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This note provides an economic approach to antitrust analysis of differential pricing (here, used synonymously with "price discrimination") and discriminatory refusals to license; grantbacks and cross-licenses; and no-challenge clauses. The analysis applies to both intellectual property rights (IPRs) in general, as well as to standard-essential patents (SEP) as to which the holder has made a commitment to license on fair, reasonable, and nondiscriminatory (FRAND) terms. This note also addresses the alleged "patent thicket" problem and the *ex-ante* incremental (or "inherent") value approach to SEP valuation.

For an economic approach to the assessment of market definition and market power, seeking or enforcing injunctive relief, tying and bundling, and excessive pricing, see Jorge Padilla, Douglas Ginsburg, & Koren W. Wong-Ervin, *Antitrust Analysis Involving Intellectual Property and Standards: Implications from Economics*, HARV. J. L & TECH. (forthcoming 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3119034. For an analysis of the major FRAND cases around the world, see Anne Layne-Farrar & Koren W. Wong-Ervin, *Methodologies for Calculating FRAND Damages: An Economic and Comparative Analysis of the Case Law from China, the European Union, India, and the United States*, JINDAL L.R. (2017), https://link.springer.com/article/10.1007/s41020-017-0048-9.

Differential Pricing and Discriminatory Refusals to License

Differential pricing of tangible products and services is defined as selling the same product to different customers at different prices not justified by differences in costs. However, the definition of differential pricing in the intellectual property (IP) licensing context generally turns on variation in licensee traits. That is, offering different licensing terms to "similarly situated" licensees is generally viewed as discriminatory. The difference in the definition in the IP context is due to the fact that patents and other forms of IP tend to emerge from costly and risky research and development efforts (*i.e.*, large upfront costs with no assurance of recoupment), yet, once an invention is developed, the marginal costs of licensing it tend to be relatively low.[2]

The licensee "situation" is typically determined by a number of characteristics, including:

- the licensee's particular use for the licensed IP (and hence its valuation of it);

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[2] *See* Anne Layne-Farrar, *Nondiscriminatory Pricing: Is Standard Setting Different?*, 6 J. COMP. LAW & ECON. 811, 815 (2010) [hereinafter Layne-Farrar].

- the licensee's size and expected revenues;

- its position in the relevant marketplace; and

- the time span for which the patented technology is expected to remain valuable to the licensee.[3]

First-degree (or "perfect") price discrimination involves a firm charging each consumer his exact willingness to pay. Second-degree price discrimination is charging a different price for different quantities (non-linear pricing), such as quantity discounts for bulk purchases. Third-degree price discrimination segments markets using observable characteristics, such as age, as proxies for willingness to pay. With respect to SEPs, first- and third-degree price discrimination are the typical forms since we are most often dealing with bilateral negotiations between patent holders and implementers. "If negotiations reveal enough information, patent licensing may approach first-degree discrimination."[4]

First-degree price discrimination unambiguously increases total welfare relative to uniform monopoly pricing because it expands output, *i.e.*, it allows consumers whose willingness to pay falls below the uniform price, but above the marginal cost of production, to be able to purchase at lower prices.[5] Although the welfare effects of second- and third-degree price discrimination are indeterminate theoretically, empirical evidence suggests that their use can be welfare-enhancing.[6]

Economic theory teaches that the welfare effects of price discrimination are ambiguous.[7] This supports the use of an effects-based approach that recognizes both the potential anticompetitive uses of price discrimination and the ubiquitous use of price discrimination to improve efficiency, grow markets, intensify competition, and enhance consumer welfare. For example, profit-maximizing firms facing distinct consumer demands for a product may reduce prices for the more price-sensitive customers and increase price to the less price-sensitive customers relative to uniform pricing. Differential pricing can therefore enable the firm to reach

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[3] *Id.*

[4] *Id.* at 817.

[5] First-degree differential pricing is welfare-reducing only if the welfare gains from increased output are less than the informational and implementation costs associated with differential pricing. *See, e.g.*, Jack Hirshleifer, *The Private and Social Value of Information and the Reward to Inventive Activity*, 61 AM. ECON. REV. 561 (1971).

[6] *See, e.g.,* Igal Hendel & Aviv Nevo, *Intertemporal Differential Pricing in Storable Goods Markets*, 103 AM. ECON. REV. 2722 (2013); Phillip Leslie, *Price Discrimination in Broadway Theater*, 35 RAND J. ECON. 520 (2004); Andrew Cohen, *Package Size and Price Discrimination in the Paper Towel Market*, 26 INT. J. INDUS. ORG. 502 (2008).

[7] *See generally* Hal R. Varian, *Price Discrimination*, *in* 1 HANDBOOK OF INDUSTRIAL ORGANIZATION 597, 619–22 (Richard Schmalensee & Robert D. Willig eds., 1989); Hal R. Varian, *Price Discrimination and Social Welfare*, 75 AM. ECON. REV. 870 (1985).

consumers that would otherwise not purchase the product. Price discrimination may also intensify competition by enabling firms to selectively meet competitor's prices.[8]

In addition, differential pricing "helps a firm with fixed costs to recover its outlays and is sometimes necessary. . . for a firm to recover those outlays."[9] Indeed, an important aspect to consider in evaluating differential pricing in licensing as compared to differential pricing for physical goods is the nature of IP development. As discussed above, the innovation process typically involves large upfront investments in research and development yet very low marginal costs at the production stage. "Economists have observed that [differential pricing] can be an important mechanism for recovering fixed costs under these circumstances."[10]

Similarly, discriminatory refusals to license or licensing to different parties on different terms may serve legitimate, procompetitive ends. For example, an IP holder may decide to license at the end-device level as opposed to at the component-level in order to better align its incentives with the licensee and thereby reduce double-marginalization effects.[11] Recall that double-marginalization refers to the distortion caused by the successive markups of independent firms in a distribution channel, which both reduces firm profits and harms consumers. Each member of the distribution channel typically adds a markup to the markups of all channel members above it, and the accumulation of these markups result in higher prices, which results in lower demand.

Incentives are more aligned with end-device royalties that consist of a payment comprising a percentage of the value of the sales of the end-product. An increase in the end-device price increases the value of sales and, hence, the royalty payment, which decreases incentives to pass-through. In other words, end-device royalties act as a tax on a price increase by end-device makers. First, a higher price results in reduced quantity sold of the end-device product and then, because end-device royalties are a percentage of the end-device price, the end-device maker must also pay a higher royalty on the lower quantity. This is not the case with component royalties, which increase the marginal cost of the end-device maker on a one-to-one basis, and thus increases incentives for pass-through. That is, end-device royalties are more similar to fixed fees than component royalties.[12]

The Cournot Complements, or royalty stacking, problem is also less of a concern under end-device royalties because SEP holders internalize the impact on the prices of the end products of an increase in their royalties to a greater extent than under component royalties. When an SEP

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[8] Jacques-Francois Thisse & Xavier Vives, *On the Strategic Choice of Spatial Price Policy*, 78 AM. ECON. REV. 122, 134 (1988); *see also* James C. Cooper et al., *Does Price Discrimination Intensify Competition? Implications for Antitrust*, 72 ANTIRUST L.J. 327 (2005).

[9] Layne-Farrar, *supra* note 2, 827 (citing William J. Baumol & Daniel G. Swanson, *The New Economy and Ubiquitous Competitive Price Discrimination: Identifying Defensible Criteria of Market Power,* 70 ANTITRUST L.J. 661 (2003) [hereinafter Baumol & Swanson]).

[10] *Id.*; *see also* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY (1999); Baumol & Swanson, *supra* note 9.

[11] Gerard Llobet & Jorge Padilla, *The Optimal Scope of the Royalty Base in Patent Licensing*, 59 J. L. & ECON. 45, 47 (2016).

[12] *Id.* at 46.

holder increases the royalty rate, "a trade-off arises between the capacity to extract more surplus and the reduction of that surplus as a result of a higher price."[13] Under end-device royalties, both SEP holders and end-device makers care about maximizing total revenues, from which each firm obtains a portion. This all results in higher total profits, which increases incentives to invest for all parties in the distribution chain. It also results in lower prices to end-consumers (again, due to reduced double-marginalization and less incentives for pass-through).[14]

Although component-level royalties tend to spur more investment by downstream producers and end-device royalties tend to spur more investment by upstream SEP holders, the two effects are not of the same magnitude. "The probability of success is higher under [end-device] royalties since the double-marginalization effect is smaller . . . and, thus, total profits are higher," increasing incentives to invest.[15] Moreover, with multiple upstream innovators with complementary technologies, "by increasing upstream profits, [end-device] royalties increase the productivity of the investment of all parties, which generates a positive feedback loop."[16] Increases in upstream research and development make technological success more likely and, due to the complementarity, the incentives to invest downstream increase.[17]

Some contend that component manufacturers such as chipmakers would be unable to pass-through component-level royalties to end-device makers due to lack of market power. But the double-marginalization problem requires only the sort of economic market power equivalent to the ability to charge above marginal costs. Of course, the magnitude of pass-through would depend on a number of factors, including elasticities of demand and supply. But there is little doubt that component manufacturers such as chipmakers face downward-sloping demand. There is no economic reason to presume component level pass-through rates would be zero.

With respect to differential terms, in order to maximize its income from its patent, an IP holder may require higher royalties from a company that has lower sales volume or offer lower royalties to a licensee that can offer valuable consideration in trade, such as a cross-license of its IP, which may be netted against the price of a license.

Nearly all concern (at least for economists) over potentially harmful discriminatory licensing has centered on the practices of vertically-integrated firms that both hold patents and practice them in a downstream market. This is because a nonintegrated patent holder, with no downstream operations, has less to gain by discriminating among licensees with whom it does not compete.[18] Nonintegrated firms will have an incentive to engage in anticompetitive licensing discrimination only if it increases their total royalty revenues, but often it is increased

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[13] *Id.* at 53.

[14] *Id.* at 48.

[15] *Id.* at 58.

[16] *Id.* at 48-49.

[17] *Id.* at 64.

[18] *See, e.g.*, Herbert Hovenkamp *et al.*, *Unilateral Refusals to License*, 2 J. COMPETITION L. & ECON. 1, 5 (2006) ("An antitrust violation is even less likely where the intellectual property owner does not compete directly with the disfavored licensee; in the absence of some showing of monopoly leveraging, it is not clear what incentive the intellectual property owner would have to try to eliminate competition in the downstream market.").

downstream competition that maximizes the upstream patentee's royalty earnings.[19] "If the patent holder is not vertically integrated, then any analysis into allegations of discriminatory licensing should be even more rigorous, as the circumstances under which an upstream patent holder would have an incentive to disadvantage one downstream licensee over another are narrower."[20] That said, the possibility of market expansion and other efficiencies, including the recoupment of research and development investments, indicates the need for a cautious approach to assessing discrimination in licensing even when vertically integrated firms are involved.

Economic modeling shows that a vertically-integrated SEP holder's refusal to license a downstream rival component maker cannot lead to the foreclosure of the component market if (1) the vertically-integrated SEP holder does not assert its patents at the component level; and (2) it licenses its SEP portfolio to downstream (finished device) manufacturers on FRAND terms, irrespective of whether they source components from its own subsidiary or from the nonintegrated rival. Intuitively, when (1) and (2) hold, the bundle (of patents and components) offered by the vertically-integrated SEP holder can be replicated competitively by end-device manufacturers by mixing and matching the component sold by the nonintegrated component supplier and the patent portfolio of the integrated SEP holder. This is because the essential patents (the bundling products) are offered on a standalone basis (*i.e.,* outside the bundle) on competitive terms. Thus, the end-product manufacturers can choose either the bundle of the vertically-integrated SEP holder or create their own bespoke bundle by purchasing the component from a nonintegrated component manufacturer and still license the SEPs of the vertically integrated SEP holder on fair and reasonable terms. As a result, the bundle is effectively constrained by the unbundled products and vice versa and, hence, bundling causes no distortion of the competitive process.[21]

With respect to an *ex-post* breach of the "ND" prong of a FRAND commitment that was made in good faith, such conduct is properly analyzed under contract not antitrust law. When an SEP holder attempts to renegotiate or deviate from its original FRAND commitment made in good faith to obtain higher royalty rates, it amounts to no more than pure *ex-post* contractual opportunism. As the U.S. Supreme Court explained in *NYNEX Corp. v. Discon, Inc.*, while the evasion of a pricing constraint may hurt consumers, it does not harm the competitive process.[22] The Court distinguished the mere breach of a pricing commitment from the unlawful acquisition or exercise of monopoly power by pointing out that, with the former, the "consumer injury flowed . . . from the exercise of market power that is lawfully in the hands of a monopolist."[23]

An antitrust violation requires a showing of *ex-ante* deception in pledging a FRAND commitment and evidence that, but-for the deception, the standard-development organization (SDO) would have adopted a different technology. As the U.S. Court of Appeals for the D.C.

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[19] Layne-Farrar, *supra* note 2, at 825.

[20] *Id.* at 828.

[21] Jorge Padilla & Koren Wong-Ervin, *Portfolio Licensing to Makers of Downstream End-User Devices: Analyzing Refusals to License FRAND-Assured Standard-Essential Patents at the Component Level*, 62 ANTITRUST BULL. 494 (2017).

[22] NYNEX Corp. v. Discon, Inc., 525 U.S. 128, 135-37 (1998).

[23] *Id.* at 136.

Circuit explained in *Rambus Inc. v. Federal Trade Commission*, absent such a showing, the SDO would have lost

> only an opportunity to secure a RAND commitment from [the SEP holder]. But loss of such a commitment is not a harm to competition from alternative technologies in the relevant markets. . . . Indeed, had [the SDO] limited [the SEP holder] to reasonable royalties and required it to provide licenses on a nondiscriminatory basis, we would expect to see *less* competition from alternative technologies, not more; high prices and constrained output tend to attract competitors, not to repel them.[24]

Grantbacks and Cross-Licenses

Grantbacks and cross-licenses, like other licensing restraints, are generally procompetitive because they may facilitate the integration of complementary technologies, promote the dissemination of a technology, reduce transaction costs, clear blocking positions, and avoid costly patent infringement litigation.

Grantbacks provide a means for the licensee and the licensor to share risks and to reward the licensor for possible further innovations based upon or informed by the licensed technology —they provide each party with some protection against the moral hazard problem on the part of the other party. The prospect of a grantback is an incentive both for innovation in the first place and for the subsequent licensing of the results of that innovation.

On the other hand, grantbacks may adversely affect competition if they substantially reduce the licensee's incentives to engage in research and development and thereby limit rivalry in innovation. Grantbacks may also "be used as a way to 'leverage' the market power of the licensor into other markets or as a way to extend patent protection beyond the term of the patents that are covered by the initial agreement."[25]

With cross licenses, each firm is free to compete, both in designing its products without fear of infringement and in pricing its products without the burden of making a per unit royalty payment due to its counterparty. Therefore, cross-licenses can solve the complements problem, at least as between two firms, and be highly procompetitive. The complements problem, or the "tragedy of the anti-commons," arises when there are multiple gatekeepers, each of which must grant permission before a resource can be used, the result of which can be to prevent the resource from being used and hence stifle innovation. In addition, when the technologies exchanged under a cross-license are not only complementary, but are each essential for the production of a good, "cross-licensing increases consumer welfare regardless of the level of contractual royalties."[26]

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[24] Rambus Inc. v. Federal Trade Commission, 522 F.3d 456, 466 (D.C. Cir. 2008).

[25] PIERRE REGIBEAU & KATHARINE ROCKETT, ASSESSMENT OF POTENTIAL ANTICOMPETITIVE CONDUCT IN THE FIELD OF INTELLECTUAL PROPERTY RIGHTS AND ASSESSMENT OF THE INTERPLAY BETWEEN COMPETITION POLICY AND IPR PROTECTION at 40 (Nov. 2011), *available at* http://ec.europa.eu/competition/consultations/2012_technology_transfer/study_ipr_en.pdf.

[26] *Id.* at 18.

This is because the cross-license provides the Coasean solution to the anti-commons/successive monopoly problem.

Cross-licenses can also have anticompetitive effects in certain limited circumstances, such as when they are used as a cover for price-fixing or market division. Some have also raised concerns that SEP holders who demand licenses to patents that are not essential to the same standard and/or force licensees to take a license to patents that are not essential to the relevant standard could decrease licensees' incentives to innovate. Concerns have also been raised that such an SEP holder could leverage its SEPs to force a cross-license of differentiated patents and/or engage in anticompetitive tying.[27] However, empirical evidence substantiating these theories in the real world is not well developed, if it exists at all.

Given the various potential pro- and anticompetitive effects, grantbacks and cross-licenses, like other licensing restraints, should be analyzed case by case, under an effects-based approach.

No-Challenge Clauses

A no-challenge clause prevents a patent licensee from challenging the validity of a licensed patent. Importantly, implementers have the opportunity to challenge the validity of an IPR at any moment from the time the patent office grants the patent at issue (and, even earlier in some jurisdictions) until the time it executes a license with a no-challenge clause. A no-challenge clause constrains the implementer's ability to challenge the validity of an IPR only *after* it has already executed a license agreement.

Patent licensing negotiations typically revolve around "proof packages" that are used to demonstrate a licensing program's value. Such packages may include a portfolio overview, innovation story, demonstration of technology leadership, benefits to licensees, use cases, and potential exemplary claim charts. When a licensor and a licensee negotiate a license for a large IP portfolio, both parties understand that some of the hundreds or thousands of patents (or claims within patents) in the portfolio may be invalid. The parties do not invest extensive resources in identifying those potentially invalid patents, which would make the transaction prohibitively costly. Instead, the parties assess generally the value of the licensed portfolio (typically through proof packages) and determine a royalty that accounts for the possibility that some of the portfolio's patents may be invalid.

In addition, IPR holders may add newly issued (or newly relevant) patents to their licensed portfolios after the parties execute a license agreement. This practice further reduces the risk that the presence of some invalid patents would impose any significant cost on the licensee. Encouraging a licensee to challenge the validity of individual licensed patents invites opportunistic litigation by the licensee so as to delay paying the IPR holder the agreed-upon royalty for the use of the many more valid patents in its licensed portfolio. Thwarting an IPR holder's ability to receive prompt compensation for its innovative contribution lessens the IPR

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[27] For an analysis of tying and bundling SEPs and non-SEPs, see Koren W. Wong-Ervin *et al.*, *Tying and Bundling Involving Standard-Essential Patents*, 24 GEO. MASON L. REV. 1091 (2017).

holder's incentive to invest in innovation, which in turn imposes significant harm on consumers.[28]

With respect to competition laws, given that the purpose of such laws is to protect the competitive process and not individual competitors, it is difficult to see how including a no-challenge clause in a license agreement could amount to the unlawful acquisition or maintenance of monopoly power or dominance. No-challenge clauses do not provide the IPR holder any enhanced leverage. Implementers have the opportunity to challenge the validity of a patent at any time after the patent is granted but before a no-challenge clause is executed. Furthermore, the negotiated royalty rate reflects the possibility that some of the portfolio's patents may be invalid. The basic effect of the no-challenge clause is to decrease transaction costs associated with negotiations by decreasing the incentive of *ex-post* opportunism by the licensee after the licensing agreement has been signed.[29]

Patent Thickets

The "patent thicket problem" posits "that the issuance of large numbers of patents held by large numbers of owners is likely to depress innovation by burdening innovators with significant transaction costs relating to dispute resolution or licensing activities."[30] Patent thicket concerns are generally linked to the "tragedy of the anti-commons" problem, which refers to the situation in which numerous entities control the rights to use some asset or related cluster of assets. The "problem" refers to the idea that, in such situations, users would need permission from multiple rights holders in order to use the assets, and that the difficulties of coordination would lead to inefficient underuse. A related concern is the Cournot Complement problem (often referred to in the SEP context as "royalty stacking"), which posits that patent holders will set their royalty rates without regard to the other strictly complementary patent holders, such that a cumulative royalty "stack" can emerge for the good's producer that is so high that it cripples the product market. Others have also raised concerns that patent thickets will result in inadvertent infringement of patents issued after products are designed, and that patent owners can use thickets to block follow-on complementary innovation.

While there are many anecdotes about the harm done by the dispersion of the ownership of complementary IPRs, we are aware of only one rigorous empirical study that suggests that the welfare effect of thickets might be ambiguous. Galasso and Schankerman (2008) analyze how

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[28] *See* J. Gregory Sidak, *Evading Portfolio Royalties For Standard-Essential Patents Through Validity Challenges*, 39 WORLD COMPETITION 191 (2016).

[29] For an analogous discussion, *see, e.g.*, Roy Kenney & Benjamin, *The Economics of Block Booking*, 26 J. OF L. & ECON. 497 (1983). The authors demonstrate that "block booking" contractual arrangements, which serve to prevent buyers from rejecting parts of a package of products that has been average-priced, is an efficient contractual mechanisms when a portfolio of goods is comprised of individual products whose individual values are not easily known—*i.e.*, a precise estimate of value for each underlying product would require costly and often duplicative and wasteful examination.

[30] Jonathan M. Barnett, *Has the Academy Led Patent Law Astray?*, 32 BERKELEY TECH. L.J. 1313, 1321 (2017).

the fragmentation of patent rights ("patent thickets") affected the duration of patent disputes.[31] Based on a model of patent litigation, they predict that settlement agreements are reached more quickly in the presence of fragmented patent rights. This prediction is confirmed in their empirical work. "This means that patent thickets have two opposite effects on the speed with which functional licensing agreements can be reached. On the one hand, the presence of thickets increases the number of required patent negotiations; on the other hand, patent disputes are resolved more quickly."[32]

In the specific context of licensing FRAND-committed SEPs, for number of reasons, the concerns expressed above do not appear to have borne out in the real-world.

First, industry practice is for SEP holders to license their patents (including related non-SEPs should the implementer so choose) on a worldwide portfolio basis. This practice significantly reduces transaction costs and provides implementers with freedom to design and operate. In addition, as the U.S. Court of Appeals for the Federal Circuit (which has nationwide jurisdiction over patent disputes) has recognized, not all SEP holders assert their patents. "The mere fact that thousands of patents are declared to be essential to a standard does not mean that a standard-compliant company will necessarily have to pay a royalty to each SEP holder."[33] In fact, many SEP holders do not assert. The expected return to licensing their SEPs is likely to be insufficient to cover the costs of launching an active licensing program. This makes sense given empirical evidence on the distribution of SEP contributions. For example, the distribution of SEPs for 3G and 4G is a long-tail with 60 percent of contributions coming from nine firms out of 492 firms that participated in the development of those standards.[34]

Additional important points to understand include:

One of the assumptions underlying the Cournot complements problem is that each input suppler will price their inputs without regard to the price charged for other needed inputs, but there is no reason to assume that will necessarily be the case in standard-setting contexts. First, SEPs may have limited or no applications outside of the standard, in contrast to the zinc and copper inputs Cournot had in mind for brass production. With only one market in which to license their patents, SEP holders may have insufficient leverage to push supra-[F]RAND rates. Moreover, the SEP holders will be cooperating with one another—and all other [standard-setting organization] SSO members—in the development of the standard, and are thus likely to know what patents are expected to be asserted and

[31] Alberto Galasso & Mark Schankerman, *Patent Thickets and the Market for Innovation: Evidence from Settlement of Patent Disputes*, (Centre for Economic Performance, CEP Discussion Paper No. 889, 2008), *available at* http://cep.lse.ac.uk/pubs/download/dp0889.pdf.

[32] REGIBEAU & ROCKETT, *supra* note 25, at 16.

[33] Ericsson v. D-Link, 773 F.3d 1201, 1234 (Fed. Cir. 2014).

[34] Justus Baron & Kirti Gupta, *Unpacking 3GPP Standards*, 27 J. ECON. & MGM'T STRAT. 433 (2018).

by whom. As a result, there is no reason to presume that SEP holders will set rates without regard to the full complement of known SEPs.

As long as the inputs for multi-component products are priced according to the value of the patented contribution to the end product, no SEP holder can be faulted for either hold up or stacking. Proper apportionment is a reasonable means to accomplish this goal. When rates are properly focused on the value that the specific patents contribute to products compliant with a standard—and not on other product features, the value of the overall standard, or implementer switching costs—then the risk of either patent hold-up or royalty stacking is eliminated.[35]

Second, the vast majority of SDOs—and seemingly all major cellular wireless SDOs—require patent holders to disclose any IPRs contributed to the standard. As such, it is highly unlikely that product manufacturers will be unaware of the potential SEPs that their products read upon.

Some have raised concerns about over-declaration of SEPs to SDOs and called for improved transparency. While improved transparency may serve both licensors and licensees, it is important to understand that some error rate and uncertainty is inherent to the process of identifying and declaring potential SEPs. This is because, among other things, the process involves standards that evolve over time, as well as changes in the patent claims being prosecuted. In addition, there are competing incentives that arise from possible risks to both under- and over-declaration. For example, patent holders may be incentivized to under-declare patents as essential to a standard in order to avoid the FRAND commitment required by most SDOs. On the other hand, patent holders may be incentivized to over-declare (including through blanket declarations as required by some SDOs) in light of the Federal Trade Commission's (FTC's) 2007 decision against Rambus, in which the Commission held that Rambus violated Section 5 of the FTC Act by deceptively failing to disclose to an SDO the patent interests it held in technologies it contributed to a standard.[36] While the U.S. Court of Appeals for the D.C. Circuit set aside the Commission's order, establishing a stricter standard (but-for the alleged deception, the SDO would have adopted a different technology), the court confirmed that antitrust liability is possible for knowing or deceptive failures to disclose.[37] Regardless of whether there is in fact a transparency problem, this should not affect the alleged patent thicket problem given the industry practice of worldwide portfolio licensing.

Third, FRAND commitments impose contractual obligations on patent owners to "mak[e] licenses available," limiting any power of the patent owner to block follow-on complementary

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[35] Anne Layne-Farrar & Koren W. Wong-Ervin, *An Analysis of the Federal Circuit's Decision in Ericsson v. D-Link*, CPI ANTITRUST CHRON. 5 (Mar. 2015), *available at* www.competitionpolicyinternational.com/assets/Uploads/LFWEMar-151.pdf.

[36] Final Order, In the Matter of Rambus Inc., FTC Docket No. 9302, *available at* www.ftc.gov/sites/default/files/documents/cases/2007/02/070205finalorder.pdf.

[37] Rambus, Inc. v. Fed. Trade Comm'n, 522 F.3d 456 (D.C. Cir. 2008).

innovation.[38] Another mitigating factor is the low likelihood of obtaining injunctive relief on SEPs, particularly in the United States following the U.S. Supreme Court's *eBay v. MercExchange* decision.

Fourth, "[a]nticommons situations may not give rise to inefficiencies when parties have access to patented goods and strategically choose to infringe."[39] Given that patents are not self-enforcing, implementers can and routinely do use patented technology without permission. Unlike real property owners, "patent holders cannot physically withhold their patented technology from implementers who have not paid for the right to use it; instead, patent holders have to resort to costly and risky litigation in order to protect their rights."[40] Given the time value of money and the fact that the worst penalty an SEP infringer is likely to face after adjudication around the world (and then typically only on a patent-by-patent basis) is merely paying the FRAND royalty that it should have agreed to pay when first asked, it is easy to understand why holdout can be an attractive strategy for an implementer.

Four potential solutions to the so-called patent thicket problem have been proposed: cross-licensing, patent pools, standardization, and package licensing for complementary patents. With respect to the first two, "one should remember that we currently know next to nothing about the size of the inefficiencies associated with patent thickets. In other words, while cross-licensing and patent pools might be effective approaches to solving thicket problems, we have no idea of what the corresponding efficiency gains are."[41] That said, it is important to allow private-ordering mechanisms to enable markets to identify and preempt potential patent thickets. The apparent success of such mechanisms "derives from pure self–interest: a thicket prevents patent holders from earning a return on their R&D investment, giving them a powerful incentive to avoid litigation and . . . reach a mutually agreeable allocation of property rights and split of the surplus value that is unlocked as a result."[42]

Ex-Ante Incremental (or "Inherent") Value Approach

Some have recommended an *ex-ante* incremental value approach to SEP valuation, under which courts would cap the royalty at the incremental value of the patented technology over alternatives available at the time the standard was defined. As Dr. Anne Layne-Farrar and Koren W. Wong-Ervin have explained:

> The underlying theory is well-established, based on decades of pricing
> theory for physical goods. . . . The problem, however, is that determining
> an "incremental" value for intangible intellectual property is [more]
> difficult [than determining] the incremental cost for a physical good in a
> number of ways. First, as Judge Robart observed [in *Microsoft v.*

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[38] *See, e.g.*, David J. Teece, *The "Tragedy of the Anticommons" Fallacy: A Law and Economics Analysis of Patent Thickets and FRAND Licensing*, 32 BERKELEY TECH. L.J. 1489, 1507 (2017).

[39] *Id*. at 1498.

[40] *Id.*

[41] REGIBEAU & ROCKETT, *supra* note 25, at 17.

[42] Barnett, *supra* note 30, at 1343.

Motorola], two flaws in the approach are "its lack of real-world applicability" and "its impracticability with respect to implementation by courts." Second, the approach crucially depends on the point of comparison: incremental value as compared to what? The state of the art prior to any standard solution emerging, which is often the starting point for innovators? The price or value of the "next best alternative" competing for inclusion in the standard? This latter approach entails valuing two intangible contributions instead of one, so the workload is far higher (reinforcing Judge Robart's point of impracticability for courts).[43]

In addition to administrability, the primary problem with an *ex-ante* incremental value approach (at least with respect to cellular wireless technologies like 5G) is that it misunderstands the nature of technology development within SDOs. The notion that there are several similarly situated technologies available prior to standardization ignores that these technologies are developed over time. In other words, technological options do not just appear like mushroom after a rainstorm, but rather are collaboratively developed over significant time periods within SDOs. In equilibrium, once an SDO signals a specific direction (*e.g.*, once a particular technology is selected for further development), competing technology holders will have no incentive to continue to develop alternative technologies. As such, an *ex-ante* incremental value approach could result in very high royalties given the likely large differential between the fully developed technology and any abandoned technologies at the time a standard is defined.

The U.S. Court of Appeals for the Federal Circuit in *Ericsson v D-Link* has held that SEPs should be valued based on their *ex ante* or inherent value (tied to the value added to the product at issue), divorced from any value from standardization.[44] It is important to understand that this approach excludes technology developers from sharing adequately in the full value of standardization. This is so even when the technology developers were significant contributors to (or even key drivers of) that value. As such, *ex-ante* value approaches prevent patent holders from recouping investments in risky research and development based on the fully realized potential of their technology.

Ex-ante proponents argue that SEP holders already obtain some of the value of standardization in the form of volume (*i.e.*, increased unit sales on which to earn royalties), as well as a potential competitive edge in product markets (assuming they compete in such markets). But, "higher unit sales are not the same as having rates determined under market conditions considering the technologies' full contribution, in which royalty rates, product prices, and volumes are considered jointly. No volumes can compensate for unreasonably low *ex ante* rates."[45] This is because standardization boosts consumer willingness to pay and increases the

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[43] Anne Layne-Farrar & Koren Wong-Ervin, *Methodologies for Calculating FRAND Damages: An Economic and Comparative Analysis of the Case Law from China, the European Union, India, and the United States*, 8 JINDAL GLOBAL L. REV. 127, 151-52 (2017) (internal citations omitted).

[44] While the Federal Circuit uses the term "incremental value," it uses that phrase to mean the *ex-ante* "inherent" value that an SEP adds to a product, separate from "any value added by the standardization of that technology." Ericsson v. D-Link, 773 F.3d 1201, 1232 (Fed. Cir. 2014).

[45] David J. Teece, et al., *Maintaining Ecosystem Innovation by Rewarding Technology Developers: FRAND, Ex Ante Rates and Inherent Value* 6 (Tusher Initiative for the Management of Intellectual Capital, Working Paper No.

volume of sales demanded at any product price. In other words, the demand curve shifts out, costs are reduced and the volume that can be produced for a given price increases, and the supply curve also shifts out, moving the market equilibrium point. "The post-standardization price [] may be higher or lower than [before standardization] depending on whether demand or supply effects dominate."[46] As such, an *ex-ante* rate may undercompensate SEP holders while providing a windfall for implementers given that the passthrough rate to end-consumers is likely less than 100%. Given that firms ordinarily expect to share the gains from cooperative efforts, it is likely that it is the prospect of a share of the full incremental surplus that motivates developers to invest fixed amounts in technology and standardization. "Unless all groups are appropriately incentivized, some may reduce innovation and/or withdraw from standards setting, with general economic harm."[47]

21, 2017), *available at* https://businessinnovation.berkeley.edu/wp-content/uploads/2017/04/Tusher-Center-Working-Paper-No.-21.pdf.

[46] *Id.* at 26.

[47] *Id.* at 53.