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The Essentiality Test for Patent Pools

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### Publication Date

2009-09-01

## The Essentiality Test for Patent Pools

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### I. Introduction

Antitrust policy for the pooling of patents and other intellectual property rights has undergone a dramatic transformation since the first cases were decided at the beginning of the twentieth century. This transformation generally reflects developments in economics that provide a better understanding of the characteristics of patent pools that warrant antitrust scrutiny. The change, however, was slow, and the U.S. antitrust agencies did not clarify their enforcement principles with respect to patent pools until the publication by the Department of Justice and the Federal Trade Commission of *Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition*, released in April 2007 (“IP Report”).<sup>1</sup>

The DOJ/FTC IP Report concludes that a patent pool is unlikely to raise antitrust concerns if:

- The pool is limited to patents that are essential to implement the standard,
- The pool grants non-exclusive licenses that do not prevent licensees from developing alternative technologies,
- Patentees grant non-exclusive licenses to the pool and retain the right to license their patents separately outside the pool, and
- Licensees are required to grant back nonexclusive licenses to use patents they hold that are essential to comply with the technology.

The definition of an essential patent can take different meanings. A patent may be technically necessary to produce a DVD, while another patent may be necessary only to produce

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<sup>1</sup> U.S. DEP’T OF JUSTICE & FED. TRADE COMM’N, ANTITRUST ENFORCEMENT AND INTELLECTUAL PROPERTY RIGHTS: PROMOTING INNOVATION AND COMPETITION (2007), *available at* <http://www.ftc.gov/reports/innovation/P040101PromotingInnovationandCompetitionrpt0704.pdf>.

a DVD that displays subtitles. A patent may not be technically essential because it has alternatives, but the alternatives may be so inferior as to render them very distant substitutes.

Patents that are technically essential or that have no close substitutes are complements to implement a standard or to make or use a product that employs the patented technology. Economic theory implies that pooling complementary patents and licensing the patents by a single entity is pro-competitive relative to individual licensing. With individual licensing there is the risk of inefficiently high total royalties if the patentees charge running royalties, because each patentee would ignore the effect of its royalty on the demand for other patents necessary to implement the technology. A single entity that licensed all of the patents would internalize this effect and have an incentive to charge a lower total royalty for the pooled patents than the sum of all the royalties charged by individual licensees.<sup>2</sup> Furthermore, if individual patentees fail to coordinate their licensing, this could delay the implementation of the technology. A single licensing entity has an incentive to coordinate the pooled licenses and would minimize licensing delays. Pooling the patents also reduces the transaction costs of negotiating licenses.

Much of the effort on the part of patent pools to comply with DOJ and FTC enforcement principles has gone into ascertaining whether the pool is limited to patents that are essential to use the licensed technology or implement a standard. For example, in its 1997 Business Review Letter for the proposed MPEG-2 patent pool,<sup>3</sup> the DOJ took comfort in the fact that “The Portfolio combines patents that an independent expert has determined to be essential to compliance with the MPEG-2 standard; there is no technical alternative to any of the Portfolio patents within the standard.” Furthermore, the DOJ noted approvingly that the pool would be limited to “technically essential patents, as opposed to merely advantageous ones,” and that an independent expert would play a continuing role to ensure that the pool is limited to patents that are technically necessary to implement the standard.<sup>4</sup>

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<sup>2</sup> This is an example of the Cournot complements problem. See AUGUSTIN COURNOT, RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH (1929). Applications to patent pooling are in Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting*, in INNOVATION POLICY AND THE ECONOMY (Adam B. Jaffe, Josh Lerner, and Scott Stern eds. 2001), and Richard Gilbert, *Antitrust for Patent Pools: A Century of Policy Evolution*, 2004 STAN. TECH. L. REV. 3 (2004).

<sup>3</sup> MPEG-2 is a standard for the compression of digital data and is used in many products and services, including cable, satellite and broadcast television, digital video disks, and telecommunications. See Business Review Letter from Joel I. Klein, Assistant Att’y Gen., U.S. Dep’t of Justice, to Garrard R. Beeney, Esq. (June 26, 1997), available at <http://www.usdoj.gov/atr/public/busreview/215742.pdf>.

<sup>4</sup> Ibid.

The DOJ considered a more expansive definition of essential patents in its 1998 and 1999 Business Review Letters for two patent pools related to the DVD-ROM and DVD-video formats.<sup>5</sup> The first DVD pool involved three licensors and is sometimes called the 3C DVD pool.<sup>6</sup> The second involved six licensors and is sometimes called the 6C DVD pool.<sup>7</sup> The 3C DVD pool broadened the concept of essentiality to encompass patents that are economically unfeasible as well as patents that are technically essential because they are inevitably infringed by compliance with the specifications.<sup>8</sup> The 6C DVD pool considers a patent to be essential if it is “necessarily infringed” or if there is “no realistic alternative” to it.<sup>9</sup>

The DOJ remarked that these definitions of essential patents are broader than the definition of “technically essential” that applied to the MPEG-2 patent pool and noted that they raise competition issues.<sup>10</sup> In particular, the DOJ expressed concern that the pool could be a price-fixing mechanism if it includes patents that are substitutes for each other.<sup>11</sup> The DOJ also noted that the pool might foreclose competing patents if it includes a patent with a substitute but excludes the substitute. Manufacturers might choose not to license a competing patent that is outside the pool because the pool would offer a package license that includes one of the substitute patents. The DOJ ultimately concluded that the broader definitions of essential patents offered reasonable protections against anticompetitive outcomes.<sup>12</sup>

A 2008 DOJ Business Review Letter related to a standard for ultra high frequency radio frequency identification (UHF RFID) affirmed the DOJ’s perspective on the types of patents in patent pools that do not raise antitrust concerns.<sup>13</sup> The DOJ noted approvingly that the RFID

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<sup>5</sup> DVD stands for digital versatile disc.

<sup>6</sup> See Business Review Letter from Joel I. Klein, Assistant Att’y Gen., U.S. Dep’t of Justice, to Garrard R. Beene, Esq. (December 16, 1998), *available at* <http://www.usdoj.gov/atr/public/busreview/2121.pdf>.

<sup>7</sup> See Business Review Letter from Joel I. Klein, Assistant Att’y Gen., U.S. Dep’t of Justice, to Carey R. Ramos, Esq. (June 10, 1999), *available at* <http://www.usdoj.gov/atr/public/busreview/2485.pdf>.

<sup>8</sup> See Business Review Letter (December 16, 1998), n. 6 above.

<sup>9</sup> DVD6C LICENSING GROUP, PATENT LIST (2009), <http://www.dvd6cla.com/list.html>, (last visited August 6, 2009).

<sup>10</sup> Business Review Letter (December 16, 1998), n. 6 above (“[t]he definition of ‘necessary (as a practical matter)’ that the expert will be employing is sufficiently clear and demanding that the portfolio is unlikely to contain patents for which there are economically viable substitutes.”).

<sup>11</sup> See *ibid.*

<sup>12</sup> Business Review Letter (June 10, 1999), n. 7 above (“So long as the patent expert applies this criterion scrupulously and independently, it is reasonable to expect that the Portfolio will combine only complementary patent rights, and not limit competition between them and other patent rights for purposes of the licensed applications.”).

<sup>13</sup> See Business Review Letter from Thomas O. Barnett, Assistant Att’y Gen., U.S. Dep’t of Justice, to William F. Dolan and Geoffrey Oliver (October 21, 2008), *available at* <http://www.usdoj.gov/atr/public/busreview/238429.pdf>.

Consortium, which licenses patents to implement the Generation-2 standard for UHF RFID devices, would limit the pool to essential patents and would exclude from the pool any patents that are found to be invalid. The definition of an essential patent used by the UHF RFID pool is one that is “necessarily essential to the standard (i.e., inevitably infringed by compliance with the [Gen-2] 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 required to manufacture a competitive product compliant with the standard, due to production or design costs, consumer preferences, or other reasons . . . .”<sup>14</sup>

The 3G Patent Platform for Third Generation Mobile Communication Systems presented different antitrust issues for patent pools.<sup>15</sup> The 3G Patent Platform refers to the International Mobile Telephony-2000 project, which includes five different radio interface technologies (“platforms”) for use in third generation digital wireless telecommunications systems for voice and data that are approved by the International Telecommunication Union. The 3G Patent Platform is actually five independent platform companies, each with its own licensing administrator, although the 3G Patent Platform will provide some administrative and educational services that are relevant for all of the five platforms.

The DOJ Business Review Letter for the 3G Patent Platform did not object to an arrangement in which each Platform Company limited patents to those that are technically essential to comply with the individual platform standard. Each Platform Company has sole responsibility for all licensing and pricing with respect to its own 3G technology. In this respect, the 3G Patent Platform is similar to five separate patent pools.

By coordinating the activities of five potentially competitive platforms, the 3G Patent Platform raises the possibility of higher royalties than would occur if all negotiations were done with fully separate entities for each platform. The 3G Patent Platform restricts the scope for coordination in the setting of royalties by limiting the role of the larger pool to suggesting standardized license agreements without price terms for use at the discretion of the separate Platform Companies, but the arrangement does not entirely eliminate the possibility of coordinated royalties. The DOJ concluded that “We believe that the Platform arrangements have been reasonably structured to preserve the efficiency-enhancing integration of the identification

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<sup>14</sup> Ibid.

<sup>15</sup> Business Review Letter from Charles A. James, Assistant Att’y Gen., U.S. Dep’t of Justice, to Ky P. Ewing, Esq. (November 12, 2002), *available at* <http://www.usdoj.gov/atr/public/busreview/200455.pdf>.

and evaluation functions, without foreclosing competition in the critical aspects of the licensing and royalty-setting process by ensuring that these functions remain separate for each of the five technologies.”<sup>16</sup>

These DOJ Business Review Letters and the conclusions in the IP Report set out the policies of the enforcement agencies with respect to the types of intellectual property that can be licensed by a patent pool without raising antitrust concerns. Similar antitrust concerns apply in some circumstances to cross-licensing arrangements.<sup>17</sup> The statement of enforcement policies is a considerable advance relative to the history of antitrust decisions for patent pools, which I briefly review in Section II. Section III considers the theoretical underpinnings of the benefits and competitive risks of including different types of intellectual property in patent pools.

Section IV makes the argument that under some circumstances the risk of excluding patents from a pool that may prove to be essential is greater than the risk of including patents that are not essential. Over-inclusion does not harm competition provided that: (i) the pool includes at least one valid essential patent and (ii) licensees are free to license the intellectual property they need to produce a product or implement a standard through independent negotiations with other rights holders. The risk of under-inclusion is that a pool may exclude a patent that is essential to implement a standard. Inclusion of patents in a pool that are not essential to produce a product or implement a standard does not harm competition if the pool contains at least one valid and essential patent and patentees are free to engage in independent licensing negotiations. A potentially greater concern is that owners of essential patents may be unwilling to join a patent pool that includes many non-essential patents. The presence of these non-essential patents would dilute their licensing revenues if royalty income were allocated in proportion to patents owned. In that case, owners of essential patents may prefer to license their patents independently, which would negate the pro-competitive benefits from the pool.

## **II. A brief history of patent pools**

Antitrust law has had a tortured history of enforcement decisions for patent pooling arrangements. In the early years of patents and antitrust, the view was that patentees had unbridled rights to assign, exchange, or combine their intellectual property rights. Courts soon

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<sup>16</sup> Ibid.

<sup>17</sup> Cross-licensing arrangements differ from patent pools in that the former do not provide for centralized licensing of the patents involved in the cross-license.

recognized that patents were not exempt from the antitrust laws. However, it was not until recently that the courts' analyses of patent pooling and cross-licensing arrangements approached the intellectual rigor expressed in advisory opinions by the DOJ and FTC, as summarized in their IP Report.<sup>18</sup>

**A. Intellectual Property Reigns Supreme: *E. Bement & Sons v. National Harrow Co.***

An early Supreme Court case on patent pooling is *E. Bement & Sons v. National Harrow Co.*, decided in 1902.<sup>19</sup> After suing each other for patent infringement, six different firms assigned eighty-five patents dealing with float spring tooth harrows to National Harrow.<sup>20</sup> Bement was a licensee. The pool grew to twenty-two firms accounting for over ninety percent of all manufacturing and sales of float spring tooth harrows in the United States.<sup>21</sup> Each firm was required to adhere to uniform price schedules for the sale of all products manufactured under the National Harrow license. The pool set uniform license terms that fixed prices for licensed products, required that licensees make or sell only the licensed products, and obligated licensees not to challenge the patents and to defend the patents if challenged by others.<sup>22</sup>

The Supreme Court did not engage in a detailed analysis of the antitrust implications of the National Harrow pool. In particular, the Court did not inquire as to whether the patents included in the pool were actually blocking or perhaps covered technologies that were substitutes for each other.<sup>23</sup> The Court held that the licensing terms were lawful, even though they fixed prices for licensed products and prohibited the manufacture or sale of unlicensed products. The Court reasoned that the pool was legal because:

[T]he general rule is absolute freedom in the use or sale of rights under the patent laws of the United States. The very object of these laws is monopoly, and the rule is, with few exceptions, that any conditions which are not in their very nature illegal with regard to this kind of property, imposed by the patentee and agreed to

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<sup>18</sup> See IP Report, n. 1 above.

<sup>19</sup> 186 U.S. 70 (1902).

<sup>20</sup> A harrow is an agricultural device for spreading crop residue on fields, usually before planting.

<sup>21</sup> See Willard Tom, Deputy Director, Bureau of Competition, Fed. Trade Comm'n, Licensing and Antitrust: Common Goals and Uncommon Problems, Address Before the American Conference Institute, Ninth National Conference on Licensing Intellectual Property (Oct. 12, 1998), *available at* <http://www.ftc.gov/speeches/other/aciipub.htm>.

<sup>22</sup> See *ibid.*

<sup>23</sup> See *National Harrow*, 186 U.S. 70. Blocking patents have overlapping claims such that the invention claimed in one patent cannot be practiced without infringing the claims of the other patent, and *visa versa*.

by the licensee for the right to manufacture or use or sell the article, will be upheld by the courts. The fact that the conditions in the contracts keep up the monopoly or fix prices does not render them illegal.<sup>24</sup>

The themes expressed by the Court in *National Harrow* are that: (1) patent laws trump antitrust laws; (2) pooling arrangements confer benefits by avoiding costly litigation over patent scope and validity; and (3) licensing terms that fix prices are not unlawful because patentees have the right to specify the prices at which their products are sold. The potential harm to competition from arrangements such as the *National Harrow* pool is clear. Fortunately, the Supreme Court did not adhere for long to the principles enunciated in *National Harrow*, although the Court continued to struggle with the concept of whether patents are substitutes or complements for each other.

#### **B. The Dawn of Antitrust for Patent Pools: *Standard Sanitary Manufacturing v. U.S.***

Ten years after the *National Harrow* decision, the Supreme Court did an about-face in *Standard Sanitary Manufacturing v. U.S.*, upholding the breakup of a joint licensing arrangement for patents relating to an enameling process for sanitary ironware.<sup>25</sup> The licensing arrangements established a standard royalty for the licensed patents and prohibited the marketing of products of inferior quality manufactured using the licensed patents.

As in *National Harrow*, the Court did not explicitly consider whether the patents involved in the Standard Sanitary licensing arrangement were blocking, complementary, or substitutes for each other. Interestingly, the Court did suggest that the licensing arrangement eliminated blocking positions. In this respect the arrangement was potentially pro-competitive, yet this fact received essentially no weight in the Court's antitrust evaluation.<sup>26</sup>

#### **C. Efficiencies Defense for Patent Pools: Complementary Patent Rights**

Two decades later, the Supreme Court specifically addressed the issue of blocking patents in its review of *Standard Oil Co. v. United States*.<sup>27</sup> In this case the Court reversed a district court finding that Standard Oil of Indiana and others had created an illegal patent pool to combine patents related to gasoline cracking, a key process in the refining of crude oil into

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<sup>24</sup> 186 U.S. at 91.

<sup>25</sup> 226 U.S. 20 (1912).

<sup>26</sup> *Ibid.*

<sup>27</sup> *Standard Oil Co. (Indiana) v. United States*, 33 F.2d 617 (D. Ill. 1929), *rev'd*, 283 U.S. 163 (1931).



gasoline.<sup>28</sup> The analysis focused on whether the cross-licensing of blocking patents violated the antitrust laws.

The Court found that the licensing agreement in *Standard Oil* contained none of the terms held to violate the antitrust laws in *Standard Sanitary*. In particular, the licensing terms did not restrict the freedom of the defendants individually to issue licenses under their own patents and did not impose any restrictions upon the quantity of gasoline to be produced or upon the price, terms, or conditions of sale, or upon the territory in which sales might be made. “The only restraint thus charged is that necessarily arising out of the making and effect of the provisions for cross-licensing and for division of royalties.”<sup>29</sup>

The Court concluded that none of the patents involved in the pool was fundamental, but that each of the defendants had developed a cracking technology that arguably infringed other defendants’ patents.<sup>30</sup> Most of the patents in the *Standard Oil* pooling arrangement were improvements upon other inventions. The basic inventions could block the use of the improvements, but the improvements did not prevent the use of the basic inventions.

#### **D. Fixing Royalties v. Fixing Product Prices**

The Supreme Court emphasized the benefits of cross-licensing of complementary patents in the *Standard Oil* pooling arrangement. Yet the Court did not perform a detailed evaluation of whether the patents in the pool were actually blocking or complementary, or whether some might have been substitutes for each other. Instead, the Court took comfort in the observation that the pool did not fix product prices or limit the use of non-licensed technologies.<sup>31</sup>

The Supreme Court returned to the issue of cross-licenses involving patents that potentially block improvements in *United States v. Line Material Co.*<sup>32</sup> The Southern States Equipment Corporation held a patent on a particular type of electric circuit protection device. Line Material held a patent that improved on the patented technology owned by Southern. The Court recognized that a cross-license between Southern and Line Material would be necessary for either company to exploit the technology inherent in both patents.

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<sup>28</sup> 283 U.S. 163.

<sup>29</sup> 283 U.S. at 170.

<sup>30</sup> 283 U.S. at 174–76.

<sup>31</sup> 283 U.S. at 176–77.

<sup>32</sup> 333 U.S. 287 (1948).

Southern and Line Material entered into a cross-licensing agreement whereby Southern made Line Material the exclusive licensor of Southern's patent. The agreement gave Line Material the power to fix prices for devices that embodied both patents. The Court held that this power to fix prices under both patents was anticompetitive. The Court emphasized that cross-licensing to promote efficient production is not by itself unlawful, thereby confirming the conclusion that it reached in the *Standard Oil* case. "There is nothing unlawful in the requirement that a licensee should pay a royalty to compensate the patentee for the invention and the use of the patent. The unlawful element is the use of the control that such cross-licensing gives to fix prices."<sup>33</sup>

The key distinction between *Standard Oil* and *Line Material* is that the cross-licensing arrangements in the former did not explicitly fix prices for gasoline made with the licensed technology, although the *Standard Oil* cross-licenses did specify royalties, which of course have an impact on product prices.

#### **E. General Observations on Legal Opinions for Patent Pools**

A key issue emphasized in the DOJ/FTC IP Report is whether a patent pool or cross-licensing arrangement involves patents that are substitutes or complements for each other.<sup>34</sup> Two patents are complements if they are each essential to practice a technology, or if a license to use one of the patents increases the value of a license to use the other patent. The first case involves two-way blocking patents, because each patent can block the use of the other patent. The second case involves one-way blocking patents, because one of the patents can block an improvement made possible using the other patent.

In most of the twenty antitrust decisions involving patent pools that I reviewed, spanning the period from 1902, when *National Harrow* was decided, to the present, the question whether patents were substitutes or complements was not the major determinant of enforcement outcomes.<sup>35</sup> Table 1 below summarizes the enforcement outcomes. Of the twenty cases, eight clearly involved patents that were complementary in that they were either essential to practice a technology or were in a one-way blocking relationship. In the other twelve cases, the patents either clearly were not complements or the court's decision gave no indication of evidence that

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<sup>33</sup> 333 U.S. at 315.

<sup>34</sup> See IP Report, n. 1 above.

<sup>35</sup> See Gilbert, n. 2 above.

the patents were substitutes or complements. In the first group of eight cases, 38 percent of the arrangements were held to be unlawful. In the second group of twelve cases, 42 percent were held to be unlawful. The difference is not statistically significant.

Table 1. Summary of enforcement outcomes

Did the arrangement include patents that were two-way or one-way blocking?	Number of arrangements	Number held to be anticompetitive	Percent
Yes	8	3	38%
No (or not known)	12	5	42%

Anticompetitive effects from patent pools and cross-licensing arrangement can stem from several sources. These include the competitive relationships of the patents in the arrangement; the competitive relationships of products sold by participants in the arrangement; the presence of vertical restrictions in licensing terms or other ancillary restraints that affect competition related to the patented products or processes; and agreements not to challenge the patents or to cooperate in the defense of the patents.

For twenty pooling and cross-licensing arrangements, the most important determinant of a verdict that the arrangement was unlawful was the presence of licensing terms that fixed prices or divided markets for downstream products.<sup>36</sup> Clearly, a patent pool might be no more than a subterfuge for competitors to join together and fix product prices or divide markets. This presumes, however, that members in the pool could compete with each other if they did not have licenses to the patents held by the other pool members. If patents are valid and blocking, such competition is not possible, and in this case the agreements among the pool members does not prevent competition that could occur in the absence of the pool. Analysis of the antitrust risk posed by a patent pooling arrangement should look first to whether the patents involved in the arrangement are substitutes or complements. While courts have become more aware over time of the importance of addressing whether patents are substitutes or complements, this is an exercise that has often been overlooked.

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<sup>36</sup> See *ibid.*

### III. Theoretical Considerations

Patent pools are procompetitive when they combine valid intellectual property rights that are complementary and do not impose licensing terms that restrict downstream competition. IP rights are complementary if they are essential to use a technology or if they increase the value of other intellectual property.

#### A. Essential Patents

Economic theory supports the conclusion that pooling of valid and essential patents is procompetitive absent licensing terms that restrict downstream competition. Suppose  $N$  patents are essential to practice a technology. Demand for the technology depends on its price, which in turn depends on the total royalties charged for use of all of the patents. Furthermore, suppose royalties are charged on a per-unit basis based on sales (running royalties). Let  $R$  be the total royalty for all  $N$  patents, and  $r_i$  the royalty rate for the  $i^{\text{th}}$  patent. The total royalty required to practice a technology for which the  $N$  patents are essential is the sum of all of the individual

royalties:  $R = \sum_{i=1}^N r_i$ . As an illustration, suppose that the demand for the licensed technology is a

linear function of the total royalty,  $D(R) = A - bR$ , and licensing incurs no marginal cost. The total revenue that a pool would earn by licensing the  $N$  essential technologies is  $R \cdot D(R)$ . The total royalty that would maximize the pool's revenue is the monopoly price,  $R^m = \frac{A}{2b}$ .<sup>37</sup>

Acting independently, each of the  $N$  patentees would choose a royalty  $r_i$  to maximize its own licensing revenue:  $r_i \cdot D(R)$ . Let  $R_{-i}$  be the sum of the royalties charged by all of the  $N-1$  other technology rights holders other than  $i$ . The demand for a license from the  $i^{\text{th}}$  patentee is the residual demand  $A - b(R_{-i} + r_i)$ , which takes into account the royalties charged by the other rights holders. If the licensor believes that its royalty rate has no effect on the royalties charged by the

$N-1$  other rights holders, then its profit-maximizing royalty is  $r_i^* = \frac{A - bR_{-i}}{2b}$ . This is the

monopoly price for its residual demand. The patentees are identical, so the profit-maximizing

royalty  $r_i^*$  is the same for all patentees ( $r^*$ ) and  $R_{-i} = (N-1)r^*$ . Consequently,  $r^* = \frac{A}{(N+1)b}$ , and

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<sup>37</sup> See, e.g., DENNIS CARLTON & JEFF PERLOFF, MODERN INDUSTRIAL ORGANIZATION (1999).

the total royalty required to license all of the  $N$  complementary technologies is

$$R^* = Nr^* = \frac{NA}{(N+1)b}.^{38}$$

Observe that for  $N > 1$ , the total royalty with independent licensing exceeds the pooled royalty, and the difference increases with  $N$ . As  $N$  becomes large, the total royalty approaches the value that eliminates all demand for the technology. These results are in part a consequence of the assumption of per-unit running royalties.<sup>39</sup> However, even with fixed fees for the licensed technologies, independent licensing can cause coordination difficulties that can lead to failures to obtain all of the licenses necessary to use the technology.

This example is a special case of the “double monopoly” or “double marginalization” problem encountered when manufacturers and distributors each add a markup to a good. A manufacturer and a distributor are in a complementary relationship that is similar to the relationship of licensors of essential patents. Acting independently, each patentee ignores the effect of its royalty on the licensing revenues of other patentees. However, the demand for licenses depends on the total royalties charged by all the licensees, and so the failure to coordinate royalty rates for essential and valid patents can result in total royalties that exceed the royalty that a pool would charge to maximize its licensing revenue. In addition, independent licensing of essential patents can delay the adoption of a technology and increase the transaction costs of negotiating licenses.

## **B. Improvement Patents**

Patent pools may include patents that are not essential to use a technology but enhance the technology’s value, whether by making it easier or more efficient to employ the technology or by enabling desired features. Common usage assigns the term “improvement” to these patents, although they can add value in ways other than enabling a higher quality product. For example, a patented pin configuration can add value to a standard for a computer memory device even if the pin configuration does not improve the performance of the device relative to other configurations. Essential patents can block the use of these improvement patents, but the

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<sup>38</sup> See Gilbert, n. 2 above. Shapiro derives a similar result using a different demand function. See Shapiro, n. 2 above. Lerner and Tirole generalize the result to examine the competitive effects of pooling patents that are imperfect complements. See Joshua Lerner & Jean Tirole, *Efficient Patent Pools*, 94 AM. ECON. REV. 691 (2004).

<sup>39</sup> A similar result would obtain with *ad valorem* royalties that are based on licensing revenues.

improvement patents do not block the use of the technology in a more basic form. This is a one-way blocking relationship. The essential patent is sometimes called the dominant patent.

As with independent licensing of essential patents, the “double monopoly” problem also can emerge with independent licensing of improvement patents. In *Line Material*, if Southern had licensed its dominant patent at a uniform per-unit royalty, Line Material would have added its own margin to the price of the final product.<sup>40</sup> As a consequence, the price of the final product could have exceeded the profit-maximizing price with a jointly determined royalty. Cooperative determination of royalties was a way for Southern and Line Material to avoid the double monopoly problem and could have resulted in lower prices for the final product.

The following examples illustrate conditions under which joint royalty setting with an improvement patent may or may not confer consumer benefits. Suppose first that all consumers are willing to pay for one unit of the good a price equal to the good’s value, which is known to all consumers. Firm 1 (e.g., Southern) has a dominant patent that it can exploit to produce a product with value  $V_1$ . Firm 2 (e.g., Line Material) has a subservient patent that, when used with Firm 1’s technology, can produce a product with a value (e.g., quality)  $V_2$  that is larger than  $V_1$  for all consumers. I assume that there are no costs of producing or selling the products other than any royalties required to license patent rights.

If the firms cooperate, Firm 1 would allow Firm 2 to use its intellectual property to make the higher quality product. The two firms could license both patents jointly at the royalty  $V_2$ , or Firm 2, after having obtained a license from Firm 1, could issue a license for the higher quality product at the royalty  $V_2$ . This way the firms maximize profit, consumers purchase the higher quality good, and the firms can choose how to divide the spoils. In terms of total economic welfare (profits plus consumer surplus), this is the best outcome in this market, although the benefits go entirely to the firms. Consumers earn no surplus because the price is equal to their maximum willingness to pay for the good.<sup>41</sup>

If the firms do not cooperate, Firm 1 could choose not to license to Firm 2. With no licensing, Firm 2 cannot compete because its product would infringe Firm 1’s patent. In this case, only Firm 1 can offer a product, which it can sell at its monopoly price  $V_1$ . This outcome is

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<sup>40</sup> 333 U.S. 287.

<sup>41</sup> Firms can perfectly price discriminate in this example because all consumers have the same willingness to pay for the good. Price discrimination would be more difficult, and consumers likely would enjoy some surplus, if they differed in their demands for the good.

inferior to the cooperative outcome because the higher quality good is not produced. The firms earn lower total profit, and consumers obtain no surplus.

Alternatively, Firm 1 could license its dominant patent to Firm 2 and commit not to compete with Firm 2 by withdrawing from the market. In this case, only Firm 2 offers a product, which it would sell at the monopoly price  $V_2$ . Firm 1 can extract the monopoly revenue by charging a royalty  $R = V_2$ . The outcome is the same as in the cooperative case. There is no double-marginalization in this licensing case, because I have assumed that demand for the final product is inelastic for all prices up to the product's value. Firm 1 can capture all of the value with its royalty and Firm 2 cannot profitably add an additional margin to the product price. With elastic demand, if Firm 1 charged a per-unit royalty, Firm 2 would add a margin to the royalty and the double monopoly problem would emerge.

The outcome with licensing is identical to the outcome with pooling of the patents when consumer demand is inelastic. With elastic demand, there would be an additional margin in the no-pooling case if Firm 1 charges a per-unit royalty, which would increase the price and lower profits. Pooling is likely procompetitive when demand is elastic and the pool includes both essential and improvement patents, as well as for the case in which all patents are essential, assuming that the patents are valid and restrictive license terms do not limit downstream competition. Stated differently, patent pools should not be limited to patents that are technically essential to make a product or implement a standard. Improvement patents are essential to obtain the benefits of some features of a technology or standard, but they are not technically essential to make products that lack those features or to implement a standard in its most basic form. Patent pools that include improvement patents also have economic benefits.

#### **IV. Does it Matter If A Pool Includes Substitute or Weak Patents?**

The antitrust agencies have focused on whether a patent pool is limited to essential patents as a central issue for a pool's competitive effects. The IP Report notes that a pool that includes patents covering substitute technologies could result in higher prices by eliminating competition between alternative technologies and by facilitating collusion through the exchange of competitively sensitive information.<sup>42</sup>

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<sup>42</sup> See IP Report, n. 1 above, at 67.

While “essentiality” may be accepted as a desirable characteristic of patents that are included in a pool, the term “essential patent” admits different definitions, and the patents that are technically essential for a standard can change if the standard evolves over time. If additional features are added to a standard, does the definition of an essential patent expand to include patents that are necessary to implement these new features? The MPEG-2 patent pool included 27 essential patents when the DOJ issued its business review letter in June 1997.<sup>43</sup> In 2009, the portfolio license for the MPEG-2 technology provided access to more than 885 patents.<sup>44</sup> The agencies recognize that it is difficult to assure that a pool includes only essential patents.<sup>45</sup>

The use of an independent patent expert to assess essentiality provides some comfort, but essentiality is often difficult to determine even for an unbiased expert. Fortunately, the Agencies may relax their scrutiny of essentiality without compromising the economic benefits of patent pools. As noted above, patent pools that include complementary patents have economic benefits even if the patents are not technically essential to make or use some products or to implement the core features of a standard. Furthermore, the risk to competition presented by a patent pool that includes substitute patents is not large if the pool includes at least one valid essential patent. Moreover, this risk is less than the risk to competition from inadvertently excluding an essential patent. It is important to keep this tradeoff in mind given that it can be difficult to determine *ex ante* whether an individual patent is a substitute or a complement for other patents in the pool.

A dramatic example of the costs of excluding essential technology from a pool is the recent litigation between Lucent-Alcatel and Microsoft over patent rights to MP3 technology, which is used to transmit compressed audio files on the Internet and to store them on personal computers and portable devices.<sup>46</sup>

There is no single pool with all of the patents that are essential to the MP3 digital audio encoding format technology. Ownership of MP3 patent rights is fractured among many different

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<sup>43</sup> See Business Review Letter (June 26, 1997), n. 3 above.

<sup>44</sup> MPEG LA, MPEG-2 Patent Portfolio License Briefing (July 6, 2009), *available at* <http://www.mpegla.com/m2/m2web.ppt> (last visited August 6, 2009).

<sup>45</sup> See IP Report, n. 1 above, at 4 (“In many cases, patents in a pool are not pure complements or pure substitutes, but display characteristics of both.”).

<sup>46</sup> See *Lucent Tech., Inc. v. Gateway, Inc.*, 543 F.3d 710 (Fed. Cir. 2008). MP3, which stands for MPEG-1 audio layer 3, is an audio compression technology. It is an enhancement to MPEG-1, and distinct from MPEG-3, which was developed for the compression of high definition television signals. See JERRY WHITAKER, *DTV HANDBOOK: THE REVOLUTION IN DIGITAL VIDEO* 168 (McGraw-Hill 2001).



rights holders, including Fraunhofer IIS, Thomson, Sisvel (and its U.S. subsidiary, Audio MPEG), Texas MP3 Technologies, and Lucent-Alcatel. Microsoft asserted its belief that it had obtained the necessary intellectual property rights to practice the MP3 technology when it negotiated a package license from Fraunhofer IIS for \$16 million. Lucent-Alcatel disagreed, claiming that Microsoft and its licensees infringed two patents necessary to use MP3 digital audio owned by Lucent-Alcatel. Lucent-Alcatel initially won a \$1.5 billion judgment.<sup>47</sup> The judgment was subsequently overturned for non-infringement, but litigation continues between the companies on other patents.<sup>48</sup>

The Lucent-Alcatel MP3 case is an illustration of the risks of under-inclusion of essential patents in a patent pool. Whether the initial \$1.5 billion judgment represents a patent ambush, or merely a stacking of royalties on top of the \$16 million for the Fraunhofer license, the point is that the total cost of licensing MP3 technology likely would be lower if all of the necessary patents were available from a single pool.

*Should patent pools include patents that are substitutes for each other?*

Antitrust enforcement agencies, in their business review letters and policy statements, have indicated that patent pools should exclude patents that are substitutes for each other. The following example illustrates that competition need not be harmed if a pool includes substitute patents, provided that the pool also includes at least one valid essential patent.<sup>49</sup> Suppose there are three patents that potentially read on a standard for a new sound recognition system. Patent X is technically essential to practice the technology. The other two patents, Y1 and Y2, read on some desirable feature of the technology that is included in the standard. For example, patent X is necessary to recognize any sound, including spoken words, while patents Y1 and Y2 cover technologies that are useful to recognize different types of music. Either Y1 or Y2 is essential to implement the music recognition feature of the technology, but either one will accomplish the same function. In this respect, patents Y1 and Y2 are perfect substitutes.

According to the guidance in both the DOJ business review letters for patent pools and the IP Report, patent X should be included in a patent pool for sound recognition technology

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<sup>47</sup> See *Lucent Tech., Inc. v. Gateway, Inc.*, 509 F. Supp. 2d 912, 937–38 (S.D. Cal. 2007).

<sup>48</sup> See 509 F. Supp. 2d at 938 (granting Microsoft’s motion for a new trial); *aff’d*, 543 F.3d 710. The Federal Circuit dismissed Lucent’s infringement claim on another patent on procedural grounds. See 543 F.3d 722.

<sup>49</sup> The examples in this section follow the analysis of package licensing in Richard Gilbert & Michael Katz, *Should Good Patents Come in Small Packages? A Welfare Analysis of Intellectual Property Bundling*, 24 INT’L J. INDUS. ORG. 931 (2006).

because it is essential to practice the standard. Patents Y1 and Y2 are not essential because each one has a perfect substitute (Y2 for Y1 and Y1 for Y2), and guidance suggests that these patents should be excluded from the pool.

Patent pools can harm competition if they involve patents that can be used to make or sell products or processes that are substitutes for each other. This, however, is not a reason to exclude patents Y1 and Y2 from a pool that also includes a valid patent X. While patents Y1 and Y2 are substitutes for each other, they cannot be used to make or sell substitute products. In this hypothetical, any speech recognition product, whether or not it offers music recognition, must have a license to use patent X. Furthermore, by assumption, patents Y1 and Y2 are both useless without patent X.

Taking this example further, suppose that all consumers are willing to pay  $V_1$  for a product that offers basic speech recognition, and that  $V_2 > V_1$  for a product that includes music recognition as well. Demand is inelastic up to a price of  $V_1$  for the basic speech recognition product and inelastic up to a price of  $V_2$  for the product with music recognition. Suppose also that there are no costs of producing or selling the products other than any royalties required to license patent rights, and the marginal cost incurred by a patentee to license its patent is zero. If the patent pool includes X, Y1 and Y2, the pool can charge a royalty  $V_2$  for a package license that enables both speech and music recognition. If the pool includes only X and Y1, it can offer a package license for X and Y1 that enables speech and music recognition for a royalty  $V_2$ . This would eliminate demand for a license for Y2. The cost to consumers would be the same as if all patents were in the pool, but in the former case Y2 would share in the pool's licensing revenues.<sup>50</sup>

Suppose the pool excludes both Y1 and Y2 because each is a substitute for the other. If competition between Y1 and Y2 eliminates royalties for these patents, then the pool can charge a royalty for X equal to  $V_2$ . A manufacturer of speech and music recognition systems could license patent X, pay a royalty  $V_2$ , and license either Y1 or Y2 at no charge or with a royalty that is close to zero. More generally, if the lesser of the royalties for a license to Y1 or Y2 is  $R_Y$ , then the pool can charge a royalty for X equal to  $V_2 - R_Y$ . Consumers would pay a total royalty  $V_2$  for the intellectual property necessary to make or use a product with a value  $V_2$ .

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<sup>50</sup> Including Y1 but not Y2 in the pool raises the concern that the patent license would foreclose demand for Y2, as the DOJ noted in its 3C DVD and 6C DVD business review letters. See above text accompanying notes 5–12. However, the foreclosure would not adversely affect the price of speech and music recognition systems.

In this example, with inelastic demand up to each consumer's willingness to pay for the technology, consumer welfare and total profits do not depend on whether patent Y1 or Y2 or both are included in the patent pool.<sup>51</sup> Whether the pool includes Y1 and/or Y2 does affect the distribution of licensing revenues for the different IP rights holders. If Y1 and Y2 are in the pool, they can share in the total pool revenues on a basis determined by the members of the pool. If either patent Y1 or Y2 is outside the pool, competition for licensing revenues between the pool and the excluded patent will dissipate royalties for the patent that is outside the pool.

If both patents Y1 and Y2 are outside the pool, competition between the two patents will dissipate the royalty that each can charge. If Y1 and Y2 compete imperfectly for licensing revenues, they can charge a royalty  $R_Y > 0$ , which would limit the royalty that the owner of X can charge to something less than the value  $V_2$ . Furthermore, as in the discussion of *United States v. Line Material Co.* and the more general analysis of patent pools with one-way blocking patents,<sup>52</sup> if demand for the licensed technology depends on the total royalty, then independent determination of royalties for X and for either Y1 or Y2 can lead to double marginalization if the pool excludes both patents Y1 and Y2 and the owners of these patents compete imperfectly. Under these conditions, with price-elastic demand for speech and music recognition systems, consumers likely would be worse off with both patents Y1 and Y2 outside the pool, and total profits likely would be reduced as well.<sup>53</sup>

The competitive effects from including non-essential patents in a pool are an application of the general principle of one-monopoly rent. This principle ignores factors such as commitment and effects in external markets, which can limit its application to conduct such as tying arrangements. It is conceivable that bundling non-essential patents into a pool's portfolio license would have anticompetitive effects similar to the effects of tying arrangements.<sup>54</sup> However, as discussed in more detail below, there are significant competitive risks from excluding patents from a pool that prove to be economically necessary to implement a technology. Courts and antitrust enforcement authorities should weigh the risks of excluding

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<sup>51</sup> See Gilbert & Katz, n. 49 above.

<sup>52</sup> See above text accompanying notes 32–33.

<sup>53</sup> While consumer welfare and total profits do not depend on whether Y1 or Y2 or both are included in the patent pool along with patent X in this example, a pool that includes only patents Y1 and Y2, but not patent X, would raise antitrust concerns by eliminating competition between substitute patents.

<sup>54</sup> See, e.g., Michael A. Lavine, *Ripples In The Patent Pool: The Impact And Implications Of The Evolving Essentiality Analysis*, 4 NYU J. LAW & BUSINESS 605 (2008).

patents from a pool against the risks of harm to competition from an over-inclusive patent portfolio.

*Should patent pools weed out weak patents?*

Antitrust agencies have expressed concerns about including patents of questionable validity in a patent pool. The IP Report notes that “[a]n invalid or unenforceable patent is not in a complementary relationship with other patents in the pool” and that “. . . the presence of invalid patents in a pool could raise competitive concerns.”<sup>55</sup> Clearly, a patent right is not essential for the manufacture, use, or sale of a technology if the patent is not valid. Patents, however, are not valid or invalid with a probability of one. In Lemley and Shapiro’s terminology, patents are “probabilistic” rights.<sup>56</sup> They are valid with some probability, and the relevant question is whether it is better to have a patent of uncertain validity inside or outside of the pool.

There are benefits to having essential patents in the pool even if it is not certain that the patents are valid, provided that one or more other patents in the pool are essential and valid. Furthermore, excluding from the pool a patent that turns out to be essential and valid can lead to excessive royalties. For example, suppose that a pool includes five patents, each of which covers some aspect of a technology that is essential to implement a standard to broadcast video signals. The market demand for products that employ the broadcast standard is  $Q = 100 - R$ , where  $R$  is the product price. To further simplify the analysis, assume that there are no costs incurred to make or sell the products other than the royalties paid for necessary patent rights, and the marginal cost of licensing a patent is also zero.

If any one of the five patents in the pool is valid, the pool can charge the profit-maximizing royalty,  $R^m = 50$ . This holds even if other patents in the pool are invalid, since a user of the technology must have access to all of the essential technological elements. Suppose each patent has an independent probability  $\frac{1}{2}$  of being invalid. The probability that at least one of the patents is valid is 0.97.<sup>57</sup> Thus the pool can charge  $R^m = 50$  with probability 0.97. With probability 0.03 the pool’s patents are all invalid and the pool cannot earn any royalties.

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<sup>55</sup> IP Report, n. 1 above, at 78.

<sup>56</sup> Mark Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSP. 75 (2005).

<sup>57</sup> This number is one minus the probability that all the patents are invalid. The latter probability is  $(.5)^5 = .03$ .

Suppose that, consistent with a business review letter from the Department of Justice, the pool conducts a quadrennial review of its patent portfolio. The review shows that one of the patents has questionable validity, and according to its agreement with the DOJ, the pool administrator concludes that the patent should be excluded from the pool. Are consumers better off if the pool excludes the patent? It is possible and even likely that consumers would be better off if all of the five patents remain in the pool, compared to a situation in which one of the patents is excluded from the pool.

If a patent is excluded, the probability that at least one of the pool's four remaining patents is valid falls from 0.97 to 0.94. This is a modest reduction. It is still almost certain that the pool can assert at least one patent that is essential to make, use, or sell the product, even if only four patents remain in the pool. Furthermore, the excluded patent may turn out to be essential, because the review may have falsely concluded that the patent is invalid. Suppose that the excluded patent turns out to be essential with probability  $\frac{1}{2}$ . Thus, with probability  $.5 \cdot .94 = 0.47$ , a potential user of the video technology would have to license at least one valid and essential patent from the pool and another valid and essential patent from an external licensor. This is a classic double-marginalization problem. Applying the Cournot pricing formula, the price in this instance would increase to  $R^c = 66.7$ , an increase of about 33 percent compared to the total profit-maximizing royalty when all five patents are in the pool and at least one patent is essential.<sup>58</sup>

The expected consequences from excluding one of the patents from the pool depend on whether patents turn out to be valid. With all five patents in the pool, the probability that at least one of them is valid is 0.97. Hence the royalty is 50 with probability 0.97 and zero with probability 0.03. The expected royalty is  $0.97 \cdot 50 = 48.50$ . The expected royalty is more complicated with four patents in the pool and one patent outside the pool. The probability is  $0.47 (= .5 \cdot .94)$  that at least one patent in the pool is valid and the patent outside the pool is valid. In this case the royalty is 66.7. There is an equal probability that at least one patent in the pool is valid, but the patent outside the pool is not valid. In this case the pool's profit-maximizing royalty is 50. With probability .06, none of the patents in the pool are valid. If the patent outside the pool is valid, its owner can charge the monopoly royalty of 50. The excluded patent is valid

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<sup>58</sup> See Gilbert, n. 2 above, and the formula for the profit-maximizing royalty assuming Cournot pricing in the text. In this example,  $N = 2$ ,  $A = 100$  and  $b = 1$ .

with probability  $\frac{1}{2}$ , hence this event occurs with probability 0.3. If the patent outside the pool is also invalid, a technology user can obtain all of the required rights with zero royalty. This event occurs with equal probability .03.

Putting all these possible events together, the expected total royalty with four patents in the pool and one patent outside the pool is  $.47*66.7+.47*50+.03*50+.03*0 = 56.4$ . This is about 16 percent higher than the expected royalty with all five patents in the pool. In expected value terms, consumers are better off when all five of the patents with uncertain validity are included in the pool compared to a situation in which one of the patents is relegated to a status outside the pool.<sup>59</sup>

This example demonstrates that it is potentially dangerous to consumer welfare and total profits to exclude complementary patents from a patent pool, provided that it is reasonably likely that the pool includes at least one valid essential patent. This point holds even if some of the patents are improvement patents that might be blocked by other essential patents in the pool.

#### *Risks of too many patents in the pool*

The usual concern about including non-essential or weak patents in a pool is that the pool may coordinate royalties for patents that offer substitute ways to produce products. But including non-essential or invalid patents in the pool does not result in higher total royalties if there is at least one other valid patent in the pool that is essential to make the product. Under the conditions for which the theory of one-monopoly rent applies, the presence of a nonessential or invalid patent in the pool does not allow the pool to charge a higher royalty, nor does it foreclose an alternative technology from making a product, provided that at least one valid and essential patent remains in the pool, because the product cannot be manufactured, used, or sold without a license to the essential patent.<sup>60</sup>

Competitive concerns arise if patents can be used to make alternative products that are substitutes for each other. Suppose that patent X1 is essential to make a “red” speech recognition system and patent X2 is essential to make a “blue” speech recognition system. The

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<sup>59</sup> The argument against excluding the patent is weaker if the excluded patent is less likely to be valid. A similar calculation shows that if the probability that the excluded patent is valid is only  $\frac{1}{4}$ , then the exclusion increases the expected royalty by about eight percent.

<sup>60</sup> I reiterate that, under some conditions, bundling invalid or non-essential patents into a pool’s portfolio license could have anticompetitive effects similar to the effects of tying arrangements.

red and blue systems are close substitutes for each other. Including X1 and X2 in the same pool presents a risk that the licensing administrator for the pool will set royalties for X1 and X2, recognizing that a low royalty for one of the patents will cannibalize revenues for the other patent. That is, the licensing administrator may act as a cartel and eliminate competition between technologies that are substitutes for each other.<sup>61</sup>

While inclusion of patents X1 and X2 in the same pool raises potential antitrust concerns, it does not necessarily lead to a conclusion that competition would be harmed. Suppose the owners of X1 and X2 could still negotiate independently with potential licensees. Then, each patent owner would have an incentive to maximize its own licensing royalties by offering a licensing deal that is more attractive than the deal offered by its competitor. Independent licensing is a reason why the DOJ did not object to the 3G Platform for Third Generation Mobile Communication Systems.<sup>62</sup> The 3G Platform patent is essentially five different patent pools, each with a separate licensing administrator. Each platform is a potential substitute for the others, and therefore the pool raises concerns that the central administrator may act to avoid competition between the different platforms. Nonetheless, the pool would not eliminate competition if the licensing administrator for each platform acts independently to negotiate licenses for its platform.

Suppose that the 3G Platform Pool did not have independent licensing administrators for each of the five platforms. It is still possible that the individual patent owners would negotiate independent licensing arrangements that maximize their profits if the pool administrator does not discourage them from doing so. Competition could occur, although the risk of coordinated royalty setting would be present. Competition requires that IP rights holders independently seek arrangements to license intellectual property for the manufacture, use or sale of alternative products. If there is sufficient independent action to license IP rights, competition can occur even if patents that can be used for substitute technologies co-exist in the pool.

Allowing pool members to license their patents individually provides a safety valve to protect against anticompetitive effects from including non-essential patents in the pool. If

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<sup>61</sup> The Federal Trade Commission alleged that Summit Technology, Inc. and VISX, Inc. raised prices for photorefractive keratectomy, a form of eye surgery used to correct vision disorders, by pooling and jointly licensing patents that were substitutes for each other. See Summit Tech., Inc., Docket No. 9286 (Fed. Trade Comm'n Mar. 24, 1998) (complaint), *available at* <http://www.ftc.gov/os/adjpro/d9286/index.shtm>.

<sup>62</sup> See above text accompanying notes 15–16.

patents are substitutes, individual patentees can license their technologies to develop competing technologies or to promote the development of the pooled technology along alternative paths. Lerner and Tirole have shown that independent licensing would lower the total profits of a pool that includes substitute technologies.<sup>63</sup> Thus, independent licensing can be a check against collusive royalties for substitute technologies.

An additional risk from including patents in a pool that are not essential, either because they are substitutes or because they are likely to be invalid, is that these patents can dilute the incentive for the owner of an essential IP right to join the pool in the first place. Consider again the example in which patent X is essential to make a basic technology with value  $V_1$  and patents Y1 and Y2 cover substitutes for an improvement to the basic technology, which has a higher value  $V_2$ . The previous section showed that with perfect competition, or with imperfect competition and inelastic demand, total royalties and profits are independent of whether the pool includes X, Y1 and Y2, or X and only Y1 (or only Y2), or only X. However, the distribution of profits, and in particular the profits earned by the owner of patent X, likely depend on whether the pool includes all three patents, or two patents, or only patent X. If the pool allocated royalty income in proportion to patent holdings, the owner of patent X would earn  $V_2$  if it is the only patent in the pool and if there is perfect competition between Y1 and Y2. But if all three patents are in the pool and the pool allocates royalty income in proportion to the number of patents owned, then the owner of patent X would earn only  $\frac{1}{3}V_2$ . Similarly, if the pool includes X and Y1 (or Y2), and the owner of the excluded patent charges close to zero in order to find a willing licensee, then the owner of patent X would collect  $\frac{1}{2}V_2$ .

If a patent pool allocates royalty income to pool members in proportion to the number of patents owned, a firm with an essential patent may choose not to join a pool if the pool includes too many non-essential patents. Suppose the pool includes non-essential patents Y1 and Y2, each of which is owned by a different patentee. The owner of patent X can guarantee royalty income of at least  $V_1$  if it refuses to join the pool. The owner can license patent X solely for use with the basic technology, and it can refuse to make the technology available for improvements. This would allow the owner of patent X to charge a royalty equal to  $V_1$ . If the owner of patent X joins

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<sup>63</sup> See Lerner & Tirole, n. 38 above.



the pool, and if royalties are allocated in proportion to the number of patents owned, it would earn only  $\frac{1}{3}V_2$ . In that case, the owner of patent X would be better off by staying outside the pool and refusing to make its technology available for improvements if  $V_1 > \frac{1}{3}V_2$ , which is equivalent to  $V_1 > \frac{1}{2}(V_2 - V_1)$ , that is, if the stand-alone value of patent X exceeds half of the incremental value of improvements. Note that the owner of patent X can earn more than  $V_1$  if it licenses its technology for improvements but refuses to pool its patent with patents Y1 and Y2. This provides a further incentive for the owner of patent X to refuse to join a pool that includes both patents Y1 and Y2 if the pool distributes royalties in proportion to the number of patents owned by each of its members. However, as in the discussion of *United States v. Line Material Co.* and the more general analysis of improvement patents,<sup>64</sup> independent licensing by a pool that includes patents Y1 and Y2 (but not X), and by the owner of patent X outside the pool, would lead to double marginalization and result in higher royalties and lower total profits if there is downward sloping demand for the product made with the licensed patents and if competition between Y1 and Y2 does not eliminate royalties for these patents. Furthermore, independent licensing for X and Y1 or Y2 can incur other costs that can delay adoption of the patented technology or lower its value.

## V. Conclusions

Patent pools have clear efficiency benefits when they include patents that are essential to make or use a product. By pooling essential patents and licensing them jointly, a pool avoids the double-marginalization that can occur with independent licensing, reduces the transaction and search costs associated with assembling rights to use essential intellectual property, and accelerates technology adoption.

Antitrust authorities have indicated concerns about pooling patents that are substitutes for each other, because joint licensing can eliminate competition between substitute technologies and lead to higher prices. This chapter argues that such concerns may be exaggerated if the pool includes at least one valid patent that is essential to make or use a product that employs the technology covered by the patents in the pool. If the pool includes at least one valid essential

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<sup>64</sup> See above text accompanying notes 32–33.

patent, under some conditions the inclusion in the pool of one or more additional patents that are substitutes for each other does not increase, and can decrease, the total profit-maximizing royalty that users have to pay for necessary technology. Bundling non-essential patents into a pool's portfolio license can have anticompetitive effects similar to the effects of tying arrangements. Courts and antitrust enforcement authorities should weigh the risks of excluding patents from a pool against the risks of harm to competition from an over-inclusive patent portfolio.

A significant concern for competition policy is the risk that owners of essential patents may choose not to participate in the pool. If essential patents or desired improvement patents remain outside the pool, independent licensing of these patents can destroy the benefits of pooling for pricing, transaction costs, and technology adoption. Under-inclusive pooling can occur because the owner of an essential patent refuses to participate in a pool, or because the pool excludes a patent that it incorrectly concludes is non-essential. Either outcome can have adverse consequences for economic efficiency and consumer welfare. Antitrust authorities should give due consideration to policies that encourage owners of essential patents to join a pool, or that discourage owners of essential patents from participating in a pool's portfolio license.