Ties That Bind: Policies to Promote (Good) Patent Pools

Richard J Gilbert
Firms that make, sell, or use products in high-technology fields, such as semiconductors, information technology, and biotechnology, often have to negotiate patent rights with many intellectual property owners.¹ The time and effort required to assemble these rights can interfere with the adoption and diffusion of new technologies and the cumulative payments to rights holders for use of their intellectual property can weigh heavily on technology costs.² Michael Heller and Rebecca Eisenberg coined the term “tragedy of the anticommons” to describe a situation in which the presence of multiple independent property rights results in wasteful underuse of economic resources.³ This dynamic contrasts with


³ Michael A. Heller & Rebecca S. Eisenberg, Can Patents Deter Innovation? The Anticommons in Biomedical Research, 280 SCIENCE 698 (May 1, 1998). See also Robert P. Merges &
the “tragedy of the commons” that describes the wasteful overuse of economic resources in the absence of property rights.4

A “patent thicket,” in which many independent patent holders have rights that cover a technology, is one example of the anticommons.5 A patent thicket exists when rights to many patents from different patentees are necessary to lawfully make or sell a product (overlapping rights).6 Patent thickets are common to many high-technology industries in which the manufacture, use, or sale of a device or process may require rights to hundreds of patents.7 Overlapping patent rights raise numerous potential economic problems. Transaction costs of licensing can be high because licensees must identify, search out, and negotiate with numerous separate licensors. Litigation risks can be high because an incomplete portfolio of patent licenses can expose a firm to potentially large infringement damages. Royalties can be high if each of many independent licensors of complementary patents attempts to obtain a large share of the economic value of products that may infringe its patent. For these reasons a patent thicket can raise prices and discourage innovation relative to a situation with fewer patents or with coordinated licensing of the overlapping patent rights.8

A patent confers the right to exclude others from making, using, or selling products that embody the patented technology in return for greater incentives for invention and disclosure of patented technologies.9 The right to exclude can restrict the use of the patented technol-


6 Carl Shapiro describes a patent thicket as “dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology.” Shapiro, Navigating the Patent Thicket, supra note 1, at 120.

7 For example, as of August 2009, more than 1000 active patents covered “semiconductor device making—cmos,” more than 890 active patents covered “electronic funds transfer” over the Internet, and almost 1000 active patents covered “genetic mutation, cell fusion, or genetic modification.” These patent counts are based on searches of the U.S. Patent and Trademark Office patent database performed on August 19, 2009, for patents issued since August 1992.


9 Several studies have questioned whether the patent system is an efficient institution to encourage innovation. See generally Adam B. Jaffe & Josh Lerner, Innovation and Its
In contrast, the underuse that can occur from a patent thicket is of a different type with potentially greater costs. By granting patent rights to many pieces of technologies that must work together, the patent system creates risks that technology users will incur costly delays in assembling the patent rights that are necessary to make or use a technology or will bear excessive royalties from the cumulative royalty demands of patent owners.

The underuse caused by a patent thicket can harm patent owners as well as consumers if collective royalty demands or the transaction costs from licensing many patents slow the adoption or impede the use of products covered by the patented technologies. One way around this lose-lose dilemma is for intellectual property owners to form a patent pool to share their intellectual property with each other and with others through a program of joint licensing. A patent pool substitutes a regularized transactional mechanism (the pool license) for a property rule that requires individual bargaining for each transaction (negotiation between a single patentee and a potential licensor).

Competition policy toward patent pools has focused on the prevention of anticompetitive practices by patent pool members—individually or collectively through the licensing policies of the pool—and has generally paid little attention to the question of how to encourage the formation and stability of patent pools that benefit consumers. While patent pools have substantial procompetitive benefits when the manufacture or use of products may infringe multiple patents, powerful economic forces prevent beneficial patent pools from forming or limit the patents in the pool to only a fraction of the patents that cover the products.

Competition policy should recognize the fragility of patent pools and ensure that patent pool members acting collectively have the same lati-

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Discontents: How Our Broken Patent System Is Endangering Innovation and Progress, and What to Do About It (2004); JAMES BENSON & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK (2008). Furthermore, by excluding the use of an invention, a patent can reduce incentives for other discoveries for which the patented invention is an input. See, e.g., Merges & Nelson, supra note 3, at 880–916; SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 127–57 (2004). In this article I take the existing system of patent rights as given and address policies that can promote the licensing of complementary patents.

10 See, e.g., DENNIS CARLTON & JEFFREY PERLOFF, MODERN INDUSTRIAL ORGANIZATION 548–54 (4th ed. 2005); SCOTCHMER, supra note 9, at 34–39.

11 A patent pool is an example of a collective rights organization. See Robert P. Merges, Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations, 84 CAL. L. REV. 1293, 1295 (1996); see also Andrewehl, supra note 2, at 611 (“The essence of a patent pool . . . is this mutual agreement among patent owners to waive their respective exclusive patent rights.”).
tude to determine royalties and licensing terms as a single licensor, provided that the pool does not harm lawful competition that would have occurred in the absence of the pool’s licenses. In determining which types of patents should be allowed in a pool, competition policy should recognize that a patent pool confers potential benefits if it includes two or more valid complementary patents, and need not harm competition if it has at least one valid patent that is essential to make, sell, or use a product. Inclusion of inessential patents raises potential concerns about foreclosure of alternative technologies and higher royalties for some licenses than would have occurred if these patents were excluded from the pool. However, these concerns should be balanced against the costs of excluding potentially essential patents from the pool.

The assessment of damages for patent infringement also has a critical role in the incentives to form and maintain beneficial patent pools. To the extent that a patent pool successfully lowers total royalties relative to independent licensing, this leaves “headroom” available for an independent licensor outside the pool to charge a high royalty for its patent. A manufacturer, seller, or user of products that employ the pool’s technology requires any single essential patent as much as it needs any other essential patent or the portfolio of essential patents licensed by the pool. As a result, the owner of an essential patent can have extraordinary bargaining power as an independent licensor to negotiate high royalties for its patent.

A calculation of damages for patent infringement that accounts for the different inputs necessary to make and use products covered by the infringed patent would reduce the incentives of a patentee to negotiate licenses independently and enhance incentives for patent pooling, although such an approach should account for different opportunity costs of licensing and cannot be applied mechanically. Competition policy towards patent pools can reinforce the positive effects of a more rational approach to infringement damages by increasing the freedom to operate within the pool. Thus, competition policy and policies for the measurement of infringement damages are complementary instruments to promote beneficial patent pools.

In this article, I explain the economic factors that determine conditions under which patent pools provide economic benefits and describe the forces that prevent beneficial pools from forming or that limit their membership. I then propose policies that will promote the formation of beneficial patent pools and encourage owners of relevant patents to join and remain members of the pool. I conclude that a flexible approach to evaluating the net benefits of patent pools, along with the use of methods to calculate patent infringement damages that recognize the values
of overlapping patent rights, are promising policies to promote and maintain beneficial patent pools.

I. GOOD POOLS AND BAD POOLS

Antitrust enforcers historically have viewed patent pools with an element of mistrust. They had good reasons, as some of the first patent pools in the United States were created to squelch competition. But many patent pools promote competition and enhance the adoption of new technology. For example, in the 1990s, several firms pooled their patents related to the MPEG-2 standard (MPEG stands for the Motion Picture Experts Group), a format for the encoding of digital video and audio signals broadcast by terrestrial, cable, and satellite television systems, as well as for movies and other programs that are distributed on Digital Versatile Discs (DVDs) and other media. The MPEG-2 standard faced a patent thicket with hundreds of patents covering the technology owned by many different firms, and the cost of locating and individually negotiating patent rights made it “virtually impossible . . . to use the standard.” The pool offered one-stop shopping for many (though not all) of the patents required to use the standard. The MPEG pool advertises that “MPEG-2 became the most successful standard in consumer electronics history, and the MPEG LA Licensing Model has become the template for addressing other patent thickets.”


15 Id.

16 Id. (LA stands for Licensing Agent.)
The U.S. Department of Justice has expressly recognized the potential procompetitive benefits of patent pools. The Department issued a positive business review letter for the MPEG LA patent pool17 and for other patent pools, including two patent pools for DVD technologies,18 a patent pool for third generation cellular technologies,19 and another for radio frequency identification (RFID) tags.20

A. Patent Pools that Limit Competition

What distinguishes a “good” patent pool or cross-licensing arrangement from one that is likely to harm the licensees of the pool’s patents and the consumers of products that employ the licensed technologies? Competition creates benefits when products or technologies are substitutes for each other. Two products or technologies are substitutes if an increase in the price of one of them increases the demand for the other. A patent pool can be anticompetitive if it inhibits competition between substitutable patented technologies or products made or sold by firms that participate in the pool, or if the pool issues licenses that restrain competition downstream between substitute products that use the pool’s technology and other products. A patent pool also may harm competition if it issues portfolio licenses that foreclose competition from alternative technologies. Such foreclosure is less likely if the pool does not prevent its members from independently negotiating individual licenses.

Early federal antitrust enforcement efforts focused on preventing these types of anticompetitive effects. The Justice Department brought an antitrust challenge when glass companies formed the Hartford-Empire pool, which combined patents that covered two competing ways to


manufacture glass. The pool members exercised almost complete control over the manufacture of glass containers in the United States and eliminated competition that could have occurred between the two main manufacturing technologies.21

Similarly, the Department challenged the cross-licensing arrangements orchestrated by the United States Gypsum Company that restricted licensees from competing in non-patented products, thereby limiting competition that would have constrained prices for patented gypsum boards.22 In United States v. National Lead Company, the Justice Department sued manufacturers of titanium compounds that had used a patent pool to set up a cartel that limited competition by establishing exclusive territories in which producers could sell their products, including products that did not infringe each other’s patents.23 These were restraints of trade, cloaked in a mantel of protection of intellectual property. It is not surprising that they cultivated a mistrust of patent pools on the part of antitrust enforcers.

B. Patent Pools Involving Complementary Technologies

In contrast, patent pools that assemble patents on complementary technologies can produce substantial procompetitive benefits. Two products or technologies are complements if an increase in the price of one of them reduces the demand for the other. Pairs of shoes that have similar style and functionality are substitutes, but right and left shoes of the same pair are complements. Computer hardware and software are complementary products. Suppliers of cell phones, DVDs, encryption standards, and microprocessors require the rights to use many complementary technologies.

Two or more patents, each of which is essential to make or use a technology, are complements because no one patent is useful without access to the others. In its review of the proposed patent pool related to a standard for RFID tags, the Justice Department relied on the Consortium’s representation that it was limiting the pool to patents that were “necessarily essential to the standard . . .” or one that is “essential to the standard as a practical matter because there are no economically viable substitutes . . . i.e., not reading on the standard itself but nonetheless

23 United States v. Nat’l Lead Co., 63 F. Supp. 513, 518 (S.D.N.Y. 1945), aff’d, 332 U.S. 319 (1947) (The suppression of this commerce was not limited to patented processes but extended to all products within the licensed field.).
required to manufacture a competitive product compliant with the standard, due to production or design costs, consumer preferences, or other reasons . . . ."24 The Department stated that such a definition, “if applied scrupulously and independently would exclude economically viable substitutes from the pool.”25

Coordination among suppliers of complements through patent pools of essential technologies can benefit consumers by reducing the search and transaction costs of assembling necessary intellectual property rights and by avoiding “royalty stacking,” which refers generally to excessive total royalties when patentees set royalties independently for complementary technologies.26 Royalty stacking is a special case of double-marginalization, which can occur when firms sell or license complementary products or technologies and demand is sensitive to price. Augustin Cournot was the first to identify the cost imposed by independent supply of complements; hence, royalty stacking or double-marginalization is also called the Cournot complements effect.27

Patents on technologies that add value to a product can also be complements to other patents even if they are not essential to the use of those patents. A patent that covers a mechanism to load a DVD is complementary to patents that cover the DVD encryption technology, even if it is not essential to record or play a DVD, because an increase in the cost of the player mechanism reduces the demand for DVD players and hence reduces the demand for licenses to the DVD standard.

As in the case of essential patents, pooling and joint licensing of patents that are complements, but not essential, can promote competition by reducing transaction costs and speeding the adoption of new technologies. But pooling of non-essential complementary patents can create costs as well. Pooling of non-essential patents can create costs by allowing the pool to exert market power in ways that would not occur if the pool were structured differently. Furthermore, pooling of non-es-

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25 Id.
26 See Lemley & Shapiro, supra note 1, at 1993.
27 Double marginalization refers to the addition of successive mark-ups by suppliers in a vertical relationship. See, e.g., Carlton & Perloff, supra note 10, at 415. More generally, double marginalization can occur whenever firms are in a complementary relationship. See Augustin Cournot, Researches into the Mathematical Principles of the Theory of Wealth 99–107 (Nathaniel T. Bacon, trans., The MacMillan Co. 1927) (1838). Cournot used the example of copper and zinc to form brass.
essential patents can foreclose competitive alternatives.\textsuperscript{28} I describe each of these concerns in more detail.

A pool that includes non-essential patents can increase prices for some consumers, while decreasing prices for other consumers, as the following stylized example demonstrates.\textsuperscript{29} Suppose that a new audio encryption technology can be used in a computer or in a portable media player. Several patents are essential to use the encryption technology with a computer or a media player. (The precise number of essential patents is not important.) I call these the “core essential encryption patents.” In addition, several patents are essential to use the encryption technology in a computer. (Again, the precise number is not important.) Use of the encryption technology in a media player does not infringe these latter “computer-specific patents.”

Pooling the computer-specific patents along with the core essential encryption patents would eliminate royalty stacking and avoid transaction costs that would be incurred if the computer-specific patents were licensed separately. However, including the computer-specific patents in the pool could also raise royalty costs for media players.

To see why, assume that firms that supply content for media players are willing to pay $3 per media player for the encryption technology and computer users (or firms that supply content) are willing to pay $5 per user. Licensors of the core essential encryption patents cannot distinguish between different licensees and must set a single royalty for both media players and computers. Furthermore, assume that independent licensing of the computer-specific patents would incur a total royalty cost of $3 per unit.

Suppose the patent pool is limited to the core essential encryption patents—the patents that are essential for both computers and media players. The pool could charge no more than $2 per media player or computer for a portfolio license if the license is to be acceptable both to firms that supply content for media players and for computers. Content suppliers for media players would pay $2 per player. Content suppliers for computers would pay the $2 royalty plus $3 for the separate licensing of the computer-specific patents. The total royalty for firms that supply content for computers would exactly equal their maximum willingness...
to pay, while firms that supply content for media players would enjoy a surplus of $1 per player.

Suppose instead that the pool includes both the core essential encryption patents and the computer-specific patents. Now the pool could charge $5 per computer or per media player for a license to its entire patent portfolio that would be acceptable both to firms that supply content for media players and for computers. This would exhaust the willingness to pay for those firms that supply content for media players, while firms that supply content for computers would enjoy a surplus of $2 per computer.

Assuming that it is profitable for the patent pool to choose a royalty that is acceptable to both types of licensees, total welfare is higher in this example when all of the patents are in the pool, since that eliminates avoidable transaction costs. However, the example shows that whether the pool includes the computer-specific patents has distributional consequences for firms that supply content for media players and computers. Firms that supply content for media players are better off if the pool is limited to the core essential encryption patents. The high costs of the computer-specific patents that are licensed independently of the pool forces the pool to lower its royalty for the core essential encryption patents to make the total royalty acceptable to firms that supply content for computers. Including all of the patents in the pool raises the royalty for firms that supply content for media players, but lowers the total royalty for firms that supply content for computers.

The example illustrates that pooling of patents that are complementary but not essential to use a technology in all applications need not make all consumers better off. Whether this is sufficient justification to oppose the pooling of patents that are complementary but not essential is another matter. Pooling of non-essential complementary patents has benefits by potentially lowering royalties for some products. Furthermore, pooling of non-essential complementary patents reduces transaction costs and can accelerate the adoption of a new technology. These

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30 Let $N_m$ be the number of media players and $N_c$ the number of computers that license patents from the pool. With zero licensing costs, this condition is satisfied if $2/3 N_c < N_m$.

31 In this example, if the pool included both the core essential and computer-specific patents and could issue field-of-use restricted licenses, the pool could charge $5 per user for a license to use its patents for media players and $5 per user for a license to use its patents for computers. This would be efficient, although it would leave no surplus for content suppliers. The pool also could charge $5 for a portfolio license and allow holders of core essential patents to negotiate independently with suppliers of media players, who would pay no more than $3 for licenses to the core essential patents.

32 Quint shows that including patents in the pool that are not essential for all applications can lower total economic welfare in some cases. See Quint, supra note 29, at 3.
are benefits for all consumers, even if the pool results in somewhat higher prices for the consumers of some products. However, as noted below, including non-essential patents in a pool can have anticompetitive foreclosure effects if the pool offers only a package license to its entire patent portfolio, or if the pool structures royalties for package and individual licenses that make individual licenses economically unattractive.

To illustrate the risk of foreclosure, consider an extension of the previous example. Suppose there is an alternative encryption technology that can be developed for transmission of high-definition signals for satellite broadcast television. The technology would not infringe the core essential encryption patents. However, development of this alternative technology requires access to one or more of the computer-specific patents. If the pool includes both the core essential encryption patents and the computer-specific patents, development of the alternative technology for satellite television could be uneconomic if the developers have to pay the $3 royalty charged by the pool for its patent portfolio. However, if the pool includes only the core encryption patents, developers of the alternative technology for satellite television might be able to secure patent rights to the required computer-specific patents at an economically attractive price. Note that this foreclosure risk would be far less of a concern if the pool did not prevent its members from independently

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33 A patent pool may raise prices for all consumers if the licensed patents add value to a product but no single patent is essential. In this instance, patents are complements because each licensed patent adds value to other licensed patents, but they are also substitutes because licensing fewer patents is a competitive alternative to licensing more patents. See Josh Lerner & Jean Tirole, Efficient Patent Pools, 94 Am. Econ. Rev. 691, 693–94 (2004). This scenario contrasts with the licensing of essential patents along with non-essential patents, for which pooling benefits some, if not all, consumers. More generally, competition in the supply of complementary products or technologies has implications for the division of profits, welfare, and incentives for innovation. See Dennis W. Carlton & Michael Waldman, The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries, 33 Rand J. Econ. 194 (2002); Jay Pil Choi & Christodoulos Stefanadis, Tying, Investment, and the Dynamic Leverage Theory, 32 Rand J. Econ. 52 (2001); Joseph Farrell & Michael L. Katz, Innovation, Rent Extraction, and Integration in Systems Markets, 48 J. Indus. Econ. 413 (2000); Richard J. Gilbert & Michael H. Riordan, Product Improvement and Technological Tying in a Winner-Take-All Market, 55 J. Indus. Econ. 113 (2007); Barry Nalebuff, Bundling as an Entry Barrier, 119 Q.J. Econ. 159 (2004); Barry Nalebuff, Exclusionary Bundling, 50 Antitrust Bull. 321 (2005).

34 The Department of Justice indicated its concern that including non-essential patents in a pool might foreclose alternative technologies in its review of the DVD 3C patent pool. The Department described an example of patents on two alternative ways to package DVD-ROM discs. In addition to the risk of eliminating price competition, the Department noted that including one of the technologies in the pool could foreclose the other technology because the pool’s portfolio license would provide, at no additional cost, a license to use the technology in the portfolio. See DVD 3C Business Review Letter, supra note 18, at 10–11.
negotiating licensing terms for their patents. The pool can facilitate independent licensing by limiting its licenses to particular fields of use.

In short, including patents in a pool that are not essential for every application can have both benefits and costs. Therefore, a rule of reason analysis is appropriate to evaluate when a patent pool is over-inclusive. Central to this analysis should be whether the patent pool insists on licensing all of the patents in the pool as a package or whether the pool allows patentees to license their patents independently of the pool through individual negotiations.

The Court of Appeals for the Federal Circuit addressed circumstances in which package licensing may raise antitrust concerns in opinions related to the licensing by U.S. Philips of patents relevant to the manufacture of recordable and rewritable compact discs. The court noted the efficiencies from package licensing and held that package licensing of essential patents could not be condemned as per se patent misuse but instead should be evaluated under the rule of reason.35 The court also observed that the royalty for a package license “is largely, if not entirely, based on the patents that are essential to the technology in question,” and that the patents that are essential to practice a technology can change as a technology matures and that it would be unwise to subject the licensor of a portfolio of patents to continuous antitrust scrutiny based on changing evaluations of essentiality.36 The court reinforced these conclusions in a subsequent opinion, but also noted that agreements between patent holders to forgo separate licensing of competing technologies are not within the rights granted to a patent holder and can constitute an antitrust violation.37

Limiting membership in a patent pool to patents that are essential to use the licensed technology does not immunize the pool from anticompetitive effects. A patent pool that includes only essential patents can

36 Id. at 1191, 1198. Package licensing would not increase profit-maximizing royalties in the short run if all patents are essential to practice a technology. Furthermore, under some conditions, package licensing of essential patents provides incentives to invent around patents and invest in complementary assets that are closer to their socially optimal levels than what would obtain if the patents were licensed separately. See Richard J. Gilbert & Michael L. Katz, Should Good Patents Come in Small Packages? A Welfare Analysis of Intellectual Property Bundling, 24 INST. J. INDUS. ORG. 931 (2006). For contrasting discussions of whether patent pools should be limited to essential patents, see Richard Gilbert, The Essentiality Test for Patent Pools, in Working Within the Boundaries of Intellectual Property: Innovation Policy for the Knowledge Society 325 (Rochelle C. Dreyfuss, Harry First & Diane L. Zimmerman eds., 2010) [hereinafter The Essentiality Test]; Michael A. Lavine, Ripples in the Patent Pool: The Impact and Implications of the Evolving Essentiality Analysis, 4 N.Y.U. J.L. & BUS. 605 (2008).
37 Princo Corp. v. ITC, 616 F.3d 1318 (Fed. Cir. 2010).
harm competition if the pool issues licenses that impede downstream competition. An example is a license that requires licensees not to deal in competitive technologies that do not infringe the pool’s patents.38 Just as a single firm with market power may engage in conduct that excludes competition, a patent pool that offers a portfolio license may engage in similar conduct.

C. PATENT POOLS’ EFFECTS ON INCENTIVES TO INNOVATE

Patent pools can harm consumers by reducing incentives to innovate. Firms have incentives to innovate by improving their products or developing new products to differentiate themselves from their rivals. A patent pool can diminish these incentives if the pool requires an innovator to share the benefits from newly patented technologies with other members of the pool. Some patent pools require members to grant nonexclusive licenses to any new patents that are essential to make or use technologies licensed by the pool.39 Furthermore, the pool may have a broad definition of essential patents, which expands the scope for grantbacks. For example, the number of patents in the MPEG-2 pool, all of which are declared to be essential to the MPEG-2 standard, increased from 27 in 1997 to more than 900 in 2010, with more than 100 patents filed in the United States.40 A grantback provision in the license from a patent pool can promote competition by making it less likely that a patentee can charge high royalties by patenting a technology that is determined to be essential for users of the pool’s technology, particularly if the pool’s licensed technology was an important input into the new invention. In this way, a grantback requirement can limit anticompetitive royalty stacking. However, this benefit has to be compared to the possible disincentive for innovation from a broad grantback provision in a patent pool license.

With the urging of the U.S. government, owners of patents on aircraft technology created the Manufacturers Aircraft Association patent pool in 1917. The government intervened to break up the pool in 1975 in part because of concerns that the pool lessened industry incentives to

innovate by requiring innovators to share royalties with their competitors.41

D. Weak Patents

Finally, patent pools can raise antitrust concerns by sheltering weak patents from validity challenges.42 Patents are “probabilistic rights.”43 They convey the exclusive right to make, use, or sell the technology covered by the patent only if the patent is valid, and challenged patents are often held to be invalid.44 The scope of a patent is also probabilistic because the patent scope depends on determinations of patent claims that are difficult to know before they are adjudicated.45

Some patent pools have included explicit agreements to support weak patents. These include covenants not to challenge patents, joint defense agreements, and allocation of patent rights to parties who are best able to defend them.46 Patent pools also can support weak patents by creating an institutional environment in which patentees find that it is mutually advantageous to recognize each other’s patents without explicit agreements that forbid challenges by the pool’s members.47 Invalid patents do not lawfully exclude competition. Including weak (or expired or non-

41 See Bittlingmayer, supra note 12, at 227, 235. A similar allegation led to the breakup of an agreement between automobile manufacturers to cross-license technology related to pollution controls. See United States v. Automobile Mfrs. Ass’n, 307 F. Supp. 617 (C.D. Cal. 1969). While this was a cross-licensing arrangement rather than a patent pool, it raised similar innovation concerns by reducing the benefit that a company could derive from its R&D efforts. See also Lampe & Moser, supra note 12 (evidence that the Singer patent pool coincided with a period of lessened innovation in the sewing machine industry).

42 Notwithstanding statutory presumptions, patent validity cannot be assumed. See, e.g., Mark A. Lemley & Carl Shapiro, Probabilistic Patents, J. Econ. Persp., Spring 2005, at 75.


45 Bessen & Meurer, supra note 9, at 46–72.

46 The cross-licensing arrangement between the Singer Manufacturing Company and a Swiss rival, Gegauf, contained provisions by which each of the parties agreed not to bring any infringement action against the other. United States v. Singer Mfg. Co., 374 U.S. 174, 178 (1965).

47 See, e.g., Jay Pil Choi, Patent Pools and Cross-Licensing in the Shadow of Patent Litigation, 51 Int’l Econ. Rev. 441 (2010); Gilbert, Antitrust for Patent Pools, supra note 2, ¶¶ 84–87. Members of a patent pool have some incentives to challenge the validity of other patents in the pool if the pool distributes royalties in proportion to the number of valid patents owned. In that case, a patentee can increase its share of the pool’s royalties by excluding invalid patents owned by other members of the pool.
essential) patents in a pool raises the risk that the pool will eliminate competition between substitute technologies.\(^{48}\)

Is it better to include uncertain patents in a pool or to exclude them from the pool’s portfolio license? Both actions present risks. Putting weak or non-essential patents in a pool risks possible coordination to raise prices, requiring licensees to pay for technology that should be free, and possibly foreclosing competition from substitute technologies that are arbitrarily excluded from the pool. As discussed in more detail below, an additional concern is that allowing patentees to contribute weak or non-essential patents to a pool can dilute the distribution of licensing revenue to essential patent holders, which can make the pool unstable or more difficult to form in the first place. But these risks have to be balanced against the risk that a pool may exclude one or more essential patents, which likely would increase royalties and the transaction costs of licensing.

E. Summary

The proceeding discussion demonstrates that the composition of a patent pool and the structure of licenses offered by members of the pool can have adverse consequences for competition and welfare. At the same time, this survey has identified important efficiencies from patent pools that include essential patents. While patent pools that include essential patents should not be treated as per se legal, pools that include essential patents create consumer and producer benefits, and policies should promote the formation of pools that offer these benefits. Consequently, a rule of reason approach is appropriate to evaluate the appropriate composition and licensing practices of patent pools. This analysis should recognize that patent pools that include two or more essential patents are likely to have procompetitive benefits by reducing transaction costs, clearing blocking positions, and reducing royalty stacking.

Including non-essential patents in a pool can have distributional consequences and may raise foreclosure concerns. Moreover, there is a risk that the pool can shelter weak patents by reducing incentives for members of the pool to challenge patents owned by other members of the

\(^{48}\) See Joseph Farrell & Carl Shapiro, How Strong Are Weak Patents?, 98 AM. ECON. REV. 1347, 1362 (2008) (“[W]eak patents can be used to impose high per-unit royalties . . . raising downstream marginal costs and thus moving the downstream price closer to the monopoly price.”). An additional plausible competitive risk is that members of a patent pool may coerce patentees to lower their royalties. See Nelson, supra note 2, at 552. Such coercion is unlikely to be effective if patentees can choose not to join a patent pool.
pool. These concerns, however, are somewhat exaggerated. While it is unlikely that every patent in a pool is valid or would be infringed by use of the technology licensed by the pool, when pools include a very large number of patents, it is likely that at least one or a few are essential to practice the technology covered by the pool.

Despite their importance, antitrust authorities have paid relatively little attention to the issue of how to encourage patentees to form beneficial pools and how to make those pools resistant to defection. As a preliminary to developing policies to promote the formation and stability of beneficial patent pools, the next Part explains why patent pools may not form or may disintegrate because of internal forces.

II. WHY GOOD PATENT POOLS MAY FAIL TO FORM OR BE UNSTABLE TO DEFECTIONS

The Coase Theorem teaches that economic agents will negotiate efficient solutions when transaction costs are low and agents have effective property rights that control the use of their resources. Ronald Coase developed his arguments in the context of agents whose activities imposed unpriced costs on others, such as pollution externalities. The intuition of Coase’s work suggests that patentees should have incentives to form patent pools to avoid royalty stacking, entrenched blocking positions, and costly search for patent rights that adversely affect joint profits. However, clear property rights and costless bargaining are not sufficient to ensure that patentees will pool their patents when pooling maximizes their joint profits.

50 See Gilbert, The Essentiality Test, supra note 36, 337–46. Recent communications from the U.S. antitrust authorities suggest some flexibility with respect to these criteria. See ANTITRUST & IP REPORT, supra note 2, at 77–78 (“The Agencies acknowledge, however, that it might be reasonable to include substitute patents in a pool in certain situations.”).

51 Suppose the pool contains $N$ patents, each of which is essential and valid with independent probability $p$. The probability that at least one patent is essential and valid is $1-(1-p)^N$. For example, if $p=0.5$ and $N=10$, the probability that at least one patent is essential and valid is $0.999$. If each patent has an independent probability that it is essential and valid, the probability that all of the pool’s patents are invalid or not infringed declines with the number of patents while the cost of litigating patents increases with the number of patents challenged. Consequently, if probabilities are independent and the number of patents is sufficiently large, it is likely that the social cost of challenging the patents is larger than the expected benefit. In that case, even if a pool undermines incentives to challenge patents, this need not harm welfare if challenges to patent validity and infringement fail a benefit-cost test.


The failure of patentees to pool their patents when pooling is jointly profitable is not a direct contradiction of the Coase Theorem. If all of the owners of patents that are necessary to make or use a technology were locked in a room and could not leave without reaching an agreement, it is likely that they would negotiate a jointly beneficial licensing outcome. For example, if ten patents, each owned by a separate firm, are essential to make or use a product, the ten patentees would have incentives to negotiate royalties that maximize their joint profits.

The problem is that patentees are not compelled to negotiate with other patentees. They do not have to enter the room, but instead can license independently or seek privately profitable arrangements with a limited set of other patentees. In the example, if the ten patentees agreed to royalties that prevented royalty stacking, one (or more) of them could have an incentive to break the agreement and exploit the low royalties charged by the other nine patentees by “leaving the room” and licensing its patent independently. In Coase’s pollution example, the parties have an incentive to negotiate with each other to internalize negative externalities. In the patent pool case, the pool creates a positive externality for an individual licensor. The more the pool succeeds in lowering royalties and avoiding transaction costs, the greater is the benefit from independent licensing of an essential patent. The incentive to leave the pool (or not join in the first place) is analogous to the incentive to defect from a cartel. By restricting output and raising prices, harmful cartels make it profitable for a firm to act as an independent competitor. The difference is that competition policies should discourage harmful cartels, while policies should promote patent pools that benefit consumers and producers.

The economic theory of the core addresses the ability of agents to bargain for efficient outcomes. Core theory considers the agents in an economy and the outcomes they can guarantee for themselves when they form coalitions with other agents. A single patent licensor is a coalition of one. Other coalitions may consist of some, or all, owners of patents that are necessary to make or use a technology. The grand coalition is the set of all the relevant players. When the core exists, the grand coalition is a stable bargaining outcome where all players prefer their payoffs to any payoffs they could earn in a smaller coalition.


54 See, e.g., id. at 154. For a demonstration that the core of a game may not exist, see, e.g., Varouj A. Aivazian & Jeffrey L. Callen, *The Coase Theorem and the Empty Core*, 24 J.L. & Econ. 175, 179–80 (1981).
In the patent example, the core exists if every patentee prefers its payoff when part of a pool that consists of all patentees to the payoff it could get in any different coalition of patentees. In general terms, the core of an economy with complementary patents may not exist. Patent owners may have many reasons not to pool their patents, even if a pool would maximize their joint profits. They may refuse to join because they believe that their patents are worth more as an independent licensor than they would receive under the pool’s royalty allocation methodology, or they may have strategic interests, such as protecting confidential R&D plans, that they feel may be compromised if they join a pool. In some cases they may refuse to join any pool. In other cases they may choose to join a pool that does not include all patentees, such as either of the two pools that license DVD patents. If patentees are motivated purely by the licensing revenues they can collect, then the pool could profitably offer enough to a single patentee to convince that patentee to remain in the pool. However, in general, the pool cannot afford to compensate every patentee that may defect to become an independent licensor.

Nonetheless, patent pools do form, and sometimes they include a large fraction of the patents that are essential to make or use a technology. Incentives to defect from a pool or not join in the first place depend on many factors. The remainder of this Part considers some of these factors that make pooling more or less attractive to individual patentees.

A. BUSINESS STRATEGIES AFFECT POOLING INCENTIVES

Patent owners often differ in their licensing objectives. Some patentees do not manufacture or sell products that use their patents, and it is

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understandable that these patentees want to maximize profits subject to any constraints from commitments they may make as part of their licensing programs.\textsuperscript{57} For patentees that are vertically integrated into downstream production the overriding objective may be to sell products that employ the patented technologies rather than profit from licensing revenues. A patent pool facilitates the adoption of a new technology by allowing one-stop shopping for patent rights and reduces the potential costs of royalty stacking. Vertically integrated patentees may settle for low or even zero royalties in return for rapid adoption of their preferred technologies and speedier or more effective market entry. It is worth noting, however, that even vertically integrated firms have incentives to collect royalties from their patents.\textsuperscript{58}

Most patent pools initiated in recent years were formed to license patents that are necessary to implement a defined standard, such as MPEG encoding, DVDs, or mobile telephony. The companies that founded these organizations are vertically integrated firms that both own intellectual property and sell products that use the patented technologies. For example, the companies that established the DVD pools manufacture and sell DVDs or complementary hardware and services, such as DVD players and movies. Similarly, in 1998, five vertically integrated companies—Ericsson, Nokia, IBM, Toshiba, and Intel—formed the Bluetooth Special Interest Group (SIG) to promote the Bluetooth short-range wireless communications technology specification. The Bluetooth SIG has grown to include more than 200 firms that guide the development of Bluetooth technology and more than 13,000 member companies (as of September 2010) that develop, manufacture, or sell Bluetooth-enabled products worldwide.\textsuperscript{59}

Cisco, Clearwire, Intel Corporation, Samsung Electronics, and others formed the Open Patent Alliance (OPA) patent pool in 2008 to promote adoption of the fourth-generation WiMAX wireless technology based on the IEEE 802.16e standard. The primary goal of the OPA is to “foster a global ecosystem focused on delivering broader choice, com-

\textsuperscript{57} Examples of commitments include an obligation to license under RAND (reasonable and non-discriminatory) terms or most-favored customer agreements that discourage the patentee from setting different license terms for licensees.


\textsuperscript{59} \textit{SIG Membership Directory}, \textsc{Bluetooth SIG, Inc.}, https://www.bluetooth.org/apps/directory/default.aspx. Royalties were not a factor in the formation of the Bluetooth Special Interest Group. Members extend royalty-free licenses to other members to build products based on Bluetooth wireless technology. \textit{See Membership Overview}, \textsc{Bluetooth SIG, Inc.}, http://www.bluetooth.com/English/SIG/pages/membership.aspx.
petitive equipment and service costs for WiMAX technology, devices and applications.\footnote{Open Patent Alliance, http://openpatentalliance.com.}

Other pools have formed that limit royalties to promote social objectives rather than to profit from new products. Syngenta and other agricultural technology companies donated patents to the Golden Rice patent pool to promote use of a genetically engineered strain of rice designed to combat vitamin A deficiency in developing countries.\footnote{See Intellectual Property-Related Issues: A Public-Private Partnership and Humanitarian Licences, Golden Rice, http://www.goldenrice.org/Content2-How/how9_IP.html.} Companies, universities, and research organizations have made patents available for royalty-free licenses to clear potential patent thickets that could hinder research in agriculture, medicine, and biotechnology. Examples include the green fluorescent protein project, the Public Intellectual Property Resource for Agriculture, the SARS IP Working Group, and the UNITAID pool for AIDS medications.\footnote{See Patent Pool Plans Progress, The Student Stop AIDS Campaign (July 15, 2008), http://www.stopaidssocieties.org.uk/2008/07/patent-pool-plans-progress; David Serafino, Survey of Patent Pools Demonstrates Variety of Purposes and Management Structures, KEI Research Note 2007:6, Knowledge Ecology International (June 4, 2007), http://keionline.org/content/view/69/1.}

Different business strategies can cause firms to pool their patents with some firms, but not with others. Two pools to license DVD patents emerged in part as a consequence of differing approaches to industry standards. Sony, Pioneer, and Philips pooled their DVD patents in 1998.\footnote{Antitrust & IP Report, supra note 2, at 69.} Soon after, Hitachi, Matsushita Electric, Matsushita Electric Industrial, Time Warner, Toshiba, and Victor formed a separate pool (the DVD 6C pool).\footnote{See DVD 6C Business Review Letter, supra note 18.}

One explanation offered for the existence of two separate pools is that the two groups could not reach an accord about their respective shares of joint royalty payments.\footnote{Yoshiko Hara, Royalty Dispute Foils One-stop DVD Patent Licensing Plan, EE Times (June 18, 1999, 11:33 AM), http://www.eetimes.com/electronics-news/4038164/Royalty-dispute-foils-one-stop-DVD-patent-licensing-plan.} Another explanation for the fork in the patent pool road was a disagreement between the two groups over the promotion of DVD standards. Philips, Pioneer, and Sony favored a single-sided disk format that could hold 3.7 GB of data while the six-firm group favored a double-sided format that could hold 5 GB of data. They resolved their disk format differences in a compromise solution prior to initiation of their licensing program, but they continued to disagree
over standards for recordable and rewritable disks. Thus, one explanation for the splitting of DVD patents into at least two separate pools is the historically divergent business interests of different owners of DVD patents.

B. Pool Royalties Affect Pooling Incentives

By lowering transaction costs and reducing royalty stacking, a patent pool can increase the profit that is available to an independent licensor. Conversely, a patent pool can discourage independent licensing if it can commit to charge a sufficiently high royalty. Consider the following stylized example. There are ten essential patents, each owned by a single firm. Each potential licensee has a willingness to pay equal to $10 per unit for the technology covered by the ten patents and incurs a transaction cost of $0.50 per unit for every licensing transaction. A pool that offers a package license for the ten patents can demand a per-unit royalty of up to $9.50 (equal to the $10 willingness to pay, less a transaction cost of $0.50). If all the licensors licensed independently, they could collect royalties that total no more than $5.00 per unit (the $10 willingness to pay, less $5.00 in transaction costs for the ten separate licensing transactions). As a simplification, I assume that licensing incurs no direct costs other than transaction costs and that a pool shares royalties equally among its members.

Suppose that the ten firms unite to form a patent pool and charge a royalty of at least $9.00 per unit. If the pool can sustain at least the $9.00 royalty, then no firm will have an incentive to leave the pool. If a firm

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67 Fortunately, there has been some convergence in the licensing and adoption of DVD technologies. Both pools currently license patents they own that cover all of the different DVD formats (although they continue to administer their licensing programs as separate pools). See Frequently Asked Questions About the DVD Patent Joint Licensing Program, DVD6C LICENSING GROUP, http://www.dvd6cla.com/faq.html (“[T]he new DVD Patent Joint License also extends to +R/+RW Discs that conform to the +R/+RW Standard Specifications.”); see also Licensing Programs, PHILIPS, https://www.ip.philips.com/services/?module=IpLicenseProgram&Command=Search. DVD players are available that support multiple DVD standards. See DVD Formats Explained, WEBOPEDIA (Jan. 8, 2010), http://www.webopedia.com/DidYouKnow/Hardware_Software/2007/DVDFormatsExplained. asp.

68 The transaction cost includes the costs of identifying licensors and negotiating licenses, but also can represent profit dissipation from independent licensing of complementary patents in a more general model with price-elastic demand; i.e., the Cournot complements/royalty-stacking problem.
attempted to license a patent on its own, it would have no demand for its patent because licensees' total willingness to pay would be $9.00 per unit (the $10 value less two licensing transactions at $0.50 each), which is less than the cost to a licensee of assembling the required patents, given that the pool alone charges at least $9.00.

The key to this result is the ability of the pool to commit to the $9.00 per-unit royalty. Whether the pool can commit to this high royalty is an open question because the $9.00 royalty may not be an equilibrium of a competition between the pool and other patentees that license their patents outside the pool. For example, under some conditions the equilibrium royalty outcome is more a function of the number of licensors than the number of patents that each licensor may control. A pool and a single independent licensor may divide royalty income on a roughly equal basis. If, however, the pool can commit to a high royalty, perhaps buttressed by a credible threat to disband the pool if the royalty falls to a low level, then the high royalty can be a means to discourage independent licensing. The $9.00 royalty in this example does not leave enough royalty “headroom” for a patentee to profit by becoming an independent licensor.

In fact, the pool is stable to defection if it can commit to a royalty of at least $8.19 per unit. The most that a single patentee can collect by defecting from the pool is $9.00 per unit less the royalty charged by the pool. If the pool charges $8.19 per unit for a package license, the most a single defecting patentee can earn is $0.81 per unit ($9.00 – $8.19). If the patentee remains in the pool, its share of the pool’s royalty is $0.819 per unit, which is more than it can make by defecting. If the pool charges any lower royalty, then a pool that includes all ten patents will not be stable because at least one firm will have an incentive to leave the pool. Thus, one element that contributes to a stable pool is the ability of the pool to commit to a high royalty.

In this example, total economic surplus achieves its maximum value when all ten patentees are in the pool as this minimizes the total transaction cost of licensing. Total surplus with a pool that includes all ten patentees is $9.50 per licensed unit (the $10 willingness to pay less the $0.50 transaction cost). The effects of pooling on consumer surplus are less dramatic. If a pool with all ten patentees commits to a royalty of $8.19 per unit, consumer surplus is $1.31 (the $10 willingness to pay, less the pool royalty of $8.19 and the $0.50 transaction cost). If the pool charges a lower royalty, at least one patentee would choose to license independently. The independent licensor’s royalty on top of the pool’s royalty and the additional transaction costs would lower consumer surplus.
The example assumes a very simple demand structure in which every licensee has the same willingness to pay for a license. The incentives to pool are captured by the assumed transaction costs of licensing, which increase with the number of independent licensors. However, the logic of the analysis extends to more general demand structures, and indeed is reinforced by the double-marginalization that can occur when licensors of essential patents face downward sloping demands. The Appendix describes a licensing model in which demand is elastic and licensing does not directly incur transaction costs. The results are similar to the simple model with a constant willingness to pay for a license. The pool can discourage independent licensing if it can commit to a sufficiently high royalty. The pool royalty that limits incentives for independent licensing increases with the number of essential patents and can be much larger than the pool’s profit-maximizing royalty if it were not constrained by the threat of independent licensing.

C. Patent Damage Infringement Rules Affect Pooling Incentives

Rules that govern damages for patent infringement also affect patentees’ decisions to join a pool or to license independently. Patent law may allow a patentee to obtain an injunction that prevents conduct that would infringe on the patent.69 The threat of injunctive relief provides a patentee with bargaining power that can be disproportional to the number of patents that she owns. In the previous example, if nine patents are in the pool and one is licensed independently, a licensee needs the one “outside” patent just as much as the nine “inside” patents. The licensee’s willingness to pay for a license net of transaction costs when the licensee has to transact with the pool and with an independent licensor is $9 per unit. Under some bargaining assumptions—including the ability to demand injunctive relief for patent infringement—the pool and the independent licensor may split the $9 net value, with each earning a royalty of $4.50 per unit.70 Of course the independent licensor with a single patent gets to keep the entire $4.50 royalty, while the pool has to

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70 One economic model that describes the outcome of bargaining among profit-maximizing firms is the Nash cooperative bargaining solution. See, e.g., Ken Binmore, Ariel Rubinstein & Asher Wolinsky, *The Nash Bargaining Solution in Economic Modelling*, 17 RAND J. ECON. 176, 176–79 (1986). Thus, “[W]hen patents are known to be valid and infringed,” the patents are essential to make or use only one technology and have no value for any other technology, patent holders maximize profits and a patent holder can “obtain injunctive relief to block any activity that infringes its patent, [the] Nash bargaining [solution] suggests that the allocation of value corresponds to the number of owners of intellectual property rights rather than to the number of patents that each firm owns.” Richard J. Gilbert & Michael L. Katz, *Efficient Division of Profits from Complementary Innovations*, Int’l J. INDUS. ORG. 1–2 (forthcoming 2011). The Nash bargaining solution differs
share its $4.50 royalty with the remaining nine patentees. If each patent has a single owner, it is clearly more profitable to be an independent licensor in this case.71

The U.S. Supreme Court limited the injunction threat in its *eBay v. MercExchange* decision.72 Prior to this decision, courts often presumed that a patent’s right to exclude entitled the patentee to injunctive relief.73 In *eBay*, the Supreme Court held that injunctive relief for patent infringement should not be automatic and instructed courts to consider the factors that influence a decision to grant injunctive relief in other disputes.74 The *eBay* decision could make pooling more attractive by lessening a patentee’s bargaining power as an independent licensor, but the effects, including the effects on incentives for innovation, will depend on how the courts apply the decision, including how they evaluate infringement damages in its absence.

D. PATENT POOL GOVERNANCE RULES AFFECT POOLING INCENTIVES

Patents that are essential to make or use a technology have a collective value that can be shared among the patent owners. There is, however, no clear market rule that determines how essential patent owners should share royalties.75 As independent licensors, royalties depend on the bargaining skills of patentees, their licensing objectives, the qualities of their patents, opportunity costs that patentees may have if they choose not to license their patents, the likelihood of injunctions, and the methods that courts apply to calculate infringement damages. These market-determined royalties from independent licensing do not translate easily to a rule that patent pools can use to allocate licensing reve-

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71 Patent law allows a patentee who does not practice the technology to earn a reasonable royalty as compensation for infringement. ALAN L. DURHAM, PATENT LAW ESSENTIALS: A CONCISE GUIDE § 11.8.1, at 189–90 (3d ed. 2009). The “reasonable royalty” can be based on royalty rates that emerge from market negotiations, but these negotiations reflect the power of the threat of an injunction.

72 *eBay v. MercExchange*, 547 U.S. at 394.


74 *Id.*

75 The allocation of rewards for discoveries that are essential to make or use a technology affects incentives to make these discoveries, and under some strong assumptions one can show that each essential discovery should earn the same reward to promote efficient investment in R&D. These include the strong assumptions that the essential patents are valid and have no alternative uses. See Gilbert & Katz, supra note 70, at 20.
nues to their members. Furthermore, such market-determined royalties do not necessarily promote efficient investment in research and development.\footnote{See id. at 24–28.}

Patent pools vary widely in their license terms and in the allocation of any royalties to pool members. Some pools license their patents royalty-free in an effort to promote adoption of new technologies covered by their patents. The Bluetooth Special Interest Group provides its members with a non-exclusive, royalty-free, perpetual license to each member’s patents that are necessarily infringed by the Bluetooth Specification and are required to make, use or sell Bluetooth-compliant products.\footnote{Bluetooth Patent/Copyright License Agreement § 5, available at https://www.bluetooth.org/Membership/agreements.htm.} The Multimedia Home Platform offers a royalty-free license for technology related to receiving and executing Java-based applications on a television set.\footnote{See Serafino, supra note 62, at 27.} The Open Invention Network for Linux offers a royalty-free license for the Linux operating system.\footnote{Id. at 28. Indeed, the open-source movement, of which the OIN is a part, can be likened to a patent pool that commits itself to offer royalty-free licenses.}

Royalty-free licenses or royalties that are deliberately held below profit-maximizing levels promote the adoption of technology covered by a pool’s patents. This can serve the objectives of some patentees, but not others. A study of nine patent pools based on standards developed since the 1990s found that the participation of owners of patents covered by the standard ranged from a low of 29 percent for the W-CDMA pool (a third-generation mobile wireless technology) to 58 percent for one of the DVD pools.\footnote{Layne-Farrar & Lerner, supra note 56, at 26 (Table 1). W-CDMA is the abbreviation for wideband code division multiple access.} Expressed as a fraction of the number of patents covered by the standards rather than the number of owners, the participation rate ranged from 10 percent for the W-CDMA pool to 75 percent for the 1394 pool (which is based on the IEEE-1394 communications standard for data transfer, also known as firewire). Participation in the nine patent pools was greater for vertically integrated firms that hold patents covered by the standards, which is consistent with the view that firms that sell products covered by the patents are more likely to benefit from a pool.

**E. Partial Pools May Be Stable**

Patent pools cannot provide one-stop shopping or fully protect technology users from royalty stacking if they do not include all of the pat-
ents that are essential to use the technology. The MPEG-2 pool includes more than 100 U.S. patents that have been declared to be essential to the MPEG-2 encoding standard, but that did not prevent Alcatel-Lucent from pursuing infringement claims for patents that it alleged covered the MPEG-2 standard and were not in the pool.\(^{81}\) The Open Patent Alliance did not prevent Adaptix from bringing a lawsuit against the Sprint-Clearwire WiMax joint venture, alleging infringement of six of its WiMax patents.\(^{82}\) Nonetheless, even partial pools that do not include all patents that are necessary to make or use a product offer considerable savings in transaction costs and can mitigate royalty stacking compared to separate licensing with independent patentees.

Pools that comprise fewer than all of the patents that cover a technology can be stable against defection when a pool that consists of all essential patents is unstable at similar licensing terms. To see why, consider again the example in which ten patents are essential to make or use a technology each of which is owned by a separate firm. Licensees value the technology covered by the patents at $10 per unit and each licensing transaction costs $0.50 per unit. Suppose that six firms pool their patents, while the remaining four firms choose to license their patents independently. The pool shares royalty income equally among its members and each of the independent licensors collects the same royalty.

Suppose the pool with six members charges a royalty of $4.50 per unit. If one of the pool members defects, it becomes another independent licensor. In that case, licensees have to complete a total of six licensing transactions (five independent licenses plus the pool), each of which incurs a cost of $0.50 per unit, for a total cost of $3 per unit. Assuming that each independent licensor would earn the same royalty, a pool member that defects to join the ranks of independent licensors would earn only $0.50 per unit. This amount is equal to the $10 willingness to pay, less the $3 total transaction cost, less the pool royalty of $4.50, which equals $2.50 per unit, divided equally among the five independent licensors. The hypothetical defector is better off in the pool, where it would collect $4.50/6 = $0.75 per unit. Thus, the six-member pool is stable if it can commit to a royalty of $4.50 per unit, even though the full ten-member pool requires a royalty of at least $8.19 per unit to be stable.

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All else equal, a large patent pool benefits independent licensors of complementary patents by reducing transaction costs (and with elastic demand, reduces royalty stacking), which allows independent licensors to collect more royalties. It is in this sense that a patent pool creates royalty “headroom” for an independent licensor. Furthermore, with a larger pool an independent licensor has to share royalty revenues with fewer other independent licensors of complementary patents. Assuming that patentees wish to maximize royalties, for the pool to be stable against defections there is a critical royalty the pool must sustain that increases with the number of patentees in the pool.

Returning to the example with ten essential patents each owned by a single patentee, let $M$ be the size of the pool, which can range from all ten patents to only one. A pool of size $M$ is stable if each patentee earns a royalty as a member of the pool that exceeds what it could earn if it defects from the pool and licenses its patent independently. Assuming that the pool shares royalties equally among its members, each member of a pool of size $M$ with a pool royalty $R$ earns a royalty equal to

$$\pi_{i,\text{pool}} = \frac{R}{M}.$$ 

A patentee that defects from the pool earns

$$\pi_{i,\text{defector}} = \frac{10 - R - (12 - M)(0.50)}{11 - M}.$$ 

To understand this equation, note that if the pool has $M$ members, then there are $10-M$ independent licensors. If one of the pool members defects and licenses its patent independently, then the number of independent licensors increases to $11-M$. This number determines the independent licensor’s share of the royalties that are available to all independent licensors. The royalty available to independent licensors is the $10\$ willingness-to-pay for the technology, less the royalty charged by the pool and total licensing costs. The total number of licensing transactions required to access all of the essential patents when one more patentee defects from a pool of size $M$ is $12-M$: for example, if the pool included all ten patentees and one defects, then licensees must conduct two separate licensing transactions to access all the patents. The independent licensors share the royalty that is available when the pool commits to a royalty of $R$. This available royalty is $10 - R - (12-M)(0.50)$. Table 1 shows how the critical royalty depends on the pool size.
TABLE 1: CRITICAL POOL ROYALTY FOR
A STABLE POOL WITH M PATENTS
(TEN ESSENTIAL PATENTS, WILLINGNESS-TO-PAY = $10 PER UNIT; PER UNIT TRANSACTION COST = $0.50 PER LICENSE)

<table>
<thead>
<tr>
<th>Pool size, M</th>
<th>Critical Pool Royalty ($ per unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.91</td>
</tr>
<tr>
<td>3</td>
<td>1.50</td>
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<tr>
<td>4</td>
<td>2.18</td>
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<tr>
<td>5</td>
<td>2.95</td>
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<td>6</td>
<td>3.82</td>
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<tr>
<td>8</td>
<td>5.80</td>
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<tr>
<td>9</td>
<td>6.96</td>
</tr>
<tr>
<td>10</td>
<td>8.19</td>
</tr>
</tbody>
</table>

The example demonstrates that if the pool cannot commit to a high royalty, then smaller pools may be stable when larger pools are not. From Table 1, if the pool can commit to a royalty of $5 per unit, but not more, then a pool with seven or fewer members is stable and larger pools are not stable. For a pool to be stable with a large number of patents, either the transaction costs from assembling different licenses must be very large or the pool must be able to commit to a royalty that captures a large fraction of the value of the technology that the patents cover. This conclusion assumes that the pool cannot disadvantage defectors or take other actions to cement its membership, as discussed in more detail in the next Part.

Patent owners that choose to remain outside a pool can unravel the benefits from pooling by interfering with one-stop shopping and by demanding high royalties. This is not to say that choosing to remain outside a patent pool is wrong or necessarily harms the high-technology

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83 In this example, every licensee has the same willingness-to-pay for a license; viz., $10 for every licensed unit. Consequently, the pool can charge a royalty that extracts all of the value of the licensed technology, leaving nothing left over for an independent licensor. The argument that a high royalty can limit incentives for independent licensing applies even if the pool cannot charge royalties that extract all of the value from licensees, although the analysis is more complex and with elastic demand a high royalty limits the profit of the pool as well as the profit of an independent licensor. The Appendix provides an analysis of incentives for patent pool formation with elastic demand.
economy. Patent pool participation is voluntary and the licensing strategies adopted by patent pools can be inconsistent with the business model of a firm that is engaged in research and development and that relies on licensing revenues to fund its business model. Toshiba may be content to license its DVD patents at a low royalty as a member of a DVD patent pool because Toshiba is a consumer of patented technology and a seller of equipment and media that use the patented technologies. However, a firm that is a “pure play” licensor of technology for DVDs and has no sales of DVD-related equipment or merchandise may reasonably choose to maximize its profits as an independent licensor.

There are costs from patent pools that are under-inclusive and from pools that never form. There are no patent pools for microprocessors (although semiconductor and related technology firms have extensive cross-licensing agreements) or for most biotechnologies. What can be done to make patent pooling more attractive to owners of essential or complementary patents, and can pools adopt policies that enhance their stability? The next Part considers different prescriptions to promote patent pools that benefit technology users and consumers. These include antitrust enforcement policies, approaches to the evaluation of damages for patent infringement, and conduct by the pools themselves.

III. HOW TO PROMOTE GOOD PATENT POOLS

Antitrust authorities must watch for patent pools that might act as cartels and limit competition. But over-zealous enforcement to minimize the risk of anticompetitive patent pools can deter the formation of pools that create value or undermine their stability. This Part offers some suggestions to promote beneficial pooling arrangements, while guarding against pools that clearly harm competition.

A. ALLOW POOLS THE FLEXIBILITY TO CHARGE HIGH ROYALTIES FOR COMPLEMENTARY PATENTS

The business review letters issued by the Department of Justice in response to the two proposed DVD pools noted approvingly that “the agreed royalty is sufficiently small relative to the total costs of manufacture that it is unlikely to enable collusion among sellers of DVD discs, decoders or players.” Low royalties obviously benefit consumers and mitigate the risk that the pool might raise royalties by eliminating competition between substitute technologies.84 But excessive focus on the risk

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84 Antitrust enforcers have other tools to guard against pools that may eliminate competition between substitute technologies. Under some conditions, a requirement that pool members offer individual licenses can be a screen to identify anticompetitive pools,
that a pool may charge too much can underestimate the risk that owners of essential patents may choose to license their patents independently, which can harm competition by increasing transaction costs and contributing to royalty stacking. In short, as I now explain, enforcers should not compel a pool that is limited to essential patents to choose a royalty so low that it encourages independent licensing of essential patents.85

A patent pool does not confer additional market power on the patentees in the pool if the patents are valid, essential to make or use a product, and have no alternative uses.86 Accordingly, in such cases the pool should have the same flexibility to set royalties and licensing terms as would apply to a single firm with a single patent, provided that the licensing terms do not harm competition in downstream markets. Scrutiny of royalty amounts by patent pools can be justified, however, given the difficulty of ascertaining when patents may cover technologies that are substitutes or when the licensing practices of the pool may foreclose competing technologies.

The flexibility to charge high royalties also should recognize limitations that would apply if the patents in the pool were owned by a single firm. Many patent pools comprise patents that cover a standard. In the course of developing the standard, patentees may have entered into commitments that bind the patent owners to charge royalties that are “fair, reasonable, and non-discriminatory” (FRAND). These FRAND commitments protect users of a standard from being held up with high royalties or a refusal to license after the users have made investments as only welfare-increasing pools are profitable with independent licensing. See Lerner & Tirole, supra note 33, at 698–700. Antitrust authorities have approved of this condition in proposed patent pools. See Antitrust & IP Report, supra note 2, at 85. In general, however, independent licensing selects against anticompetitive pools only when the pools include all essential patents. See Steffen Brenner, Optimal Formation Rules for Patent Pools, 40 Econ. Theory 373, 384 (2009). Empirical evidence suggests that pools of complementary patents are more likely to allow independent licensing. See Josh Lerner, Marcin Strojwas & Jean Tirole, The Design of Patent Pools: The Determinants of Licensing Rules, 38 RAND J. Econ. 610, 621 (2007).

85 A corollary is that patent pools should have discretion in how they allocate royalty income to their members. For example, it may be necessary to allow firms that specialize in research to earn higher royalties than vertically integrated firms to compel the former to join a pool. See, e.g., Reiko Aoki & Sadao Nagaoka, The Consortium Standard and Patent Pools 17 (Hitotsubashi Univ. Research Unit for Statistical Analysis in Social Sciences (Hi-Stat) Working Paper No. 32, May 2004), available at http://hdl.handle.net/10086/14026.

86 See, e.g., Elhauge, supra note 28, at 478 (no additional market power if products in a bundle are used in fixed proportions and lack separate utility). Patents that are essential for a particular application are used in fixed proportions for that application because lawful use of the pool’s technology requires a license to use each patent.
that are specific to the standard and make it costly to switch to a different technology.\textsuperscript{87}

There are two types of holdup that can occur with overlapping patents rights. One type of holdup is associated with the lock-in from investments that are specific to a standard. FRAND commitments are intended to prevent or limit this standardization-related type of holdup. A second type of holdup can occur if an owner of an essential patent chooses to license its patent outside the pool. To the extent that a pool reduces royalty stacking or transaction costs, the pool can make it easier for an independent licensor to charge a high royalty. I call this “headroom holdup”: the independent licensor can charge a high royalty because the pool has lowered the royalty or reduced transaction costs for other complementary patents, leaving more value (headroom) available to the independent licensor.

If the patents in a pool have FRAND commitments, those commitments should apply to the pool’s license terms. The implication of FRAND commitments for some patents in a pool is less clear if the pool includes other patents that lack such commitments. Individual licenses for the patents with FRAND commitments should respect those commitments. A more difficult question is whether FRAND commitments for a subset of patents in a pool would apply as well to package licenses offered for the pool’s entire patent portfolio. At a minimum, a patentee’s share of royalties from pool licenses should be constrained by any “fair and reasonable” royalty commitments made by the patentee, but that need not constrain the royalty for the package. Furthermore, if the patentee has pledged to license its patent under non-discriminatory terms, those terms should apply if its patent is included in a package license offered by the pool. This suggests that commitments by some patentees to license patents under non-discriminatory terms may have to spill over to other patents included in a package license.

There is a tension between the objectives of limiting standard-related holdup and headroom holdup. If FRAND commitments constrain the royalties that the pool can charge, patentees that lack FRAND commitments can choose not to participate in the pool. This independent licensing can negate some of the benefits of the pool if the independent

licensor can bargain for large infringement damages, particularly if the licensor has additional leverage from the threat of injunctive relief.

One approach to resolve this tension is to allow somewhat greater flexibility for the pool to charge royalties and design licensing terms than might apply to a single patentee if some of the patents in the pool do not have FRAND commitments. A preferable solution is to better align infringement damages for an independent licensor to the value of the patent, as described in Part III.D below. Incentives to license independently would be lower if damage calculations for patent infringement recognize overlapping patent rights and other inputs necessary to create product value and allocate a reasonable share of value to the infringed patent. This is not an easy calculation under any circumstances. In addition to the inherent difficulties of allocating values to patents that may have different opportunity costs of licensing, the allocation presumably should recognize whether the patent has a FRAND commitment. The patent’s share of value that would be appropriate under this allocation could be higher if it does not have a FRAND commitment than it would be with such a commitment.

A further complication is that high pool royalties can raise concerns about raising rivals’ costs.\(^8\) A vertically integrated firm can tilt the playing field for downstream competition by increasing the price of an input that it sells to downstream competitors. A patent is an input to the production of a downstream good. A potential concern is that a patent pool consisting of patentees that are vertically integrated into downstream production will charge high royalties to disadvantage unintegrated downstream competitors.\(^9\)

However, a patent pool does not necessarily increase the incentives to raise the costs of downstream rivals relative to incentives to engage in such behavior in the absence of the pool. Consider an industry in which some firms are vertically integrated while other firms only compete in a downstream market. The vertically integrated firms own patents that are essential to make or sell the downstream product and also sell products in the downstream market that use the patented technologies. In the absence of a pool, each integrated firm has an incentive to raise the costs of its downstream rival by charging a high royalty for its essential patent. This incentive to raise rivals’ costs is not necessarily increased if the integrated firms license their patents jointly in a patent pool. In ad-


\(^9\) See, e.g., Nelson, supra note 2, at 542.
dition, the pool reduces double-marginalization at the upstream level of the patentees. This effect lowers the total royalty for the pooled patents. While in general the combined effect is unclear, at least in some cases the elimination of double-marginalization at the upstream level will more than compensate for any increase in the incentive of the pool to raise the costs of downstream rivals.90

Furthermore, the raising rivals’ costs concern for a patent pool is attenuated if the pool charges a uniform royalty to all licensees including members of the pool, the ownership of patents is widely distributed among the pool members, and the pool shares licensing revenue equally among its members. In this case, which holds for many patent pools, the pool royalty will closely approximate each firm’s marginal cost for the licensed technology.

More specifically, suppose that a pool allocates royalty revenues in proportion to the number of patents $m$ that each member firm owns. Then each member of the pool pays the pool royalty $R$ for a portfolio license and gets back $(m/N)R$ in royalty income. Its net cost for the portfolio license is essentially the same price that non-members pay for a portfolio license if its share, $m/N$, of the pool’s patents is small. In effect, if many firms own essential patents, then no firm is fully integrated with respect to the cost of patent rights. This holds provided that the pool charges a uniform royalty to all licensees and shares revenues among its members, with no one member of the pool accounting for a large share of that revenue.91

Concerns about raising rivals’ costs could arise if the pool charges a higher royalty to firms that are not members of the pool. A related potential concern is that the licensing policies of a patent pool may allow vertically integrated members of the pool to coordinate conduct to exclude or diminish competition from downstream rivals in ways that would not be feasible with independent patent licensing. Of course, as in other allegations of cost-raising conduct, there are factors that should be considered that might justify differential royalties or conduct that may potentially exclude rivals.


91 A uniform royalty does not mean that the pool has to charge only a single royalty, provided that each potential licensee faces the same royalty schedule. For example, the royalty could depend on the number of licensed units.
The preceding discussion offers reasons why patent pools should be treated no differently than a single firm with regard to the setting of a profit-maximizing uniform royalty for the pool’s patent portfolio, provided that the pool does not limit competition among technologies that are substitutes for each other or otherwise foreclose competition. Indeed, there are procompetitive reasons to allow the pool to set royalties that exceed the level that would maximize its royalty revenue if the pool ignored the effects of its royalty on incentives for patent owners to join or defect. A high royalty undercuts the attraction of independent licensing by leaving less headroom available to an independent licensor and in this way discourages “headroom holdup.” If the pool can commit to a sufficiently high royalty, it can reduce the incentive of owners of essential patents to leave the pool or not join the pool in the first place. The high royalty can benefit consumers if the alternative is that the pool fragments and the resulting royalty stacking or high transaction costs from independent licensing create higher costs for the necessary patent rights or slow the adoption of new technologies.

Agency advice, such as business review letters that endorse the setting of low royalties by a patent pool, do not imply that the pool would violate the antitrust laws if it were to set a high royalty. However, the focus on low royalties shapes the policies adopted by patent pools. While competition authorities do not have to coax patent pools to increase their royalties, they should recognize that higher royalties for patent pool portfolio licenses do not necessarily mean higher prices for consumers. Indeed, compelling pools to charge low royalties could make consumers worse off by causing a pool to fragment or not form in the first place. Of course, an antitrust policy that takes a more permissive stance toward royalty setting by patent pools is beneficial only if pools do not eliminate competition between alternative technologies or otherwise foreclose competition. Furthermore, concerns about possible standard-related holdup are relevant to pool portfolio licenses as well as to licenses for individual patents that are essential to a standard.

B. ALLOW MORE FLEXIBLE LICENSING TERMS FOR POOLS OF COMPLEMENTARY PATENTS

Antitrust enforcers also should recognize that the use of licensing terms in patent pools that impose vertical restrictions can produce substantial procompetitive effects. Vertical restraints can promote competition by allowing firms to better appropriate the benefits of investments in service or product quality. A licensor might want to limit competition to provide incentives for the licensee to make investments in the licensed technology. The licensor might want to reserve certain regions
or applications for her own use, without which she would not be willing to license the technology to others. Differential licensing terms can promote competition by encouraging the licensor to make the technology available in places or for uses in which the technology has different values.

Vertical restraints, such as exclusive dealing and resale price maintenance, also can harm competition by eliminating competition at a level of a supply chain or by enhancing incentives for collusion. Some of the most egregious patent pools of the past created market power by enforcing strict limits on the ability of the pool members to compete downstream using alternative technologies. For example, the members of the U.S. Gypsum patent pool fixed prices and prevented its members from selling unpatented gypsum board.92

Restrictive licensing terms can segment markets and harm competition if imposed by patent rights’ owners who control technologies that are actual or potential substitutes for each other. Suppose two owners of patents that cover alternative types of DSL modems choose to pool their patents. One owner has patents that cover a type X modem and the other owner has patents that cover a type Y modem. The modem technologies are substitutes—consumers can use either type for high-speed Internet access. It would harm competition if the owners agreed to license only type X modems for residential users and only type Y modems for commercial users, assuming that each modem type would be an acceptable alternative for both users.

The source of the competition problem in this example is the fact that the pool includes technologies that are substitutes for each other. When the technologies are substitutes, the restriction of licensing to residential and commercial users limits competition that would have occurred in the absence of the licensing restrictions. Suppose we change the example and assume that the patentees own patents that are essential to manufacture or use both modem types. In this case, the pooling of the patents does not eliminate competition that would have occurred without the pool. Neither type X nor type Y modems can be manufactured or sold without licenses from both patent owners. Residential users who are limited to the type X modem might want to try the type Y modem, but no one can legally make or sell a type Y modem without obtaining licenses to patents that also cover the type X modem as both modem technologies require rights to both sets of patents. This is analogous to a situation in which a single firm owns the patent rights to both

X and Y modem types and chooses to include field of use restrictions in its licensing terms. Analysis of the competitive effects from vertical restraints imposed by a pool that is limited to essential patents should parallel the analysis for restraints imposed by a single firm, provided that the restraints do not enable the patentees to limit competition in ways that would not have been possible as independent licensors, for example by colluding to set prices, divide territories, or share competitively sensitive information that is not necessary to license the pool’s patents.93

When vertical restrictions present antitrust concerns, their effects should be analyzed taking into account the specific circumstances and, in particular, whether the entities that are imposing vertical restraints have significant market power. These principles apply as well to patent pools and do not imply that patent pools comprised of essential patents generally should be prohibited from issuing restricted licenses. Furthermore, by preventing the pool from issuing restricted licenses that might promote beneficial investments, heightened antitrust scrutiny can make the pool less attractive to its members and contribute to fragmented ownership of patent rights.

Antitrust authorities have been open to some licensing restrictions imposed by patent pools. The agencies have not objected to requirements that licensees grant back to the pool members a non-exclusive license to a patent that is deemed essential to practice the pool’s technology. The business review letters published by the Department of Justice concerning several patent pools do not explicitly prohibit the pools from imposing flexible licensing terms.94 But the MPEG LA letter approvingly notes the absence of such terms, as do the DVD 3C and 6C business review letters and the business review letter for the RFID patent pool. These statements do not imply that restrictive licenses would incur antitrust liability, but positive statements to the contrary for benign restraints would provide a useful template for others to design their licensing programs.

93 Of course, vertical restraints can adversely affect consumers, whether imposed by a single firm or by a pool comprised of essential patents. For example, under some conditions, the owner of an essential input that sells (or licenses) the input to downstream producers can increase prices by choosing an exclusive distributor (or licensee). See Patrick Rey & Jean Tirole, A Primer on Foreclosure, in 3 HANDBOOK OF INDUSTRIAL ORGANIZATION 2145, 2176 (Mark Armstrong & Robert H. Porter eds., 2007). The pool might do the same, but this risk would have to be weighed against the benefits created by joint licensing.

In its present form, antitrust policy potentially can cause an unwarranted lowering of the benefit to a patentee from participating in a pool, while giving individual licensors greater discretion to design licensing terms that capture value from their technologies. Of course, as with royalty levels, an antitrust policy that takes a more permissive stance toward restrictive licensing by patent pools is beneficial only if pools do not eliminate competition between alternative technologies or otherwise foreclose competition.

C. **Poison Pills for Patent Pools**

The incentives for a patentee to leave a patent pool or not join the pool in the first place are similar to the incentives of a firm to defect from or not join a cartel, although with very different welfare consequences. Each member of the cartel would like to defect, provided others remain in the cartel. If they all defect, they are all worse off than if they remained in the cartel. A cartel can be stable if its members know that all of its members will defect if any one of them defects. Similarly, a beneficial patent pool may be stable if each of its members knows that the pool will unravel if any one of them leaves the pool.95 This reasoning suggests that a patent pool may be more stable if it can commit to its own destruction if enough of its members defect and that antitrust enforcers should be careful not to impede such commitment mechanisms.

Corporate finance offers insight into a way to deter members from leaving patent pools. Firms sometimes adopt “poison pills” to discourage a hostile takeover by another company. “Poison pill securities change fundamental aspects of the corporate rules that govern the relationship between shareholders, managers, and the board of directors when a control-related event occurs” to make the company less attractive to a potential acquirer.96 A poison pill for a patent pool is a binding resolution that would require the pool’s dissolution in the event that a critical number of its members choose to exit the pool and act as independent licensors of an essential patent (or possibly not join the pool in the first place). This agreement can strengthen the stability of a patent pool if patentees know that they are worse off if the pool dissolves or never forms.

To see why such a resolution can contribute to the stability of a patent pool, consider again the example of a pool with ten members, each of which owns a single essential patent. As before, licensees are willing to

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95 A formal derivation of this argument can be found in Brenner, *supra* note 84, at 381.
pay $10 per unit for all ten patents and the cost of negotiating each license is $0.50 per unit. The previous analysis showed that a pool consisting of all ten members is stable only if it can commit to a per-unit royalty of at least $8.19. (See Table 1.) If the pool cannot commit to a royalty as high as $8.19 per unit, then at least one of its members would have an incentive to defect or not join the pool in the first place. However, a resolution that requires the dissolution of the pool in the event of a defection can allow the pool to be stable with a much lower royalty.

Suppose the pool with all ten patentees charges only $5.01 per unit for a package license. A single patentee that leaves the pool could charge up to $3.99 for an independent licensee (the $10 willingness to pay, less $1 in transaction costs, less the pool royalty of $5.01) if the pool keeps its other members and continues to charge $5.01 for a package license. If, however, the pool dissolves after the defection, then each patentee, including the defector, could command a royalty of only $0.50 per unit (equal to the $10 willingness to pay, less $5 in transaction costs, divided among the ten individual patentees). This is less than each patentee’s share of royalties when it remains in the pool ($5.01 shared equally among the ten patentees, or $.501).

The value of the threat to dissolve the pool depends on the costs from independent licensing. If these costs are small, independent licensing does not impose a large penalty on patentees relative to what they could earn as members of a patent pool. For example, if the transaction costs from independent licensing were only $0.10 per unit, then the ten patentees would earn $0.90 per unit as symmetric independent licensors (the $10 willingness to pay less $0.10 in transaction costs, divided among ten independent licensors). The pool would have to offer each patentee a royalty share of at least $0.90 per unit to keep the patentee in the pool, which would require the pool to maintain a royalty of at least $9.

A governance rule that dissolves the pool if membership falls below a pre-determined level can lower the minimum royalty that the pool must charge to discourage its members from leaving the pool or not joining in the first place. This is a valuable tool because the pool may not be able to commit to a high royalty, particularly when the pool does not include all of the essential patents. Independent licensors of essential patents can have sufficient bargaining power to extract a large share of the value of the licensed technology. This bargaining power forces the pool to accept a correspondingly lower royalty for its patent portfolio, which makes the pool less stable.

In practice it is problematic for a pool to adopt and commit to an automatic self-destruct mechanism. It is difficult to know how many pat-
ents are essential to make or use a technology, which makes it difficult to know where to set the critical membership level. It is also difficult to know the impact from independent licensing until it occurs and infringement suits have been resolved, which can take a long time. In the interim, the pool members would have an interest in maintaining the status quo.

D. APPORTION ROYALTIES FOR PATENT INFRINGEMENT

Mechanisms for calculating damages in patent infringement cases can enhance the incentives for an individual patentee to remain outside a pool. A concrete example is the MP3 patent litigation brought by Lucent against Microsoft. Lucent alleged that Microsoft’s Windows Media Players WMP10 and WMP11 and the software contained therein for encoding into MP3 format infringed two of Lucent’s patents.97 The trial resulted in a jury decision that initially awarded Lucent (and its successor, Alcatel-Lucent) $1.5 billion for infringement of two MP3 patents.98

There is no single collective rights organization for the licensing of MP3 patents. Thompson is the licensing agent for patents owned by Fraunhofer IIS, a research laboratory that contributed to the development of digital encoding technologies.99 Thompson lists twenty patent families related to the MP3 standard, of which eighteen have patents issued in the United States. Audio MPEG, a subsidiary of Sisvel S.p.A., licenses MP3 patents owned by France Telecom, Philips, and others. Audio MPEG lists sixteen U.S. patents that it states are relevant for MP3 players, decoders, and encoders.100 Including Lucent’s two MP3 patents, there are at least thirty-six U.S. patents that are arguably essential to use the MP3 format standard, most of which are licensed by two firms, Thompson and Sisvel.

In the Lucent patent case, Lucent presented a damages model that assumed a royalty for each patent of 0.5 percent of the average selling price of an infringing computer and then applied that figure to the total number of computers sold over the damages period. Apparently influ-

98 Id. at 940. The district court granted defendants judgment as a matter of law. On appeal, the Federal Circuit ruled that Lucent had no standing to sue for one of the patents and that the defendants had not infringed the other patent. Lucent Tech. Inc. v. Gateway, Inc., 543 F.3d 710, 729, 733 (Fed. Cir. 2008).
99 Thompson is also the licensing agent for Coding Technologies from Sweden (co-inventors of MP3 PRO) and Agere Systems (co-inventors of MP3 Surround). See About Us, MP3licensing.com, http://mp3licensing.com/about/thm.html (last visited Sept. 13, 2010).
enced by this methodology, the jury arrived at total damages of $1.5 billion.101

A key problem with such an approach to calculating damages is that it attributed the royalty to the entire market value of the computer rather than apportioning the royalty to account for the value contributed by the MP3 patents at issue. The notion that royalty calculations should be apportioned to account for the value of the patents is not novel and, indeed, the district court judge identified the failure to do so as a basis for a new trial to quantify damages. The court said:

Two major problems arise in applying the entire market value rule here. The first is the failure of the evidence to establish a link between the cost of the computers (rather than the operating system, Windows Media Player, the MP3 codec or some other “unit”) and the customer demand or value of the patented technology. The second and probably even more troublesome problem is the failure to establish that the patented features themselves produced any customer demand or value of the product.102

It is evident that the initial jury award of damages made no sense. At least thirty-six patents are claimed to be essential to the MP3 standard. Assuming that each patent should earn the same 0.5 percent royalty accepted by the jury in the Lucent MP3 case, the total royalty if applied to the value of the computer would be at least 18 percent of its selling price. For a $1000 computer, this is comparable to the retail price of the entire Windows operating system. On its face, this result assigns too much value to the MP3 technology, given all of the other functionality of the Windows operating system.

Damage awards like the jury award in the Lucent case have important incentive effects both for investments in research and development and for patent pooling. Damage awards give correct incentives for R&D if they correspond to the incremental value added by innovations that result from R&D effort. Damage awards that are excessive as measured against this benchmark may energize efforts to patent new technologies, but they also increase costs to technology users, which can make it more difficult for those users to develop and commercialize their innovations.

When a large number of patents are essential to make or use a product, one starting point for the assessment of a reasonable royalty is the

101 Lucent, 509 F. Supp. 2d at 982 (“The jury awarded $769 million for infringement on each patent. According to the Special Verdict Form, it used a 0.5% royalty rate.”).

102 Id. at 935. A codec is “[a] device that performs encoding and decoding of communications protocols.” DICTIONARY OF COMPUTER SCIENCE, ENGINEERING AND TECHNOLOGY 82 (Philip A. Laplante ed., 2001).
share of royalty income that the patents would command if licensed by a patent pool that included all essential patents. Suppose 100 patents are essential to make or use a product, the patents have no alternative uses, and the profit-maximizing royalty for a pool that includes all 100 patents is $10 per unit. Then each patent should command a royalty of $0.10 per unit. I call this approach the “patent pool rule of thumb” for estimating reasonable royalties for essential patents.

I emphasize that this rule of thumb is only a starting point. In particular, patents can differ in value even if they are all essential for a particular application because the patents can have alternative uses in other applications and differ in other dimensions, such as the probability that the patent is valid and infringed. For example, suppose that two of the 100 patents that are essential for one application with a value of $10 per unit net of other inputs can be licensed for use in an alternative application for which the profit maximizing royalty is $5 per unit. The applications are mutually exclusive: the patentees cannot license both applications. The other ninety-eight patents have no alternative use. In this case, the two patents taken together should earn a royalty of at least $5 per unit, since that is what they could command in the alternative use. The other ninety-eight patents would share the remaining product value, net of other inputs, and would earn far lower royalties.

Application of the patent pool rule of thumb may generate a wide range of plausible values for reasonable royalties in patent infringement cases because patents often have alternative uses and differ in other relevant dimensions. Furthermore, the calculation of the profit-maximizing royalty for a patent pool is a complex exercise that should consider the value added to a product by all other inputs, reputation and brand value, and intellectual capital. Patent values generated by the patent pool rule of thumb contrast sharply with estimates of reasonable royalties based on a hypothetical market negotiation with an independent licensor. The latter may employ a convention, such as the 0.5 percent royalty rate applied to the entire product value accepted by the jury in the Lucent MP3 litigation. Such a royalty rate is plausible in a hypothetical negotiation if the patentee has a credible threat of an injunction or otherwise has significant bargaining power as the owner of an essential patent. However, a high royalty for an individual patent is not necessarily indicative of the economic value of the patent when it is only one of many patents that are essential to make or use a product.

The patent pool rule of thumb is not a perfect answer to the complex question of assessing reasonable royalties for a patent when the patent is only one of many sources of value. Nevertheless, it is a starting point that, with qualifications to allow for differences in the alternative uses of
patented technologies, is likely to provide estimates of patent values that align more closely with their contribution to innovation.\textsuperscript{103}

E. Compulsory Licensing and Involuntary Patent Pools

Compulsory licensing is fundamentally the substitution of a liability right for a property right. The property right inherent in a patent is the right to exclude access to the intellectual property or to allow access on negotiated terms. A liability right offers no right to exclude, but only a right to demand compensation for access.

U.S. copyright law specifically enables compulsory licensing in some discrete situations, such as works for use by public broadcasting entities and retransmission by cable and satellite systems.\textsuperscript{104} Patent owners, however, generally have no obligation to license their patents and instances of compulsory licensing have been rare. When compulsory licensing has occurred, the justification usually has been for reasons related to national security or public health.\textsuperscript{105} An exception is in the area of antitrust enforcement, where patent owners have consented on several occasions to license their patents to alleviate competition concerns.\textsuperscript{106}

While compulsory licensing of intellectual property—including patents—has the potential to promote competition and stimulate innovation, and some studies suggest that these benefits have been realized in certain instances of compulsory licensing decrees,\textsuperscript{107} compulsory licens-

\textsuperscript{103} See Gilbert & Katz, supra note 70, at 24–32 (Patent awards that correspond to a patentee’s bargaining power with a credible injunction threat are unlikely to provide efficient signals for investment in R&D compared to awards that correspond to a patentee’s share of essential patents multiplied by the value of the technology).

\textsuperscript{104} See, e.g., Thomas F. Cotter, Fair Use and Copyright Overenforcement, 93 IOWA L. REV. 1271, 1279 (2008).


ing is a clumsy and heavy-handed approach to clear patent thickets. It is very difficult to design royalties that strike an appropriate balance between promoting the utilization of technology covered by the licensed intellectual property and providing adequate incentives for innovation. In most circumstances, voluntary collective rights organizations are a superior alternative to compulsory licensing for patents, if only because the owners of patents are likely to have better information about patent values than would an agency charged with designing the terms of a compulsory license.

Nonetheless, the threat of compulsory licensing has been an effective stick to force firms to pool their patents as a way to break open patent logjams. The U.S. government used the threat of compulsory licensing to compel the pioneers of the aircraft industry to form a patent pool in 1917. The industry was enmeshed in litigation over the scope and validity of patents, and some patentees, particularly the Wright-Martin Company, were demanding royalties that the government and other aircraft manufacturers deemed excessive. Creation of the Manufacturers Aircraft Association patent pool resolved the litigation chaos.

The government negotiated a portfolio license from the pool with a royalty of $200 per aircraft, which was a fraction of the royalty that Wright-Martin was demanding for a single patent ($1,000 per aircraft). This suggests that the government was doing more than just reducing the cost of inefficient pricing of complementary patents and instead may have been exerting its considerable market power as both an industry regulator and a purchaser of aircraft and related equipment.

The government also had strategic motivations when it urged General Electric to buy out the U.S. branch of Marconi, a foreign pioneer of


109 See Merges, *supra* note 11 (arguing that collective rights organizations are superior to compulsory licensing because they are more likely to set efficient prices and less susceptible to lobbying); Robert P. Merges, *Compulsory Licensing vs. the Three “Golden Oldies”: Property Rights, Contracts, and Markets* (Cato Inst. Pol’y Analysis, No. 508, 2004), http://www.cato.org/pub_display.php?pub_id=1366.

110 See Bittlingmayer, *supra* note 12, at 232 (discussion of the Aircraft Manufacturers Association); see also Merges & Nelson, *supra* note 3, at 909 (In some cases, “patent logjams have been broken only with the powerful force of government intervention.”).


radio technology, and pool patents from Marconi, AT&T, Telefunken, and Westinghouse into what became in 1919 the Radio Corporation of America (RCA). A purpose of this patent pool was to exclude foreign manufacturers and operators from a technology of strategic importance. In engineering the RCA pool, the government also condoned an allocation of patent rights in which GE, RCA, and Westinghouse acquired rights to the pool patents to develop wireless communication technologies, while AT&T and its manufacturing subsidiary, Western Electric, focused on wired communications, with little interference between the two groups.  

The government negotiated a consent decree in 1932 that dissolved the RCA pool. In 1972 the U.S. government intervened to break up the Manufacturers Aircraft Association, which by that time had grown to encompass virtually the entire aircraft industry. The government complained that the pool hindered innovation by forcing manufacturers to cross-license any innovations to each other at low royalties.

In summary, the option of a compulsory patent pool is advantageous as a last resort to resolve instances in which the development of an industry is threatened by refusals to license patents. Fortunately, such instances are rare. In the few instances where the government has pursued compulsory patent pools, its objectives were not limited to reducing transaction costs and royalty stacking but also included broader strategic concerns. Policies that increase the incentives for patentees to pool their patents by making membership in a patent pool more profitable relative to independent licensing are much more attractive options to lower the costs of licensing and hasten the development of new technologies.

IV. CONCLUSION

Over time, antitrust authorities have refined their views of patent pools and have concluded that they promote competition under some circumstances. In business reviews and policy statements the agencies have spoken approvingly of pools that are limited to patents that are

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114 Id. at 899; see also Merges & Nelson, supra note 3, at 892.

115 See Bittlingmayer, supra note 12, at 227-28.

116 In the field of biotechnology, various studies have shown that a combination of widespread cross-licensing and informal arrangements that deter infringement actions have allowed this industry to develop without major impediments from a dense thicket of intellectual property rights. See Claude Barfield & John E. Calfee, Biotechnology and the Patent System: Balancing Innovation and Property Rights 36–55 (2007).
valid and essential to practice a technology, that allow patents to be li-
censed individually as well as in a package, and that do not impose re-
strictive license terms. These are desirable characteristics. However,
agency guidance has largely overlooked the important question of how
to create incentives for patentees to form and maintain beneficial pools.

Antitrust authorities can promote the creation and stability of benefi-
cial patent pools by allowing the pool to charge high royalties and im-
pose restrictive licensing terms, provided that the terms are no more
restrictive than would be imposed by a single licensor and the pool does
not otherwise foreclose competition that would occur in the absence of
the pool’s licenses. Apportioning damages for patent infringement,
which involves imputing a patent’s contribution to product value taking
into account other inputs, would promote pooling of complementary
patents by reducing the ability of an independent licensor to obtain a
disproportionate share of the value of the patents that cover a technol-
gy. Antitrust authorities also should allow pools to adopt creative gov-
ernance rules that make the pool less susceptible to defection and better
able to attract a critical mass of complementary patents. One example is
an agreement to dissolve the pool if membership falls below a threshold
level. This self-destruct mechanism can be a threat to keep patentees in
the pool, as dissolution of the pool could make all patentees worse off.

The tensions between the benefits of pooling and the incentives for
independent licensing are powerful. No one policy will provide the glue
necessary to make pooling of complementary patents an equilibrium
outcome for most industries. Instead, antitrust authorities and the
courts should encourage policies that promote the formation and dura-
bility of beneficial pools that combine complementary patents, while
working to prevent and limit pools that are potentially anticompetitive
because they combine patents that are substitutes for each other or oth-
erwise harm competition.
APPENDIX
CHOOSING ROYALTIES TO PROMOTE PATENT POOLING WITH LINEAR PRODUCT DEMAND

Suppose that \(i = 1, \ldots, N\) patents are essential to make or use a product, each of which is owned by a separate firm. Let \(r_i\) be the per-unit royalty for patent \(i\) and let

\[
R = \sum_{i=1}^{N} r_i
\]

be the total royalty for the \(N\) essential patents. As a simplification, assume there are no costs of licensing or supplying the downstream product. The demand for the product, and therefore the demand for patent licenses, is a linear function of the total royalty: \(Q = A - bR\).

The \(N\) patentees may choose to form a patent pool. The pool would charge a per-unit royalty \(R^N\) for a license to its patent portfolio and share royalty income equally with its members. As a member of the patent pool each patentee would earn (ignoring the transaction costs of licensing)

\[
\pi = \frac{1}{N} R^N Q(R^N) = \frac{1}{N} [R^N(A - bR^N)]. \tag{A.1}
\]

The pool’s profit-maximizing royalty, if the pool ignores the risk that one or more of its members may defect or not join the pool in the first place, is

\[
R^* = \frac{A}{2b}. \tag{A.2}
\]

Let \(r_j\) be the royalty charged by patentee \(j\) as an independent licensor. The independent licensor faces demand \(Q = A - b(R^N + r_j)\) when the other patentees remain in the pool and charge a portfolio royalty \(R^N\). Its profit as an independent licensor is

\[
\pi_j = r_j Q(R^N + r_j) = r_j [A - b(R^N + r_j)],
\]

which it maximizes with a royalty

\[
\hat{r}_j = \frac{A - bR^N}{2b}.
\]

As an independent licensor, a patentee would earn

\[
\pi_j = \frac{1}{b} \left[ \frac{A - bR^N}{2} \right]^2. \tag{A.3}
\]
A necessary and sufficient condition for the pool to be stable is that each member of the pool must earn at least as much as it could earn if it left the pool and licensed its patent independently. Comparing equations (A.1) and (A.3), this requires that the pool choose a total royalty that is at least as large as a “limit royalty” equal to

\[ R^N_L = \frac{NA}{b(N+4)}. \]  

The threat that a member of the pool may defect or not join the pool in the first place is not a constraint on the pool’s choice of a royalty if the pool is sufficiently small. This follows by comparing the limit royalty in equation (A.4) with the pool’s unconstrained profit-maximizing royalty given by equation (A.2). The pool’s profit-maximizing royalty is greater than the limit royalty if \( N \) is less than or equal to four.

The pool’s royalty acts as a tax on the profits that a patentee can earn as an independent licensor. The larger the royalty, the smaller are the profits that are available for a patentee that chooses to leave the pool or not join the pool in the first place. If the number of essential patents is large, the pool may have to set a very high royalty to make independent licensing an unprofitable choice. This is illustrated in Figure A.1, which assumes \( A=10 \) and \( b=1 \). The limit royalty can be more than 50 percent higher than the pool’s unconstrained profit-maximizing royalty if the number of essential patents exceeds ten. For comparison, Figure A.1 also shows the total royalty when all \( N \) patentees act as independent licensors. This royalty is significantly higher than the limit royalty as a consequence of the Cournot complements (royalty stacking) effect.

This analysis assumes that the pool can commit to a royalty for its patent portfolio. Alternatively, independent licensing may trigger a new competition in which the pool and the independent licensor choose royalty levels that maximize their profits. This could make independent licensing even more attractive, as the pool may choose a lower royalty to maximize its profits, leaving more profit available to the patentee that defects from the pool. Commitment is key to the stability of the pool, although high transaction costs or other costs associated with independent licensing would make the pool more stable by lowering the critical royalty level (the limit royalty) necessary to maintain the integrity of the pool.