovation specialist, \((\alpha - C)/(N + 1)\), when royalties are set upstream.\(^{30}\) On the other hand, when royalties are set upstream, each producing firm pays \( N(\alpha - C)/(N + 1) \), while if they are set by integrated firms (which don’t pay royalties to themselves), each producing firm pays \((N - 1)(\alpha - C)(N - 3)/(N^2 + 4N - 1)\), and it is easy to show that the former quantity exceeds the latter. Accordingly, output and consumer welfare are higher when \( N \) integrated firms charge royalties to each other than when \( N \) manufacturing specialists are charged royalties by \( N \) upstream innovation specialists.\(^{31}\)

The strategic use of intellectual property to raise rivals costs is clearest when a single integrated firm, firm 1, say, has essential intellectual property. Differentiating (11) for \( i = 1 \) and setting \( R_j = 0 \) for \( j \neq 1 \) yields

\[
R_1 = (\alpha - C)(2 - \gamma)(4 - 2\gamma + 2\gamma N + \gamma^2 + \gamma^2 N)/(16 - 16\gamma + 8\gamma N + 6\gamma^2 - 6\gamma^2 N).
\]

This quantity equals \((\alpha - C)/2\) for \( \gamma = 0 \) and \( \gamma = 1 \). For intermediate values of \( \gamma \) and for \( 2 \leq N \leq 30 \), \( R_1 \) is less than this value and greater than \( 0.45(\alpha - C) \).

When \( \gamma = 0 \), firm 1 is effectively an upstream supplier of intellectual property to all other firms, and it charges the same royalty rate as an innovation specialist – given by (10) with \( K = 1 \). For larger values of \( \gamma \), firm 1 faces more direct competition from its rivals, and its incentive to increase their costs rises. The equilibrium ratio of \( X_1 \) to the output of any of its competitors is 2 when \( \gamma = 0 \), because those competitors mark up \( R_1 \), and it rises with \( \gamma \). As Kim [2004] has shown, when \( \gamma = 1 \), firm 1’s equilibrium royalty rate is so high that all other firms produce zero, and firm 1 simply acts as a monopolist.

This extreme exclusion occurs even though firm 1 (just) passes the Efficient Components Pricing Rule (ECPR) test for exclusionary behavior proposed by Swanson and

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\(^{30}\) Schmidt [2006] has previously shown this.

\(^{31}\) It is straightforward to demonstrate that the qualitative comparisons in this paragraph also hold when \( N = 2 \) for any \( \gamma \in [0,1] \).
Baumol [2005]: the implicit royalty rate firm 1 charges itself for its intellectual property, defined as the difference between its final output price and its marginal cost, just equals the explicit royalty rate it charges its rivals. The ECPR test fails to detect exclusionary behavior here because competition is in outputs not prices, as Swanson and Baumol implicitly assumed, and firm 1 rationally ignores the implicit royalty rate in setting its output.\textsuperscript{32} It in fact has lower marginal costs than its rivals, and it sets output accordingly. For $0 < \gamma < 1$, the royalty rate given by (14) passes the ECPR test; it is slightly below firm 1’s price-cost margin.

Finally, as Shapiro [1985] has noted, rival integrated firms in models of this sort can use cooperatively set royalty rates, perhaps via a patent pool, to induce monopoly output in stage 2. With $N$ symmetric integrated firms, it is easy to show that total profits are maximized if each charges

$$ (15) \quad R = \gamma(\alpha - C) / [2(1 + \gamma(N - 1))]. $$

While this quantity declines with $N$, the total royalty rate paid by each firm, $(N-1)$ times this quantity, rises with $N$. The larger is $N$, the more intense is output competition in stage 2, and the greater the need to restrain that competition by raising costs in order to restrict output to the monopoly level.

When $\gamma = 0$ and each firm is effectively in a separate market, royalties would serve no purpose. Total profits are maximized if royalties are set to zero, below the non-cooperative level. As $\gamma$ increases, the private payoff to restricting competition rises, Nonetheless, for $\gamma = 1$ it is easy to show that the cooperative royalty rate, given by (15), is less than the non-cooperative rate, given by (12) with $K = N$. It follows that total output and consumer welfare are higher under cooperative than under non-cooperative behavior: collusion or mutual forbearance in royalty-setting can be socially beneficial as well as privately profitable. Of course, permitting integrated rivals to have discussions that could lead to reductions in royalty rates could also facilitate less socially desirable collusion – involving reductions in innovative activity, for instance.

The analysis of this section shows that strategic factors affect royalty rate determination by both innovation specialists and integrated firms, though the factors differ.

\textsuperscript{32} Farrell et al [2007, p. 641] argue that the ECPR test can also fail to detect exclusionary conduct when competition is in price and products are differentiated.
somewhat. Royalty-stacking occurs in this model whether royalties are set upstream by
innovation specialists, which face vertical double marginalization, or by integrated firms,
which have incentives to raise rivals’ costs and thus gain competitive advantage. In this
model, at least, integrated firms can use royalty-setting to exclude rivals entirely under some
conditions or, acting cooperatively or showing mutual forbearance, to cartelize the market. It
is hard to take away from this analysis a strong preference for either innovation specialists or
integrated firms – certainly not a preference strong enough to overcome the normal
presumption that market forces should be allowed to determine firms’ boundaries and activity
mixes.

IV. FORMAL EX ANTE COMPETITION

Swanson and Baumol [2005] analyzed ex ante competition between alternative
standards involving one patent each. Layne-Farrar et al [2007, Section IV.A.] considered ex
ante competition for inclusion in standards involving two patents. Building on the latter
analysis, this section first presents a model of ideal ex ante competition among holders of
intellectual property for inclusion in standards involving M components. We then use this
model, along with some implications of the oligopoly model considered above, to evaluate the
potential of formal ex ante competition for determining royalty rates and the utility of ideal ex
ante competition for evaluating observed royalty rates.

Suppose that in order for a standard to be viable, it needs one technology, assumed for
convenience to be covered by patents held by a single firm, for each of the M components.
Let us also assume, again mainly for convenience, that there are unique best and second-best
technologies for each component, defined in terms of incremental contribution to the value of
the standards, regardless of which technologies are used for the other components. (The
analysis below implies that only the first- and second-best technologies can affect the final
outcome.)

In order for formal ex ante competition to work well, we need strong assumptions,
which will be discussed below. First, all we assume that potential new standards would yield

33 This model seems broadly consistent with the discussion in Farrell et al [2007, p. 642].
a new product of exactly the same quality, so they differ only in the unit cost of production they would imply. This means that there is no need to consider quality/cost tradeoffs.

Second, let us assume that the value of any potential standard is the same to all manufacturers and depends only on the total unit cost of the final product – production cost plus royalty cost – and not on the ownership of the underlying intellectual property. This assumption requires that manufacturers be identical in the at least some dimensions. More important, as we discuss below, the model introduced above can be used to demonstrate that this assumption rules out any role for the intellectual property of integrated firms in the standard-setting process. We are thus in a world of innovation specialists and manufacturing specialists.

Third, we assume that unit cost of producing the final product using any potential standard is known. Let that cost be given by the function

\[ C(d_1, d_2, \ldots, d_N), \]

where \( d_i = a \) if the best technology is used for component \( i \), and \( d_i = b \) if the second-best technology is used. Finally, we assume that total sales of the final product will be some fixed number of units as long as total production plus royalty cost is less than or equal to \( C_T \) and zero otherwise.

Let \( a_i \geq 0 \) be the per-unit royalty charged for the best technology for component \( i \), and let \( b_i \geq 0 \) be the rate charged by the second-best technology. (We neglect licensing costs throughout for simplicity.) Suppose first that \( M = 1 \) and that the owners of the two technologies simultaneously announce their royalties. The conditions for the first-best technology to be selected as the standard and for the standard to be used are

\begin{align}
(16a) & \quad a_1 \leq b_1 + [C(b) – C(a)]. \\
(16b) & \quad a_1 \leq C_T – C(a).
\end{align}

If the inequality in (16a) is reversed, the first-best technology is not selected. Because of our demand assumption, if the inequality in (16b) is not satisfied, the standard is not used. The quantity in brackets on the right of (16a) is non-negative by the definition of first- and second-best technologies. If \( a_1 \) is less than or equal to that quantity, the first-best technology will be selected regardless of the value of \( b_1 \). In this simple case, the obvious competitive outcome is \( a_1 = \min\{C_T – C(a), [C(b) – C(a)]\} \) and \( b_1 = 0 \).
Now suppose that $M=2$. In the sort of Bertrand regime we are considering here, ex ante competition is provided by the willingness of the owners of the second-best technologies to license them at any non-negative rates. Setting $b_1 = b_2 = 0$ accordingly, the inequalities corresponding to (16) that must be satisfied in order for the standard with the lowest production cost to be selected and to be used are the following:

(17a) $a_1 \leq C(b,a) - C(a,a) \equiv \Delta_1$
(17b) $a_2 \leq C(a,b) - C(a,a) \equiv \Delta_2$
(17c) $a_1 + a_2 \leq C(b,b) - C(a,a) \equiv \Delta_{12}$
(17d) $a_1 + a_2 \leq C_T - C(a,a) = \Delta_{11}$

By the definition of first- and second-best technologies, all the right-hand sides of these inequalities are non-negative.

Now consider the following game. The owners of the first-best technologies for components 1 and 2 – call them firms 1 and 2 for simplicity – submit sealed bids $a_1$ and $a_2$ simultaneously. If all of inequalities (17) are satisfied, firm i receives per-unit royalty $a_i$ times the (fixed) number of units sold. If any of inequalities (17) are violated, however, another round of bids is solicited, and the process continues until bids satisfying (17) are received.

This game clearly has at least one Nash equilibrium. Because the right-hand sides of inequalities (17) are non-negative, all these inequalities are satisfied by $a_1 = a_2 = 0$. An equilibrium is a pair of non-negative $a$’s such that neither can be increased without violating these inequalities. If at the point $a_1 = a_2 = 0$ neither royalty rate can be increased without violating at least one of inequalities (17), that point is the unique equilibrium. If not, one or more equilibria can be found by increasing one or both of the $a_i$ until one of inequalities (17) hold with equality.

It follows from the analysis of Layne-Farrar et al [2007] that there may be many equilibria of this game and that if one technology has a good substitute and the other does not, the latter will generally command higher royalties in equilibrium. In particular, if the first- and second-best technologies for component 1, say, are equivalent, so $\Delta_1 = 0$, then $a_1 = 0$ in equilibrium. At the other extreme, if there is only one viable technology for component 2, so that $C(a,b) = C(b,b) = \infty$, then (17b) and (17c) are irrelevant, and $a_2$ is only constrained by
If $\Delta_1 = 0$ also, so $a_1 = 0$ in equilibrium, then $a_2 = C_T - C(a,a)$, and and firm 2 captures all the rent associated with the standard. Alternatively, if technology 1 has only an imperfect substitute, so $\Delta_1 > 0$, then there is a continuum of equilibria.

It is easy to describe the hold-up problem in this simple model. Suppose that there is no ex ante competition and that the value-maximizing standard is nonetheless adopted. If firms 1 and 2 then proceed ex post to set royalty rates, perhaps by the auction mechanism sketched above, the only constraint binding them is (17d). If licensors expectations were based on the assumption that all of inequalities (17) would be satisfied, and if both technologies had substitutes ex ante, hold-up has occurred. There are an infinite number of equilibria to the game above with (17d) replacing (17). Because these ex post equilibria are not constrained by the presence of second-best technologies, they may involve higher rates charged by both firms. The firms most likely to benefit are those facing close substitute technologies ex ante, since the tight competitive constraint provided by those technologies is eliminated once the standard is set. At the other extreme, if one firm has the only viable technology for one of the components, it is less likely to benefit from a shift from all of (17) to (17d) alone. Indeed, in the polar case discussed above in which one firm captures all the rents in ex ante competition, there will be a continuum of ex post equilibria in which its returns are lower.

This model of ideal ex ante competition easily generalizes beyond the two-component case. With M components, there are $2^M$ potential standards, and thus $2^M$ constraining inequalities corresponding to (17): $2^M - 1$ involving differences between costs under alternative standards and costs under the first-best standard, and one comparing total costs to $C_T$. The right-hand sides of all these inequalities are non-negative, so all are satisfied by $a_i = 0$ for all i. If it is not possible to increase any $a_i$ without violating any inequalities, $a_i = 0$ for all i is an equilibrium. In general, any point at which all $a_i$ are non-negative and it is not possible to increase any $a_i$ without violating a constraining inequality is an equilibrium.

As in the case N=2, there may be an infinite number of equilibria of this game. Similarly, if the first-best technology for any component i has a perfect substitute, the inequality on $a_i$ alone (which corresponds to (17a) or (17b)) ensures that it cannot charge positive royalties in equilibrium. And if, say, technology j has no substitutes, so that all
standards that do not use it have zero value, then the right-hand sides of all inequalities involving \( a_j \) are infinite, except the inequality corresponding to (17d).

Ex ante competition as described here is attractive in a number of important respects. It involves no strategic behavior, and all participants would agree on the evaluation of bids. It completely solves the hold-up and royalty-stacking problems. It ensures that the best standard is adopted and rewards patents that are essential to that standard on the basis of their incremental contributions to the value of that standard, something that strikes most observers as fair.\(^{34}\)

Unfortunately, however, relaxing the four strong assumptions made at the start of this section in the direction of realism removes those properties.\(^{35,36}\) Without the assumption that market size is fixed as long as total cost is below \( C_T \), for instance royalty-stacking appears. If (17d) is eliminated, for instance, if firm 1 raises its royalty slightly, it will raise the cost of the final product slightly, reducing the number of units sold, and thus reducing the number of units on which it and firm 2 receive royalties. But, just as Cournot’s [1838] copper monopolist ignores the impact of its pricing on the demand for zinc, firm 1 does not take into account the impact of its price-setting on firm 2’s royalties. Ex ante competition under reasonable assumptions about downstream demand does not eliminate incentives for royalty-stacking.

We also assumed that the value of any standard to all potential users depends only on the total unit cost of the final product that it implies – production cost plus royalty cost – and not on the ownership of the underlying intellectual property. Once we allow for the presence of both integrated firms and innovation specialists, however, this assumption cannot be maintained. To illustrate, let us use the model of the preceding section and assume \( M = 1 \). Suppose there are two bids on the table, one from integrated firm 1 and one from an upstream

\(^{34}\) Layne-Farrar et al [2007, Section IV.B] discuss ex ante application of the Shapley value from cooperative game theory as an alternative to ex ante competition. The Shapley value approach also bases rewards on incremental contributions, but it has the somewhat unpalatable implication that technologies considered but not included in the standard typically receive positive royalties.

\(^{35}\) Though this is not a formal defect, it is worth noting that the equilibria described above are extraordinarily delicate. That is, if one firm sets its royalty rate a penny too high, everyone goes back to square one. This is a particular problem when there are multiple equilibria, which seems likely, since unless every licensor aims for the same equilibrium, with great accuracy, it is not clear how the process of bidding and rebidding converges.

\(^{36}\) For more extensive discussions of the limitations of ex ante competition, see Geradin [2006], Geradin and Layne-Farrar [2007], and Geradin et al [2008b].
innovation specialist. Both would enable production at unit cost $C$, and both bidders would charge per-unit royalty $r$. The integrated firm would clearly vote for its own standard, as it would rather receive royalties than pay them, and charging its rivals royalties would give it a cost advantage over them. The innovation specialist, if it had a seat at the table, would vote for its own standard, since if it does not receive royalties it has no income. What about firms 2, …, $N$, which, by assumption, would license the patent underlying the standard selected and compete with firm 1? From (11), if the innovation specialist’s bid is accepted, each can look forward to profit of

\[
\Pi_i^\text{II} = \frac{(2 - \gamma)(\alpha - C - r)}{(2 - \gamma)(2 + \gamma(N - 1))}, \quad i = 2, \ldots, N,
\]

while if integrated firm1’s bid is accepted, the typical manufacturing specialist will earn

\[
\Pi_i^1 = \frac{(2 - \gamma)(\alpha - C) - 2r}{(2 - \gamma)(2 + \gamma(N - 1))}, \quad i = 2, \ldots, N.
\]

If $\gamma = 0$ the markets are independent, and firms 2, …, $N$ are indifferent between the two bids. But for $\gamma > 0$, they prefer the standard offered by the innovation specialist. The reason is simple: while their per-unit royalty payments would be the same under both standards, (18a) shows the results of competition in which all manufacturers pay $r$, while (18b) shows what happens when firms 2, …, $N$ pay $r$ but firm 1 does not. All else equal, manufacturing specialists prefer standards offered by innovation specialists; the presence of integrated firms adds a strategic dimension to bid evaluation.

We also assumed that the cost implications of alternative standards were known, because such knowledge is clearly essential to evaluate patent-holders’ bids. In a standard of any complexity, however, writing down the counterparts of (17) would require knowing the cost implications of many potential standards, only one of which will be adopted. With only 10 components, for instance, the cost characteristics of 1024 potential standards would have to be evaluated – even after all first- and second-best technologies have been identified. Standard-setting is a process that unfolds over time, during which information is exchanged and participants refine their understanding of the characteristics of alternative technologies and potential standards. Indeed, as Miller [2007] has stressed, claims of pending patents can be altered during that process. It is not clear when during such a process competition would

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37 See the discussion of the “toehold effect” by Geradin et al [2008b].

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take place? If too early, it is likely to be based on poor information; if too late, the standard may be largely determined and hold-up may be unavoidable.

Finally, we assumed that potential standards differed only in their implications for the cost of the final product, not their implications for the attributes or overall quality of that product. If it would cost more to implement standard A than standard B but the former would produce higher quality products, firms that served different geographic markets or different market segments might well disagree on which was the better standard. Bid evaluation under such conditions would not be simply a matter of comparing total costs, and the identity of the bid evaluators and/or the details of the SSOs collective decision-making process could determine the outcome.

Not only is formal ex ante competition not likely to be workable in practice, the sort of ideal ex ante competition described above is not likely to be of much use as a standard for determining whether observed royalties are consistent with FRAND commitments. For all the reasons just discussed, real ex ante competition is not likely to have the attractive properties of the ideal version presented above. Moreover, there will almost certainly be insufficient information in any real case to compute the equilibria of the game described above or of any more realistic alternative – and there may be multiple equilibria to boot. This means that the standard of ex ante competition cannot be used to evaluate the total royalty rate in any case or to make detailed quantitative predictions about the structure of royalties. The qualitative predictions of the analysis above are of some use, however. Generally, technologies without good substitutes receive higher royalty rates in ideal ex ante competition than technologies that do have good substitutes. This clearly rules out simplistic characterizations of FRAND royalties such as numerical proportionality – the proposal that total royalties should be divided among patent-holders in proportion to the number of essential patents they hold. In addition, comparison of the constraints on royalties in ideal ex ante competition with the constraints operative ex post, after the standard is adopted, indicates that hold-up is much more likely to be a problem for technologies with good substitutes ex ante. It is the market power of those technologies, rather than of technologies that lack good substitutes ex ante, that is augmented by being included in a standard.

38 On this notion, see Layne-Farrar et al [2007].
V. COLLECTIVE EX ANTE NEGOTIATION

If the sort of formal, arms-length competitive process considered above is not workable, one alternative approach to mitigating hold-up problems would be to allow or even require collective is to allow collective negotiation of royalty terms before standards are set. Both the US and the EU have recently moved a considerable distance toward such a policy

This shift seems clearest in the EU. In its Technology Transfer Guidelines, the European Commission [2004, ¶225] states

Undertakings setting up a technology pool …, and any industry standard that it may support, are normally free to negotiate and fix royalties for the technology package and each share of the royalties either before or after the standard is set.

But for the slight ambiguity introduced by “normally,” this would be a blanket endorsement of collective negotiation of royalty rates.

In the US, the Federal Trade Commission and the Department of Justice have made it clear that they believe per se condemnation of collective negotiation is inappropriate, and in their recent intellectual property report [2007, p. 52] they have taken a stance on the relevant rule of reason analysis that brings them close to the EU’s position:

In most cases, it is likely that the Agencies would find that joint ex ante activity undertaken by an SSO or its members to establish licensing terms as part of the standard-setting process is likely to confer substantial precompetitive benefits…

Though the agencies go on to say that “joint ex ante licensing negotiations may raise competition concerns in some settings,” they provide only an extreme example (collectively forcing down the royalty rate for the only acceptable technology), and they cite Majoras [2005] for the proposition that collective negotiation rarely poses a risk to innovation incentives.39 This does not quite add up to a blanket endorsement of collective negotiation,

39 See also Antitrust Modernization Commission [2007, ch. I.D], where a rule of reason analysis of collective negotiation is recommended, but no guidelines for such analyses are provided, and Masoudi [2007].
and Oliver [2008, pp. 43] counsels firms not to assume per se legality, but the general U.S. policy stance is surely also favorable to collective negotiation as a Galbraithian, “countervailing power” reaction to hold-up concerns.

There are two important problems with collective negotiation, however, that make its use socially problematic at best. 40 First, collective negotiation necessarily entails the exercise of whatever collective monopsony power that potential licensees have. And to the extent that collective negotiation serves its purpose of reducing royalty rates, it reduces the incentive to innovate, with potentially high social costs. In addition, when integrated firms are engaged in collective decision-making about royalty rates, there is some risk of collusion to reduce innovative efforts.

Those who favor collective negotiation typically either ignore or attempt to minimize its possible adverse impact on the pace of technical progress. Thus while the Antitrust Modernization Commission [2007, p. 121] does worry that the collective exercise of monopsony power might force rates below “a reasonable level,” it then lists among the benefits of collective negotiation “reasonable licensing terms,” without suggesting how reasonability could be ensured or assessed. In a widely-cited speech, Majoras [2005] argues that if SSO members jointly lack buying power, “they would be not be able to impose a lower than competitive rate,” 41 though of course if they collectively lack buying power it is not clear what joint negotiations could accomplish for them that bilateral negotiations could not. She goes on to argue that the potential exercise of monopsony power would be limited in practice both by patent-holders ability to decline to participate (and, of course, risk having their technology not included in the standard) and by mutual forbearance among integrated firms (which, of course, would also operate without collective negotiation). Skitol [2005] asserts that a variety of potentially promising but untested procedural safeguards can avoid buyer cartel behavior, and Farrell et al [2007, pp. 632-3] simply argue that it is worth running

40 See also Geradin [2006], Lemley [2007], Swanson and Baumol [2005, esp. ppl 13-14]
41 In this literature, one sometimes encounters references to the “competitive” level of royalties, always without a definition of that term. It may seem most natural to define the “competitive” level as the aggregate royalty level that would emerge from ideal ex ante competition, but not only is there no guarantee that all equilibria of that process have the same aggregate level, the impossibility of computing those equilibria make that definition empirically vacuous.
some risk of cartel behavior that discourages innovation in order to reduce the hold-up problem.

These authors and others cited in elsewhere in this paper seem preoccupied with what might be called short-run dynamic efficiency: bringing existing knowledge efficiently to the marketplace in the form of new products and processes. Imperfections in standard-setting processes clearly reduce short-run dynamic efficiency. But while short-run dynamic efficiency is important, it is surely ultimately less important than long-run dynamic efficiency: the production of valuable new knowledge. Prospective reductions in the returns to knowledge generation via reductions in prospective patent royalties unambiguously reduce the incentive to generate new knowledge and thus adversely affect long-run dynamic efficiency. This is not to say that it is undesirable ever to reduce the returns to patent-holders; it is rather to argue that this must be done with care. Proposals to reform the patent system, for instance, typically aim to reduce the returns to minor advances (or non-advances) that many believe should not be embodied in patents.42 Most such reform proposals do not aim materially to reduce the appropriately substantial returns to major advances, because the attendant reduction in incentives for important innovations would have very high social costs.

In the standard-setting context, I have seen no evidence that we know enough to devise an operational framework for rule of reason analysis of collective negotiation processes that would reliably prevent monopsonistic reductions in the returns to major advances. It is fine to assert, as a senior official of the U.S. Department of Justice has recently done (Meyer [2008]) that “the rule of reason … will not sanction monopsonistic behavior that leads to allocative inefficiencies by unreasonably suppressing prices paid for IP used in standards,” but with no obvious standards for the reasonability of prices or behavior, this assertion gives one little confidence that innovation incentives will be preserved by antitrust enforcement. Indeed, the next sentence’s assertion that SSOs “should be confident that they have substantial legal breathing room” seems to signal an enforcement stance that worries little about those important incentives.

The second basic problem with collective negotiation is mechanical: even apart from
the monopsony problem, there are many reasons to believe that ex ante collective negotiation
will simply not work well in practice. One reason is that negotiation is inherently a messy
process. It is fine for EU Competition Commissioner Kroes [2008] to condemn “…voting the
in the standard-setting context [that] is influenced less by the technical merits of the
technology but rather by side agreements, inducements, package deals, reciprocal agreements,
or commercial pressures...,” but once it becomes legitimate for the parties to make collective
decisions on price, it is hard to dictate what sorts of considerations will shape those decisions.
Moreover, one person’s reciprocal agreement is another’s mutual forbearance, and one
person’s inducement is another person’s nonlinear pricing. Other reasons to be skeptical
about ex ante negotiation are closely related to the problems with ex ante competition
identified in Section IV. Assuming well-behaved demand for the final product, for instance,
collective negotiation will not remove incentives for royalty-stacking – unless, of course, one
wishes to allow licensor cartels as well as licensee cartels. Since knowledge accumulates in
standard-setting processes, it is not clear when negotiations should take place. It is not clear
how quality/cost tradeoffs would be handled when firms’ assets and objectives differ.
Finally, as above, the differing strategic incentives of innovation specialists and
integrated firms complicate matters. It is not obvious on which side of the negotiating table
integrated firms should sit. An even harder question is how one could structure a negotiation
process so as to appropriately neutralize the different strategic incentives of innovation
specialists and integrated firms. In Section IV we showed that in our simple oligopoly model
in ex ante competition, manufacturing specialists will always prefer a bid from an innovation
specialist to an identical bid from an integrated firm with which it would compete ex post. In
the absence of a useful general model of negotiation in this setting, it is at least somewhat
instructive to consider willingness to pay to have alternative standards selected – perhaps via
the sorts of mechanisms that Commissioner Kroes [2008] would condemn. Suppose an
innovation specialist proposes a standard with unit cost C and unit royalty S and an integrated
firm proposes a standard with unit cost C and unit royalty R. If firms 2, …, N, assumed again
to be manufacturing specialists, find these two offers equally attractive, it follows from
equations (18) that $S = 2R/(2 – \gamma)$: as long as \(\gamma\) is positive, firm 1 must charge a lower royalty
in order to offset the reluctance of manufacturing specialists to compete against it with a cost
disadvantage.

The maximum amount the innovation specialist would be willing to pay to be selected,
\( \Delta \Pi_u \) is simply equal to its profits if it is selected and it can charge royalty rate \( S = \frac{2R}{2 - \gamma} \),
since if it is not selected it has zero income. The corresponding quantity for firm 1, \( \Delta \Pi_1 \), is
equal to firm 1’s profit if it is selected and it can charge royalty rate \( R \) minus its profit if the
upstream firm is selected and imposes royalty rate \( S = \frac{2R}{2 - \gamma} \). For small enough \( R \), both
\( \Delta \Pi_u \) and \( \Delta \Pi_1 \) are increasing in \( R \). A bit of algebra yields
\[
(19) \quad \Delta \Pi_1 - \Delta \Pi_u = R[AR - B(\alpha - C)],
\]
where \( A \) and \( B \) are polynomials in \( N \) and \( \gamma \) that can be shown to be positive at \( N = 2 \) and
increasing in \( N \) thereafter. When \( R \) is zero, neither firm is willing to pay anything to be
selected. It follows from (19) that for \( R > 0 \) but less than some positive value, \( R^* \), the
upstream firm is willing to pay more to be chosen, while if \( R > R^* \) the integrated firm would
pay more. The intuition is that if \( R \) is small, the specialist is hungrier because it has no
income if it loses, while if \( R \) is large and \( \gamma > 0 \), the significant cost advantage the integrated
firm would obtain if it won makes it hungrier.

The polar cases are instructive. When \( \gamma = 0 \), \( R^* = \frac{(N + 1)(\alpha - C)}{2} \), which is well
above the relevant range. Firm 1’s cost advantage is not worth much in this case, and the
innovation specialist is always willing to pay more to be chosen. In the other polar case, \( \gamma = 1 \), \( R^* = \frac{(N + 1)(\alpha - C)}{3N - 1} \). This quantity equals \( \frac{\alpha - C}{5} \) when \( N = 2 \) and approaches \( \frac{\alpha - C}{3} \) in the limit as \( N \) increases. Thus when \( \gamma = 1 \), there are royalty rates within the relevant
range at which the integrated firm would be willing to pay more to be selected.

At the very least, this analysis suggests that collective negotiation of royalty rates
would be strategically complex. Integrated firms and innovation specialists would not
generally be similarly positioned in negotiation even if they had similar technologies.
Without a reliable general model of collective negotiations, however, it is not obvious which
sort of firm would have the upper hand under what conditions.
VI. APPROPRIATE ANTITRUST POLICY

Antitrust policy rests on the assumption that markets generally work well in the absence of artificial impediments to competition. It is also widely, if not universally accepted that antitrust policy is a blunt instrument, not capable of reliably fine-tuning market processes or outcomes to the benefit of consumers. Thus, for instance, even though vertical integration can have anti-competitive effects under some conditions, antitrust agencies rarely seek vertical disintegration, since market forces, even in imperfect markets, tend to produce efficient firm boundaries. Similarly, even though prices of complements sold by independent firms tend to exceed prices that would be set by merged firms, I do not believe US or EU antitrust agencies have ever sought to force mergers among such firms. And even though buyer cartels can sometimes benefit consumers in theory, antitrust authorities have generally not endorsed collective purchasing regimes that have the potential to exercise monopsony power.

Despite recent controversies deriving in part from the growing importance of innovation specialists, the analysis here does not support departing from these principles when dealing with standard-setting processes and organizations. As noted in Section I, voluntary standard-setting generally works well despite its theoretical infirmities, a few high-profile legal battles notwithstanding. Section II formalized the basic rationale for antitrust’s traditional friendliness toward cooperation among competitors to determine compatibility standards. Section III demonstrates that royalty-stacking incentives are present whether royalties are set by innovation specialists or integrated firms. In addition, it showed that integrated firms have incentives to use high royalty rates to exclude rivals or to collude on royalties in order to induce monopoly price and output. Section IV argued that formal ex ante competition is unlikely in practice to be a desirable or even practical mechanism for determining royalty rates. Finally, Section IV argued that collective negotiation of royalty rates shares many of the deficiencies of ex ante competition and, in addition, will tend to reduce incentives to innovate and thus slow the pace of technical progress.

What, then, should antitrust policy-makers do – if anything – to respond to the perceived recent increase in the importance of hold-up and royalty-stacking, which many observers attribute in significant part to the rise of innovation specialists? I believe that a
number of recent developments have in fact been appropriate responses to this situation but that to go much farther in the direction of ex ante competition or collective negotiation risks imposing significant economic costs without commensurate benefits. Thus, for instance, to the extent that hold-up problems stem from troll-like behavior, those problems will be mitigated to some extent by the recent hostility toward such behavior by enforcement authorities in the US and the EU. (It may often difficult in practice to prove that a troll’s ex post market power was attributable to its deception, however.43)

Similarly, it is hard to object to the move on both sides of the Atlantic away from per se condemnation of consideration of royalty rates in standard-setting processes. Practices and processes that allow for some ex ante reduction in the uncertainty regarding ex post licensing terms will certainly raise the probability of the most appropriate standard being selected and lower the incidence of hold-up somewhat. (As the analysis above indicates, there is no reason to expect a material effect on whatever incentives for royalty-stacking exist.) Bilateral ex ante negotiation of royalty rates is surely procompetitive, for instance, particularly if coupled with a FRAND commitment that should at least inhibit charging dramatically different royalty rates ex post to similarly situated licensees.44

I argued above, however, that to go farther and encourage practices and processes that would allow the collective exercise of shared monopsony power would almost certainly not be socially beneficial. The general statements of U.S. and E.U. policy-makers on this issue seem remarkably unconcerned about enabling cartels of potential licensees that would force down royalty rates, reduce innovation incentives, and slow technical progress. On the other hand, however, the main recent case-specific actions in the U.S. have been at least somewhat less worrisome than these general statements. These actions are the favorable business review letters issued in 2006 and 2007 by the U.S. Department of Justice in response to proposals from two standard-setting organizations: VITA and IEEE-SA.45

The core of the VITA proposal was a requirement that participants in any standard-setting processes disclose all patents that may become essential to the standard being

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43 See note 7, above.
45 Barnett [2006] and [2007]. See Masoudi [2007] for discussions and more detailed summaries of these proposals.
developed, along with the maximum royalty rates and the most restrictive non-royalty provisions they would demand. Individual working group members were permitted to consider these rates and terms in developing the standard, but they were not permitted to negotiate or discuss them. This looks fine on paper, since it seems to involve discovery of ex post royalty rates without collective action to reduce them, but it is hard to see how the announced rates and terms can help determine the standard if they cannot be discussed at all by those who are actually determining it. One can easily imagine a set of winks, nods, and other signals being developed to get around this somewhat artificial limitation on communication – and thereby to facilitate collective negotiation and the exercise of monopsony power.

The IEEE-SA proposal involves voluntary disclosure of potentially essential patents, rather than VITA’s nearly compulsory disclosure, along with maximum royalty rates or most restrictive non-royalty terms. If patents and licensing terms are disclosed, working groups may use them to evaluate the relative costs of alternative standards, though specific licensing terms may not be discussed. This, too, seems an artificial limitation on communication that participants in standard-setting processes may well work around. The Department of Justice did note that discussions of costs “could, in certain circumstances, rise to the level of joint negotiation of licensing terms” and simply said that such negotiations would be analyzed under the rule of reason. Its failure to provide any guidance as to the methods or standards it would employ in such an analysis could be read as wink-and-nod encouragement of collective negotiation, and it seems likely that at least some buyer cartel behavior will occur under the new IEEE-SA process. On the other hand, the voluntary nature of disclosure provides patent-holders some insurance against such behavior, though the availability of this sort of insurance may both encourage troll-like behavior and inhibit price discovery.

When implemented, both these processes will increase ex ante competition among patent-holders to some extent and better inform prospective licensees about ex post royalty rates and licensing terms, thus reducing the risk of hold-up. On the other hand, both processes seem to me also to increase the likelihood of collective negotiation and thus the risk of monopsonistic suppression of innovation incentives. On balance, I think the Department did the right thing at this stage of our knowledge to respond favorably to both proposals, but I
would be very concerned were it to move farther away from traditional antitrust concerns about the collective exercise of market power and toward endorsement of collective negotiation of royalty rates. And I would hope that experience with these two new processes will be carefully monitored so that it can help shape future policies toward SSOs and their activities. As then Deputy Assistant Attorney General Masoudi [2007] put it,

… antitrust enforcers need to act with caution in the standard setting area. Antitrust has a role to play, but we need to bear in mind that where an unsound rule is proposed by a government enforcer, there is often no way to contract around it, and worse, there may be no way to conduct a natural experiment without the rule that can prove it should be abandoned.
REFERENCES


