

Measuring the Costs and Benefits of Patent Pools

Robert P. Merges[†] & Michael Mattioli[‡]
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Abstract: This Article addresses a policy question that has challenged scholars and lawmakers since the 1850s: Do the transaction cost benefits of patent pools outweigh their potential for consumer harm? This question has special importance today. Patent pools are on the increase, due to large numbers of patents in critical industries such as software and mobile phones. In this Article, we present the first empirically-based estimate of the transaction costs savings engendered by patent pools. Drawing on interviews with administrators of prominent pools, we document the costs of assembling and administering a functioning pool. We then estimate the transaction costs that would result if the pool were never formed. This means estimating the costs of large-scale bilateral licensing of all patents included in the pool. We include an estimate, again based on empirical data, of the cost of occasional litigation when bilateral negotiations break down. Comparing the cost of running a pool with the counterfactual cost of licensing (plus probabilistic litigation) in the absence of a pool, we estimate empirically the transaction cost savings from pooling patents. The numbers are impressive: many pools save *hundreds of millions of dollars* in transaction costs.

Next, we tackle consumer welfare losses. Antitrust regulators and scholars identify two chief costs: lost substitutes and lowered incentives to invent improvements. Substitutes may be lost when a pool combines patents on two technologies that perform the same function. This has the potential to increase consumer prices. We present a method for estimating social welfare losses from combining substitutes. Through case studies, we apply this method to estimate the welfare losses (in dollars) caused by specific patent pools. We present a second method for estimating the consumer welfare losses represented by lowered incentives to innovate. The chief feature of pools that affects future incentives is the “grantback clause,” under which members agree to license future members into the pool. Again drawing from real-world case studies, we

[†] Wilson Sonsini Goodrich & Rosati Professor of Law and Co-Director, Berkeley Center for Law & Technology, University of California at Berkeley.

[‡] Associate Professor of Law, Indiana University Maurer School of Law (Bloomington).

apply our method to estimate the potential losses in dollars that flow from grantbacks. This phase of the analysis draws on cutting-edge patent portfolio mapping techniques to estimate future lost substitutes due to grantback clauses.

When the welfare loss estimates are compared to the transaction cost savings, one arrives at a comprehensive methodology for evaluating patent pools. The systematic approach presented here allows a regulator to say, for example, that society could tolerate a certain number of lost substitutes, given the cost savings of a pool. And it allows a regulator to estimate the *future* substitutes, lost due to grantback provisions, that can be tolerated given the pool's cost savings. Thus we present a comprehensive, reproducible, and rigorous framework for evaluating the net effects of any proposed patent pool.

This Article contributes two important "firsts" to the patent pooling debate: (1) We quantify the benefits (transaction cost savings) of patent pools, and (2) we quantify the consumer welfare costs from (a) lost substitutes, and (b) pool grantback clauses. The bottom line is a rigorous empirical approach to a policy question that has, until now, been carried along solely by theory and conjecture.

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Introduction

The fantastic technological progress fueling our economy has yielded a peculiar and costly side effect: heavy patent licensing costs. Most complex products today are assembled from a multitude of separate components.¹ Each component is covered by many patents, and these patents are typically owned by many scattered companies.² Just as innovative components must be assembled to form a whole, integrated product, so too many patents must be licensed to give full legal rights over the integrated product.³ Mobile phones are a good example: because many components are included in the phone, manufacturers must obtain many patent licenses.⁴ This can be a costly and risky endeavor.

Technology companies have developed some creative and effective ways to facilitate the integration of multiple technical components. Many companies make their components modular—i.e., product parts speak common languages and can plug into each other and work together.⁵ The common languages that components speak are typically developed by

¹ See Oren Bar-Gill & Gideon Parchomovsky, *The Value of Giving Away Secrets*, 89 Va. L. Rev. 1857, 1868 (2003) (discussing the important role that cumulative innovation plays in high-tech industries, including “computer software, semiconductors, molecular biology, and pharmacology.”) (footnotes omitted).

² See Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, in 1 *Innovation Policy and the Economy* 119, 124-26 (Adam B. Jaffe et al., eds., 2001) [hereinafter Shapiro, *Thicket*]; Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 *Sci.* 698, 698-700 (1998) (discussing this phenomenon in the context of medical and biotech); Michael Mattioli, *Communities of Innovation*, 106 *Nw. U. L. Rev.* 103, 110-13 (2012) [hereinafter Mattioli, *Communities of Innovation*] (describing this problem as a form of transactional gridlock that impedes the productive use of patents across industries).

³ *Id.*

⁴ A widely-cited 2012 study estimated that approximately 250,000 patents were relevant to an average smartphone. RPX Corp., Amendment No. 3 to Form S-1, 59 (Apr. 11, 2011), available at <http://www.sec.gov/Archives/edgar/data/1509432/000119312511240287/ds1.htm> (last visited Jan. 29, 2016).

⁵ See, e.g., James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, *Law & Contemp. Probs.* 33, 46 (2003) (discussing the special value of modularization in large-scale distributed technology development projects.); Erich Gamma et al., *Design Patterns: Elements of Reusable Object-Oriented Software 2* (1st ed., Addison-Wesley Professional, 1994) (discussing the conveniences of designing software in a modular fashion).

consortia of technology companies brought together in standards setting organizations (SSOs).⁶ This makes it less costly to take a component off the shelf and incorporate it into an integrated product.⁷

Similarly, companies try to save money when acquiring the many patent rights they need. Some patent owners make this easy, by explicitly or implicitly foregoing their right to enforce patents against adopters of a standard.⁸ Patent policies of standard setting organizations (SSOs) also help in this regard. Companies helping to set a standard are required to inform others that they have patents covering part of the standard.⁹ These “standard essential patents” must be licensed to others on fair, reasonable and non-discriminatory terms (“FRAND licensing”).¹⁰ This reduces costs by assuring adopters that they will not be forced to overpay for patents if and when the time comes to put a dollar value on them.

Another way companies save on patent-related costs is to form a patent pool. A pool bundles together related patents held by the members of the pool.¹¹ It then offers to other

⁶ See Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations* 90 Cal. L. Rev. 1889 (2002).

⁷ *Id.*

⁸ See, e.g., Jorge Contreras, *A Market Reliance Theory for FRAND Commitments and other Patent Pledges*, 2015 Utah L. Rev. 479 (2015).

⁹ *Id.*; Benjamin Chiao, Josh Lerner & Jean Tirole, *The Rules of Standard-Setting Organizations: An Empirical Analysis*, 38 RAND Journal of Economics 4 (2007); Mark A. Lemley, *supra* note 6 (discussing the process of standard-setting); ISO/IEC Directives, Part 1 available at <http://www.iso.org/sites/directives/directives.html> (scroll to Rule 1.5) (explaining the obligation to disclose information about standards-essential patents) (last accessed July 28, 2015).

¹⁰ See generally Jorge L. Contreras, *A Brief History of Frand: Analyzing Current Debates in Standard Setting and Antitrust Through A Historical Lens*, 80 Antitrust L.J. 39 (2015) (providing a helpful introduction and overview of FRAND commitments in standard setting); Chiao et al., *supra* note 9. See also Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 Colum. L. Rev. 2117 at note 107 (noting that the adoption of a FRAND licensing arrangement may make injunctions more difficult to obtain, because they reflect that monetary compensation is an adequate remedy for patent infringement); Anne Layne-Farrar et al., *Pricing Patents for Licensing in Standard-Setting Organizations: Making Sense of Frand Commitments*, 74 Antitrust L.J. 671 (2007) (discussing patent valuation in connection with FRAND licensing).

¹¹ See generally, Robert P. Merges, *Contracting Into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 Cal. Rev. 1293 (1996); Robert P. Merges, *Institutions for Intellectual Property Transactions: The Case of Patent Pools*, in *Expanding the Boundaries of Intellectual Property: Innovation Policy for the Knowledge Society* 123, 129-

companies a single license that includes all the bundled patents. (The members of the patent pool typically receive a license as well.)¹² Many pools in the contemporary economy form around building-block components of complex technologies. Two examples are: Data compression protocols for transmitting video, graphics, and other high-density digital content; and data transmission rules that allow computers, tablets and mobile phones to communicate with local area networks (i.e., WiFi standards).¹³ Pools are more formal than FRAND commitments, because they set and charge a single price for use of the pooled patents; unlike FRAND commitments, they do not simply put off for another day the question of whether and how much a user must pay for a patent.

Patent pools are important to their members (i.e., licensors) and to their users (i.e., licensees).¹⁴ The benefit for users is easy to appreciate: “one stop shopping” for many patents at once. This conserves on the cost of licensing numerous patents from dispersed patent holders by, in a sense, compressing that process into a single event. This yields a secondary benefit: patent pools reduce the odds that any patent holder, aware that its permission is necessary to a licensee, will strategically hold out for exorbitant licensing fees.¹⁵ For their

30, 132, 144 (Rochelle Cooper Dreyfuss et al. eds., 2000), available at <https://www.law.berkeley.edu/files/pools.pdf> [hereinafter Merges, Patent Pools] (last accessed Jan. 29, 2016); Michael Mattioli, Power and Governance in Patent Pools, 27 Harv. J. Law & Tech. 421 (2014) [hereinafter Mattioli, Power & Governance]; Floyd L. Vaughan, The United States Patent System (U. of Oklahoma Press, 1956) [hereinafter Vaughan, Patent System].

¹² Id.

¹³ Patent pools covering such technologies are the subjects of examination in this Article. See *infra*, Section II (“What Do Patent Pools Cost to Operate?”). Two patent pool administrators, MPEG LA and Via Licensing Corporation oversee the licensing of patents covering the MPEG audio and video standards, 802.11 WiFi, and other protocols widely used in the consumer electronics industry. See “Current Programs” at <http://www.mpegla.com/> (click on “Current Programs”) (last visited Jan. 29, 2016); “Licensing Programs” at <http://www.vialicensing.com/> (click on “Licensing Programs”) (last visited Jan. 29, 2016).

¹⁴ See Brad Biddle, Andrew White, and Sean Woods, How Many Standards in a Laptop? (And Other Empirical Questions), 2010 Int’l Telcomm. Union Sec. Telecomm. Standardization Kaleidoscope Acad. Conf. Prof. 123 (2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1619440 (last visited Feb. 1, 2016) (of 251 standards embodied in a laptop computer, only 3% are associated with patent pools).

¹⁵ See Thomas F. Cotter, Patent Holdup, Patent Remedies, and Antitrust Responses, 34 J. Corp. L. 1151, 1160 (2009) (describing this phenomenon); Shapiro, *supra* note 2 at 124-26 (Adam B. Jaffe et al. eds., 2001) (describing patent licensing holdup).

members, meanwhile, pools provide compensation for the use of patented technologies while obviating the need to engage in multiple negotiations with licensees. Members of patent pools who are *also* licensees—a common scenario— benefit from both sides of the deal.

Sometimes, companies choose to forego pools and give away platform technologies for free. Or they may, as described, encourage the diffusion of platforms by putting off for the future any royalty demands,¹⁶ by making FRAND pledges for standard-essential patents. Indeed, pools are relatively rare compared to FRAND commitments.¹⁷ These strategies require that companies have some other way to make money besides the sale of the platform itself, however. Usually they sell software or other products that “plug into” to the platform.¹⁸ Encouraging adoption of the platform furthers sales of related products.

Many standards contributors do not have this option. Universities, for example, sponsor research but do not generally sell products that plug into platforms.¹⁹ For them, pools may be the only way to obtain compensation for platform-related patents. Giveaways and pledges to forego enforcing their patent rights will not help them. More generally, allowing direct

¹⁶ On a proposed rule to prevent patentees from acquiescing in royalty-free use, and then holding up licensees once they are locked into a technology, see Robert P. Merges and Jeffrey Kuhn, *An Estoppel Doctrine for Patented Standards*, 97 Cal. L. Rev. 1 (2009).

¹⁷ Josh Lerner & Jean Tirole, *Standard-Essential Patents 2* (Toulouse Sch. of Econ., Working Paper No. IDEI-803, 2013) (“[M]ost [standard-setting organizations (SSOs)] require the owners of patents covered by the standard to grant licenses on fair, reasonable and nondiscriminatory (FRAND) terms.”); Jorge L. Contreras, *Fixing FRAND: A Pseudo-Pool Approach to Standards-Based Patent Licensing*, 79 *Antitrust L.J.* 47, 50–51 (2013) (asserting that FRAND licensing commitments are the “most prevalent” mechanism used in standard-setting to lower holdout risks).

¹⁸ A notable example is Sun Microsystems, Inc., which in the early 2000s— years before it was acquired by Oracle Corporation—licensed its Java software platform in hopes of encouraging software developers to adopt it. See Press Release, Sun Microsystems, *Sun Opens Java* (November 13, 2006) available at <https://web.archive.org/web/20070124154133/http://www.sun.com/2006-1113/feature/story.jsp> (last visited Feb 1, 2006).

¹⁹ See, e.g., Robin Feldman & W. Nicholson Price II, *Patent Trolling: Why Bio & Pharmaceuticals Are at Risk*, 17 *Stan. Tech. L. Rev.* 773, 784 (2014) (“Universities are in the business of scientific research and education, and they generally do not engage in the production of products from their inventors.”); Liza Vertinsky, *Universities As Guardians of Their Inventions*, 2012 *Utah L. Rev.* 1949, 1960–61 (2012) (“With some exceptions, U.S. research universities, particularly private research universities, have historically viewed their mission as one that excludes product-development activities...”).

compensation for specific technologies encourages specialization.²⁰ Without direct compensation, a platform specialist has to diversify into related products, which may not be its strength. The point is that patent pools provide some of the transaction cost savings of free patent giveaways and FRAND pledges, but also provide higher monetary returns. This can be a good thing.

Patent pools, like all collaborations among competitors, pose a risk to consumers. They can serve as covers for anticompetitive arrangements that raise prices beyond what they would be under competitive conditions.²¹ Antitrust regulators and courts are charged with weighing the pluses and minuses of patent pools. To date, this has been a largely qualitative exercise. Regulators acknowledge transaction cost savings; they describe potential harm to consumers; and the decision-maker arrives at some sense of the net effect of the pool.

In this Article, we add precision to this analysis. We begin by bringing to life the transaction cost savings provided by patent pools. Through interviews with people who work on forming and running actual patent pools, we quantify how much these joint licensing organizations save in transaction costs. We estimate how much it costs to establish and run a patent pool. And then, crucially for our purposes, we estimate the cost of the *next best alternative* mechanism for conducting the high volume of patent licensing that pools undertake. We ask, in effect, a simple question, and compare the answer with a simple counterfactual: how much do pools cost, and how much would it cost the firms involved to conduct the same volume of licensing transactions if the pool did not exist?

Through this simple setup, we arrive at some startling numbers. Pools save enormous amounts of money. They are

²⁰ See Robert P. Merges, A Transactional View of Property Rights, 20 Berkeley Tech. L.J. 1477 (2005); Robert P. Merges, Autonomy and Independence: The Normative Face of Transaction Costs, 53 Ariz. L. Rev. 145, 148 (2011) (explaining how the availability of patent rights encouraged specialization in the early railroad industry); Ashish Arora & Robert P. Merges, Specialized Supply Firms, Property Rights, and Firm Boundaries, 13 Indus. & Corp. Change 451 (2004) (explaining how intellectual property rights can promote technological advances in specialized firms). See generally, Alfred D. Chandler, Jr., The Visible Hand 15-36 (1977) (arguing that, to some extent, firm specialization and spur economic growth); Oliver E. Williamson, Markets and Hierarchies: Analysis and Antitrust Implications 197-205 (1975) (discussing economist George Stigler's views on research, economic growth, and firm specialization).

²¹ See *infra*, Section 1-C (“The Push for Greater Antitrust Scrutiny”).

mind-blowingly efficient at conducting high volumes of patent licensing. They are, as someone once said, “the Rolls Royce of Cadillac” licensing arrangements.

In itself, this is interesting and useful information. But in the context of the standard economic analysis of patent pools, it is more than that. It amounts to a challenge. Now that we have put a dollar figure on the transaction cost savings that pools provide, the burden shifts to the analysis of potential consumer welfare costs. Put simply, we believe it takes a number to beat a number. So those who are concerned with the potential downside of pools will, from now on, need to make a good faith effort to quantify the costs they describe. Otherwise, unless perhaps intuition tells us that the pooling costs will be very high indeed, the benefit-side analysis we provide should carry the day. Simply modeling potential concerns should no longer be enough to poke a fatal hole in a proposed patent pool. Consumer welfare losses will have to be quantified one way or the other.

We demonstrate what we mean by presenting methods of estimating the potential welfare costs of patent pools. The greatest concern on the cost side is that would-be competitors joining a pool will suppress competing technologies.²² Two firms with alternative technologies will structure the pool to authorize only one, shelving the other. We call this a case of lost substitutes.²³ Lost substitutes happen when pools combine patents on two technologies that perform the same function. This has the potential to increase consumer prices. A company that might have competed with another company using its patented alternative technology will not bother.²⁴ By essentially shelving one of the two competing technologies, the two companies can charge a higher price and split the premium. In this Article, we provide a method for estimating social welfare losses from combining substitutes. Then we provide some case studies, derived from the detailed data available in some patent infringement cases, showing dollar estimates of welfare loss in specific cases. From this, we generalize a bit, estimating the number of substitute patents it would take to offset the benefits of a patent pool.

²² *Id.*

²³ Richard R. Nelson, *Uncertainty, Learning, and the Economics of Parallel Research and Development Efforts*, 43 *Review of Economics and Statistics* 351-364 (1961).

²⁴ See, e.g., *infra* notes 131-134 and accompanying text (discussing how such a scenario played out around the standard for compact discs).

Next, we describe a technique for analyzing the second-greatest concern critics of patent pools have voiced: dampened incentives to invent improvements. According to regulators and scholars who have written on this subject, pools can suppress incentives when they include “grantback clauses.” These are contract provisions that require patent licensees to grant back to the pool any current or future patent rights relating to the pooled technology.²⁵ We employ a novel methodology to estimate these costs. We start with cutting-edge patent portfolio mapping techniques. Using these, we determine the historical degree of R&D overlap between rival companies within a pool. By using this as a baseline, an antitrust regulator will know how many rival technologies the companies developed before the pool was formed. This will be helpful in analyzing the impact of reduced incentives to invent in the future. If there has been little historical overlap between rival companies, the post-pool reduction in incentives is less important. There are likely to be very few “lost future overlapping inventions” due the formation of the pool. If on the other hand the overlap is large, the reduced incentives to invent may have a greater impact.

Part I of this Article provides a review of the three intertwined topics that form the backdrop for our analysis: the scholarly debate about transaction costs in our patent system, how patent pools reduce these costs, and economic commentary describing consumer welfare losses from patent pools. This background discussion demonstrates the need for more information about the core function of all patent pools: the conservation of transaction costs. In Part II, we present the results of an original study examining the costs of two prominent patent pools in operation today. Based on our interviews, we believe this data is representative of many other pools in operation. In Part III, we calculate the cost savings of patent pools by comparing what they cost to the cost of the next best alternative—a set of individual licenses. Part IV moves to the consumer welfare losses that are possible with patent pools. These take two primary forms: lost substitutes, and, in those pools that include grantback clauses, reduced incentives to invent in the future. For lost substitutes, we provide a detailed methodology for estimating welfare losses in dollar terms. Then we illustrate its application using data drawn from patent infringement litigation. The analysis of grantbacks comes next; we show how to use state of the art patent portfolio mapping techniques to determine the degree of past R&D overlap of any

²⁵ See *infra*, Section 1-C (“The Push for Greater Antitrust Scrutiny”).

two companies joining a pool. This becomes a benchmark against which to estimate predicted future overlap, which we then use to estimate the number of future lost substitutes expected to result from pooling. With this in hand, we explain how to simply deploy the lost substitute analysis from earlier in Part IV to arrive at an estimate of future welfare loss due to grantback clauses. We conclude with a policy proposal for future governmental oversight of patent pools using the methodology we advance here.

I. Background

Most scholarship on patent pooling follows one of two narratives. One says patent pools facilitate commerce and innovation by reducing transaction costs.²⁶ The second narrative, meanwhile, describes patent pools as platforms for dangerous anti-competitive behavior that reduces competition and slows innovative research.²⁷ Contrary to what one might assume, these stories are not necessarily at odds: a patent pool could conserve substantial transaction costs on the one hand, while simultaneously reducing competition or innovation to some extent on the other. It seems the operative question for regulators and theorists, then, should be simple: on the whole, do patent pools generate more social welfare costs than the transaction costs they conserve? The following discussion lays out the basis for this pressing policy question, which until now, has remained unanswered.

A. Patent Transaction Costs

The concept that patent pools conserve transaction costs is engrained so deeply in legal scholarship that commentators tend to treat it as a maxim, requiring no further explanation.²⁸ As happens sometimes in economics, this conclusion is simply assumed. Estimating the transaction costs patent pools actually save, however, requires some care. Here, we explain the sources of transaction costs that commentators believe hinder efficient exchanges of patent rights, whom these costs fall upon in the

²⁶ See *infra* Section I-B (“How Patent Pools Reduce Transaction Costs”).

²⁷ See *infra* Section I-C (“Antitrust Scrutiny”).

²⁸ Merges *supra* note 11 at 1346 (1996) (“The Aircraft patent pool was “lauded and a far wide success.”); Eisenberg & Heller, *supra* note 2; Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 *Nw. U. L. Rev.* 77, 129 (1999) (“Formal mechanisms [that reduce transaction costs] might include patent pools.”).

absence of patent pools, and how patent pools can reduce them. This discussion lays the foundation for this Article’s central study.

Transaction costs are the expenses a bargainer incurs in the course of discovering whom she wishes to deal with, negotiating agreements, ensuring that the other party fulfills its obligations, and, when necessary, enforcing agreements. Ronald Coase famously showed the importance of transaction costs by, paradoxically, modeling a world where they do not exist. In Coase’s theoretical universe of frictionless bargains, parties always reach agreements that result in the optimal distribution of economic resources, regardless of how initial property rights are assigned.²⁹ In reality, however, transaction costs are as unavoidable and unyielding as gravity. Negotiations fail, litigation foils cooperation, and countless similar impediments can stand between what should happen between bargainers, and what does. Economists count these forgone exchanges as a major source of social cost.³⁰

Commentators believe that a chief source of patent transaction costs is the diffusion of patent ownership.³¹ In the U.S. patent system’s earliest days, single patents typically covered complete commercial products.³² As a result, manufacturers who sought to make and sell patented devices typically needed to negotiate with only one patent holder to license the necessary rights. The relatively simple nature of technologies at that time made tended to concentrate patent entitlements in product manufacturing firms. By contrast, the tools that define our age—the smartphone, internet services, biopharmaceuticals—embody scores of patented inventions

²⁹ Oliver E. Williamson, *The Economic Institutions of Capitalism* 20-22 (1985); Merges, *Contracting Into Liability Rules*, *supra* note 11 1393 (1996) (“In order to carry out a market transaction, it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contracts, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on.”).

³⁰ See Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights*, 60 *Stan. L. Rev.* 863, 867 (2007) (discussing scholarly focus from static to dynamic efficiency costs).

³¹ Heller & Eisenberg, *supra* note 2.

³² See, e.g., Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 *Cal. L. Rev.* 803, 876 (1988) at note 167 (explaining that the “prospect theory” of intellectual property “failure to recognize that in the usual case a patent circumscribes a fairly small corner of technology. The inventor’s ‘prospect’ is usually narrow, hemmed in on all sides by the claims of other inventors....”).

held by different owners. Mark Lemley and Carl Shapiro explain the situation well: “Not only have patents on chemical, biotechnological, hardware, and software inventions proliferated,” they write, “but more and more products incorporate not a single new invention but a combination of many different components, each of which may be the subject of one or more patents.”³³ Consequently, manufacturers today must obtain licenses from *many* different rights holders—a more costly endeavor than licensing from a single rights holder.

Rebecca Eisenberg and Michael Heller coined the term “anticommons” to call attention to the high costs of licensing many patents held by many independent owners.³⁴ In a seminal *Science* article, they explained that researchers in the field of genomics must obtain permission to practice diversely-held “upstream” patent rights before they can pursue promising avenues of “downstream” research.³⁵ Carl Shapiro analogizes this challenge to the process of assembling a pyramid: “in order to scale the pyramid and place a new block on the top,” he explains, “a researcher must gain the permission of each person who previously placed a block in the pyramid.”³⁶

Let’s consider these costs in more specific terms. A prospective licensee—a manufacturer or a researcher—first must identify each of the relevant patent owners holding relevant patents. This typically involves paying attorney fees for a freedom-to-operate opinion.³⁷ If this search yields a list of potential patent holders, the prospective licensee must then contact and successfully negotiate a license with each one. The negotiation process places costs upon both the patent holders and the licensee. These include, for instance, salaries paid to

³³ Mark A. Lemley & Carl Shapiro, Patent Holdup and Royalty Stacking, 85 *Tex. L. Rev.* 1991, 1992 (2007).

³⁴ Heller & Eisenberg, *supra* note 2.

³⁵ *Id.*

³⁶ Shapiro, *supra* note 2 at 120. For examples, see e.g., Bronwyn H. Hall & Rosemarie Ham Ziedonis, The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995, 32 *RAND J. Econ.* 101, 110 (2001). The licensing challenge also exists for researchers who combine existing inventions in non-obvious ways in a horizontal fashion. Edison’s mimeograph combined aspects of the telegraph with a rapidly moving stylus already in existence. It represented the combing of those two ideas—i.e., “recombinant innovation.” See, e.g., Andrew Hargadon, *Sustainable Innovation: Build Your Company’s Capacity to Change the World* 127-147 (Stanford University Press, 2015). This distinction is stylized, of course, as there are mixtures between these two forms as well.

³⁷ *Id.*

business personnel who conduct the deal and fees or salaries paid to lawyers who draft the agreements.³⁸

The potential transaction costs don't end there, however. Because prospective licensees must secure a *sequence* of licenses from different patent holders, each license may be subject to yet another transaction cost in the form of holdouts.³⁹ Scholars sometimes analogize this phenomenon to the dilemma faced by real estate developers who cannot build a large structure—a shopping mall, say—unless they purchase a set of adjacent lots held by different owners. With each lot it purchases, the developer becomes more financially committed to completing the project, and the remaining lot owners become more emboldened to hold out for ever higher prices.⁴⁰ When these holdout demands become too great, the developer may scuttle the project.⁴¹ As Dan Burke and Mark Lemley have explained, “Every property holder needed for the project is subject to this same incentive, and if everyone holds out, the cost of the project will rise substantially and probably prohibitively.”⁴²

Similarly, any patent holder who is contacted for a license may learn that the prospective licensee views their patent rights as necessary parts of a larger set of rights that the licensee must acquire. Knowing that its cooperation is essential to the licensee's plan, the patent holder, like the lot owner, will have an incentive to demand high royalties—i.e., royalties in excess of the normal price for a single patent that patent holders are expected to charge.⁴³ As Carl Shapiro and Mark Lemley have

³⁸ *Id.*

³⁹ See, e.g., Shapiro, *supra* note 2 at 124-126 (terming this phenomenon “The Holdup Problem”).

⁴⁰ Abraham Bell & Gideon Parchomovsky, *The Hidden Function of Takings Compensation*, 96 VA. L. REV. 1673, 1685 (2010); Thomas J. Miceli & Kathleen Segerson, *Sequential Bargaining and Land Assembly: A New Theory of the Holdout Problem*, 14 Am. L. Econ. Rev. 372, 373 (2012) (“[A]s the buyer becomes more committed to the project, sellers are able to extract a larger share of the surplus . . .”).

⁴¹ Mark A. Lemley & Philip J. Weiser, *Should Property or Liability Rules Govern Information?*, 85 Tex. L. Rev. 783, 786-88 (2007); (likening patent holdup to similar strategic behavior in land development); Mattioli, *Communities of Innovation*, *supra* note 2 at 113-14 (drawing an analogy to the phenomenon of “nailhouses” that dot China's urban landscapes).

⁴² Dan L. Burk & Mark A. Lemley, *The Patent Crisis and How The Courts Can Solve It* 76 (2009); Thomas F. Cotter, *Patent Holdup, Patent Remedies, and Antitrust Responses*, 34 J. Corp. L. 1131, 1160 (2009) (analyzing the holdup or holdout problem from an economic perspective).

⁴³ Mattioli, *Power & Governance*, *supra* note 11 at 428 (“This surplus fee (which is distinct from the supra-competitive prices that naturally arise in a

explained, “the threat of an injunction can enable a patent holder to negotiate royalties far in excess of the patent holder’s true economic contribution.”⁴⁴

Yet another transaction cost that can hinder productive patent exchanges stems from litigation. Citing empirical evidence and anecdotal accounts, leading commentators agree that recent steep rises in patent litigation have been spurred by the uncertain validity and scope of coverage that so many patents provide.⁴⁵ Because patents do not possess the clear boundaries of physical property, it may be difficult for a prospective licensee to identify *all* patents that cover a particular product or area of research.⁴⁶ As a result, manufacturers and researchers must incur costs in the form of “freedom-to operate” analyses,⁴⁷ and they must prepare for the strong possibility that they will miss some relevant patents.⁴⁸ The high cost of patent litigation adds to the cost of manufacturing products and developing new technologies.⁴⁹

Commentators agree that the high transaction costs, of which litigation costs are a component, slow innovation and thus harm social welfare. Rebecca Eisenberg and Michael Heller cogently explained how the various costs and risks of licensing upstream patent rights could lead researchers to abandon their projects—a result they call “The Tragedy of the

monopoly setting) could reach as high as the total value of the buyer’s project.”).

⁴⁴ Lemley & Shapiro, *supra* note 33 at 1993 (2007).

⁴⁵ See, e.g., Michael Abramowicz, *Perfecting Patent Prizes*, 56 *Vand. L. Rev.* 115, 216 (2003) (“As in law generally, the existence of litigation suggests that litigations sometimes have different predictions about the law, whether about patent validity or about patent scope.”); Tun-Jen Chiang, *Fixing Patent Boundaries*, 108 *Mich. L. Rev.* 523, 548 (2010).

⁴⁶ See Peter S. Menell and Michael Meurer, *Notice Failure and Notice Externalities*, 5 *Journal of Legal Analysis* 1 (2013), available at <http://jla.oxfordjournals.org/content/early/2013/01/03/jla.las019.full?keytype=ref&ijkey=mJWjpbgGY8Qmru3> (last visited Feb. 1, 2016); Robin Feldman & Tom Ewing, *The Giants Among Us*, 2012 *Stan. Tech. L. Rev.* 1 (2012) (discussing the difficulty of identifying the holders of patent rights relevant to a particular project.).

⁴⁷ See Jamie Sheridan, *New Product Clearance: Freedom to Operate Search and Analysis*, 23 *No. 1 Intell. Prop. & Tech. L.J.* 14 (2011).

⁴⁸ *Id.*

⁴⁹ The annual member survey survey of the American Intellectual Property Law Association (AIPLA) found in 2015 that when a patent claim is worth less than \$1 million, median legal costs are \$873,000 through trial. When a patent claim involves \$25 million or more, costs through trial reach a median of \$6.3 million. American Intellectual Property Law Ass’n (AIPLA) Report of the Economic Survey 2015.

Anticommons.”⁵⁰ Even when projects do proceed, however, transaction costs could still decrease the overall level of innovation in society. Arti Rai has noted, “Even if [transactional] difficulties did not lead to bargaining breakdown, they would create transaction costs that reduced the cooperative surplus to be gained from a license and would thus deter at least some inventors and improvers from negotiating in the first instance.”⁵¹ Mark Lemley and Carl Shapiro have called the holdout problem, meanwhile, a kind of “market failure that leads to inefficiency, primarily by discouraging what would otherwise be socially desirable investments,” adding that “[s]uch royalty overcharges act as a tax on new products incorporating the patented technology, thereby impeding rather than promoting innovation.”⁵² Arti Rai has similarly noted, “at a minimum, holdup strategies produce delay and increase transaction costs.”⁵³ The harmful impact of patent litigation on innovation has matured into a sub-domain of patent scholarship in its own right.⁵⁴ As James Bessen and Michael Meurer have noted, “patent litigation is a real problem for innovators and it does impose a cost on investment in innovation.”⁵⁵

⁵⁰ Heller & Eisenberg, *supra* note 2. See also, Augustin Cournot, *Researches into the Mathematical Principles of the Theory of Wealth* 103-04 (Nathaniel T. Bacon trans., Augustus M. Kelley 2d ed. 1971) (1838) (discussing the increase in price that can result when multiple monopolists control the sale of complementary goods); Richard J. Gilbert, *Ties That Bind: Policies To Promote (Good) Patent Pools*, 77 *Antitrust L.J.* 1, 8 (“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.”).

⁵¹ Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 *Nw. U. L. Rev.* 77, 126 (1999).

⁵² Mark A. Lemley & Carl Shapiro, *Reply: Patent Holdup and Royalty Stacking*, 85 *Tex. L. Rev.* 2163, 2164 (2007).

⁵³ Rai, *supra* note 51 at 128.

⁵⁴ James Bessen & Michael J. Meurer, *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk* 120 (2008) (discussing the cost of disputes) [hereinafter Bessen & Meurer, *Patent Failure*]. See also Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 *Berkeley Tech. L.J.* 1583, 1588 (2009):

[T]here is . . . a problem with the argument that all trolls are just market makers and hence beneficial to economic activity. Not all arbitrage exchange is in fact efficient and socially desirable. . . . [P]atent trolls are selling information with no social value. . . . There is such a thing as a patent troll--someone who engages in inefficient, socially wasteful patent transactions.

⁵⁵ *Id.* at 127.

B. How Patent Pools Reduce Transaction Costs

The cost of patent-related transactions are reduced substantially when a licensee gets rights over many patents from a single licensor. This is the primary purpose of patent pooling.⁵⁶ Patent pools are cooperative business arrangements in which two or more patent holders license out a set of complementary patent rights through a unified “blanket” agreement.⁵⁷ A patent pool may grant these aggregated rights back to each patent-holding member of the group, to outside licensees, or to both.⁵⁸ Some patent pools are operated by corporations to which members have assigned ownership of their patents (usually in exchange for shares); other patent pools are defined by byzantine webs of cross-licenses that define the terms of the cooperative endeavor.⁵⁹ But whatever the particulars, all patent pools accomplish the same thing: they coordinate the licensing of complementary patent rights.

Patent pools can elegantly reduce each of the transaction costs outlined in the foregoing discussion.⁶⁰ By assembling the patent rights that are essential to an underlying technology, for instance, they reduce the cost of freedom-to-operate studies, thus reducing search costs. Importantly, this *ex ante* aggregation of patent rights doesn’t merely shift search costs from prospective licensees to patent holders: it reduces the total number of times the same search for essential patents must be performed. In a world without patent pools, any company that wishes to license patents for a particular purpose does its own search prior to contacting licensors. A patent pool eliminates altogether the need to search in a particular technology area.⁶¹

⁵⁶ Merges, Patent Pools, *supra* note 11 at 10 (“In one respect the optimists and anticommons pessimists agree: the key issue is the cost of integrating disparate rights.”).

⁵⁷ See *supra* notes 11-17 and accompanying text.

⁵⁸ See, e.g., Vaughan, Patent System, *supra* note 11 at 39.

⁵⁹ *Id.* See also Mattioli, Power & Governance, *supra* note 11 at 439-455 for an empirical study of these different structures.

⁶⁰ See generally, Merges, Patent Pools, *supra* note 11 at 13.

⁶¹ We believe it is helpful to appreciate that the founding members of patent pools often have strong incentives to ensure that all standard essential patents (SEPs) are included in their pool: a significant motivation stems from the fact that these patent holders are often also licensees of the underlying technology and would, as a result, wish to avoid being sued by non-members for patent infringement. Some commentators have argued that many patent pools do not contain complete sets of essential patents, however. [Layne-Farrar and Joshua Lerner surveyed nine patent pools, mostly related to standards, and found that they contained between 5% and 89% of the relevant patents specifically identified to the standard.] Nevertheless, even if

Patent pools also reduce the costs of negotiating individual patent licenses and the associated risk of holdouts. By reducing the number of licensors with whom a patent licensee must deal, patent pools eliminate the need for multiple costly negotiations. Moreover, by standardizing the terms on which they offer their bundled rights through form contracts, patent pools render costly negotiations unnecessary.⁶² The risk of holdouts, meanwhile, is reduced by virtue of the fact that patent pools collapse what would ordinarily be a sequence of licenses into a single, discrete event. As Rob Shapiro has explained, “Thus, from the licensee’s perspective, licensing the entire package is simpler and avoids the danger of paying for some patent rights that turn out to be useless without other complementary rights.”⁶³

The savings don’t only accrue to licensees. Patent pools significantly reduce transaction costs for their members as well. Patent holders who license out their rights through patent pools are often also licensees—i.e., they are manufacturers, sellers, and users of the underlying technology.⁶⁴ Most patent pools extend licenses to their members, either on a royalty-free basis or at a standard rate.⁶⁵ In this way, patent pools solve a difficult valuation problem and regularize transactions by settling the rates licensees will pay for access to the entire pool and the rules for dividing the spoils.⁶⁶ Of course, these savings come only after a pool is first set up – which itself involves some expense, as we see Section II, below.⁶⁷

Patent pools also substantially reduce the odds of patent litigation between their members.⁶⁸ In fact, many historic patent pools were designed to resolve tangled webs of litigation among

a patent pool does not contain all patents essential to an underlying technology, it still undoubtedly reduces search costs by simplifying searches for additional patents and by offering searches a foundation upon which to base their searches. Mark Lemley and Carl Shapiro have opined that even if a pool cannot aggregate all the complementary rights in a stacked industry, they can still help. Lemley & Shapiro, *supra* note 33 at 2029.

⁶² FRAND licensing plans offer a similar benefit.

⁶³ Shapiro, Thicket, *supra* note 2 at 134.

⁶⁴ This is reflected in the membership agreements of patent pools examined in this very study. Mattioli, Power & Governance, *supra* note 11 shows the membership of many patent pools includes licensor-licensees.

⁶⁵ Josh Lerner et al., The Design of Patent Pools: The Determinants of Licensing Rules, 38 *Rand J. Econ.* 610 (2007).

⁶⁶ Merges, Patent Pools, *supra* note 11 at 13.

⁶⁷ *Infra*, Section II (“What Do Patent Pools Cost to Operate? (A Study)”).

⁶⁸ Shapiro, Thicket, *supra* note 2 at 128-129.

the founding members.⁶⁹ As Roger B. Andewelt, former chief of the Intellectual Property division of the Department of Justice once observed, “A patent pool can be economically beneficial because pooling can be a highly efficient way of resolving legal conflicts involving patent infringement or patent interference.”⁷⁰

In summary, patent pools can conserve transaction costs normally incurred by patent holders and outside licensees. These include the costs of searching for licensors, negotiating licenses with them, and weathering the costly challenges posed by holdout behavior and litigation.⁷¹ Scholars have identified many additional benefits that patent pools may confer, but these fall outside of this discussion’s narrow focus on transaction costs.⁷²

The foregoing discussion has fleshed out the theoretical picture of how patent pools conserve transaction costs. By categorizing these costs and describing them in plain terms, we have provided a framework upon which we will base our empirical study. Before that, however, we next explain why our study is needed.

C. Antitrust Scrutiny

For all of their efficiencies, patent pools have long concerned antitrust authorities and scholars for their potential to harm competition—a sensible concern in any setting where

⁶⁹ See, e.g., Mattioli, *Communities of Innovation*, supra note 2 at 130-33 (discussing the development of the Manufacturers Aircraft Association).

⁷⁰ Roger B. Andewelt Chief, Intellectual Property Section Antitrust Division, *Analysis of Patent Pools Under the Antitrust Laws*, 53 *Antitrust L.J.* 611, 615 (1985).

⁷¹ In the absence of a patent pool, some of these costs would fall solely on a prospective licensee, while other costs (e.g., litigation) could fall upon both the prospective licensee and licensor.

⁷² For patent holders, a patent pool could mean the difference between collecting some royalty and collecting no royalties. As Ward S. Bowman observed, “both courts and commentators have recognized a valid need for the interchange or the pooling of complementary or blocking patents as the only feasible alternative to a waiver of valid patent rights.” Ward S. Bowman, *Patent and Antitrust Law: A Legal and Economic Appraisal* 202 (1973). Stated differently, a patent pool may sometimes be the only means for a patent holder to capture the value of their patents. Andewelt, supra note 70 at 616 - 17. The benefits for licensees seem substantial as well. A recent study estimated that \$100 billion in product sales have come from patent pools. Gavin Clarkson, *Objective Identification of Patent Thickets: A Network Analytics Approach for Measuring the Density of Patent Space* (Ph.D. thesis, Harvard University, 2004) (on file with authors).

competitors cooperate.⁷³ Such concerns waxed and waned during the 20th Century and have recently returned to the forefront, largely in response to the formation of new patent pools in the consumer electronics industry.

The Antitrust Division of the Department of Justice (DOJ) is primarily responsible for oversight of patent pools. Statements from the DOJ on patent pools—which typically take the form of published guidelines and advisory letters—mostly center on the negative effects of cooperation between competitors. In the past, some patent pools were thinly veiled cartel arrangements through which companies selling the same product agreed to fix prices or limit output.⁷⁴ Because these “horizontal” arrangements are clearly harmful to competition and, by extension, to consumer welfare, antitrust authorities cast a wary eye on them. This oversight is supported and motivated by the academic scholarship on patent pools, which has often been critical as well.⁷⁵

1. Substitute Patents and Complementary Patents

Pools can facilitate other forms of consumer-harming behavior among competitors. The most common source of antitrust anxiety is a deal among companies that limits competition with respect to a certain technology. In many cases, there is more than one way to achieve a technical goal. Where multiple, competitive approaches are each subject to independent patents, agreements by competing companies can suppress competition between those patents. The effect is the same as when two producers of a given product agree that they will no longer compete vigorously, but instead will sell a standardized product and split the market between them.

⁷³ Gilbert, *supra* note 50 at 5 (“Antitrust enforcers historically have viewed patent with an element of mistrust.”).

⁷⁴ U.S. Department of Justice and U.S. Federal Trade Commission, *Antitrust Guidelines for the Licensing of Intellectual Property*, April 6, 1995, avail. at <http://www.justice.gov/sites/default/files/atr/legacy/2006/04/27/0558.pdf>, at pp. 27-30 (“DOJ 1995 Guidelines”).

⁷⁵ Steven C. Carlson, *Patent Pools and the Antitrust Dilemma*, 16 *Yale J. on Reg.* 359, 372 (1999) (exploring a variety of potential costs patent pools impose upon society: that some blocking patents, when pooled, may nevertheless harm competition; that patent pools shield invalid patents from litigation; that pools can bring competitors into collusion; and that patent pools can facilitate harmful package licensing unless they are very carefully structured). Philip B. Nelson, *Patent Pools: An Economic Assessment of Current Law and Policy*, 38 *Rutgers J.J.* 539 (2007) (expanding upon earlier work related to the potential anticompetitive effects of patent pools).

In the parlance of antitrust, this kind of arrangement is described as a pool that includes “substitutes.” Generally, economists and the DOJ are suspicious of patent pools that include substitute technologies (i.e., patents that cover technological substitutes). As the DOJ stated in its 2007 review of hearings on this issue,

[A] pool containing substitutable patents, i.e., patents covering technologies that compete with each other and that licensee producers would choose between, may have the anticompetitive effect of increasing the total royalty rate to licensees. Thus, an important part of the analysis of a patent pool is whether, and to what extent, licensees use the patents in the pool as complements or as substitutes.⁷⁶

Some view this as a pressing policy concern. Two commentators, for instance, recently contended that a prominent patent pool has harmed competition by wrongfully including patents that are not essential to the pool’s underlying technology. They separately faulted the pool for being overzealous in seeking licensing fees over the practice of rival technologies that may infringe upon the pooled patent rights. The authors argued that federal agencies should impose new conditions on patent pools, including a continuing obligation to rely fully on independent experts to identify standard-essential patents for inclusion in a pool. The notion that a patent pool may reduce competition even when it does not have a monopoly over the underlying technology is novel, and notably, in conflict with Justice Brandeis’ majority opinion in *Standard Oil*—a seminal Supreme Court case approving of a patent pool explicitly because it did not dominate the industry.

2. Grantbacks and Innovation Markets

Competition-based concerns relating to patent pools have been around for a long time. Beginning with the DOJ’s IP Licensing Guidelines in 1995, a new wrinkle was added. In that document, the DOJ described more dynamic, long-term potential harms from collaboration among potential

⁷⁶ U.S. Department of Justice, *Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition*, April, 2007, available at <http://www.justice.gov/atr/antitrust-enforcement-and-intellectual-property-rights-promoting-innovation-and-competition> (last visited February 1, 2016).

technological competitors. Under the rubric of “innovation markets,” the DOJ said that patent pooling has the potential to affect future R&D efforts, and that antitrust review must take account of this.⁷⁷

This topic has spawned a thread of academic commentary that, in broad strokes, maintains that patent pools have a net negative effect upon the rate and direction of technological advancement. The respected economist, Richard Gilbert, for instance, has called attention to the fact that a patent pool may require its members or licensees to license-back to the pool after-arising patents covering competing technologies. A pool could achieve this, Gilbert explains, by broadly defining “essential” technologies that a licensee must grant back. As a result, he writes, “[p]atent pools can harm consumers by reducing incentives to innovate.”⁷⁸ Ryan Lampe and Petra Moser turned to historical records of the Singer Combination to investigate this possibility. Using the rate of stitches-per-minute that sewing machines were capable of as a proxy for the level of innovation in that industry, Lampe and Moser concluded that the Singer Combination discouraged technological progress by increasing the threat of litigation perceived by firms outside the pool.⁷⁹ Inspired by this new line of scholarship, a rising chorus of commentators argues that courts and regulators should regard patent pools with greater scrutiny and subject them to greater restrictions.⁸⁰

⁷⁷ See DOJ 1995 Guidelines, at 10-11 (footnote omitted):

An innovation market consists of the research and development directed to particular new or improved goods or processes, and the close substitutes for that research and development. The close substitutes are research and development efforts, technologies, and goods that significantly constrain the exercise of market power with respect to the relevant research and development, for example by limiting the ability and incentive of a hypothetical monopolist to retard the pace of research and development.

⁷⁸ Gilbert, *supra* note 50 at 13 (“Patent pools can harm consumers by reducing incentives to innovate.”); Richard J. Gilbert, *Antitrust for Patent Pools: A Century of Policy Evaluation*, 4 *Stan. Tech. Rev. L.J.* (2004).

⁷⁹ Ryan Lampe & Petra Moser, *Do Patent Pools Encourage Innovation? Evidence from the 19th-Century Sewing Machine Industry* (working paper dated June 8, 2010).

⁸⁰ Scott Sher et al., *The Role of Antitrust in Evaluating the Competitive Impact of Patent Pooling Arrangements*, 13 *Sedona Conf. J.* 111 (2012) (arguing for enhanced antitrust scrutiny of patent pools).

D. The Need for a Baseline Measurement

On balance, patent pooling literature paints two seemingly conflicting portraits: patent pools threaten competition and innovation and yet, they cure inefficiencies that are believed to hinder innovation and production.⁸¹ Contradictory as these two views may seem, they are not necessarily in conflict. By virtue of their structure, nearly all patent pools will conserve some transaction costs, but some may also reduce competition or innovation. In this light, the current wave of critical commentary seems puzzling. Why would commentators argue that patent pools require swift governmental attention unless they believe that, on the whole, patent pools cost society more than they bestow? There is no clear evidence supporting this view and yet it appears to have real support.

A baseline measurement of the transaction costs that patent pools save would ground this theoretical debate and offer useful guidance to policymakers. If the critics of patent pools are concerned about a set of social costs that pale in comparison to the benefits that patent pools bestow, then their concerns may require no action. Carl Shapiro realized this when he considered the dual capabilities of patent pools in the late 1990s. “[A] concern,” he wrote, “is that the granting of licenses to future patents will reduce each company’s incentive to innovation because its rival will be able to imitate its improvements. While correct in theory, it is clear, it least in the case of semiconductors and no doubt more widely, that this concern is dwarfed by the benefits arising when each firm enjoys enhanced design freedom by virtue of its access to the other firm’s patent portfolio.”⁸²

A baseline measurement of the costs and savings of patent pools could also be helpful to policymakers. That is how other fields of law have grappled with private behavior that presents twin potentials of reducing transaction costs while

⁸¹ Commentators have sometimes framed the issue in such either/or terms. Ward S. Bowman wrote, “A central issue in any pooling of assets is whether competition among the merged resources is eliminated or whether more efficient use of the merged resources results.” Bowman, *supra* note 72 at 200.

⁸² Shapiro, *supra* note 2 at 130 (“Under these circumstances, we can ill afford to further raise transaction costs by making it difficult for patentees possessing complementary and potentially blocking patents to coordinate to engage in cross licensing, package licensing, or to form patent pools. Yet antitrust law can potentially play such a counterproductive role, especially since antitrust jurisprudence starts with a hostility toward cooperation among horizontal rivals.”).

potentially imposing social costs. Form contracts, for instance, facilitate valuable commerce by eliminating the need for negotiations in everyday transactions.⁸³ Because consumers rarely read these agreements, however, an unscrupulous offeror could bind its customers to terms they would not ordinarily agree to.⁸⁴ Form contracts are commonly enforced under U.S. law because, often, judges and lawmakers have made a policy determination that, on average, their benefits outweigh their potential for harm.⁸⁵ Similarly, if patent pools confer more benefits than costs on average, then policymakers should begin their analysis of any pool with an attitude of presumptive approval. Only if adequate evidence exists to prove that a patent pool has violated the law should any further legal action be taken. In the next Section, we present original evidence that reveals just such a baseline.

II. What Do Patent Pools Cost to Operate? (A Study)

To estimate the transaction costs that patent pools conserve, we rely on two numbers: an estimate of what they cost, and an estimated cost of the next best alternative mechanism for producing the same result—i.e., a set of individual licenses. We begin with the first number. The information presented in this Section was provided directly by two of the largest patent pool administrators in operation today: MPEG LA, LLC and Via Licensing Corp.⁸⁶ Through a set of semi-structured interviews

⁸³ See, e.g., David Horton, *Flipping the Script: Contra Proferentem and Standard Form Contracts*, 80 U. Colo. L. Rev. 431, 433 (2009) (discussing the potential costs and benefits of form contracts); A. Corbin, *Corbin on Contracts* § 559A, at 479 (C. Kaufman Supp. 1982) (“Since the bulk of contracts signed in this country, if not every major Western nation, are adhesion contracts, a rule automatically invalidating adhesion contracts would be completely unworkable.”). Patent pool licenses are typically presented to prospective licensees as form agreements.

⁸⁴ *Id.*

⁸⁵ See *Carnival Cruise Lines v Shute*, 499 US 585, 594 (1991) (upholding a forum selection clause in a form contract attached to a cruise ticket, based in part on reasoning that such clauses promote efficiency); See also Russell Korobkin, *Bounded Rationality, Standard Form Contracts and Unconscionability*, 70 U. Chi. L. Rev. 1203, 1275-76 (2003) (“Depending on the significant of these savings in a particular market, the benefit to buyers of even a one-sided arbitration clause, in the form of lower prices, might outweigh the costs of waiving their rights to invoke the jurisdiction of the public courts.”).

⁸⁶ These are the largest two administrators based on the number of pools they oversee and the economic importance of the technologies those pools cover.

with senior personnel at these companies, we gathered a wealth of information on the costs of establishing and operating two patent pools based around technological standards.

A. Interview Methodology

As a prelude to the substance of our study, we wish to explain our interview methodology. Our process began with a draft set of questions that we hoped to ask the administrators of patent pools. (We selected an interview format because this information is not published or otherwise available.) Our draft questions included, for instance, the costs involved with bringing a set of patent holders together to determine which patents are essential to an underlying technology; and the cost of hammering out an agreement that governs matters such as prices to be charged, the division of royalties, and so forth. We refined our questions and received necessary internal review board approval.

We then contacted senior personnel at two of the largest patent pool administrators in operation today: MPEG-LA, LLC and Via Licensing. MPEG-LA is based in Denver, Colorado and administers 13 patent pools covering an array of digital standards including MPEG video (“2” and “4”), DisplayPort, and High Efficiency Video Encoding (HEVC).⁸⁷ Via is based in San Francisco and administers 9 patent pools covering a different set of widely used standards, including 802.11 (“Wi-Fi”), LTE (wireless data), and MPEG Audio.⁸⁸ The individuals we contacted agreed to participate in our study, and answered our questions by phone and by email. Each subject offered information relevant to one patent pool that they believed represented the average (in terms of scale and cost) among the set of pools they administer.

B. Cost of Establishing MPEG Audio Patent Pool

The MPEG Audio patent pool took form in the late 1990s, amidst the monumental shift toward digital media as the preferred medium for distribution and playback of recorded sound.⁸⁹ A

⁸⁷ See “Revolutionizing Intellectual Property Rights Management” at <http://www.mpegla.com/main/Pages/About.aspx> (click on “Current Programs”) (last visited Feb. 1, 2016).

⁸⁸ See “About Via” at <http://www.vialicensing.com/about/index.aspx> (click on “Licensing Programs”) (last visited Feb. 1, 2016).

⁸⁹ For an historical account of this shift, see Stephen Witt, *How Music Got Free, The End of an Industry, the Turn of the Century, and the Patient Zero of*

consortium of prominent technology companies organized by the International Standards Organization's ("ISO") Moving Picture Experts Group ("MPEG") had developed the MPEG Audio standard during the late 1980s and the early 1990s.⁹⁰ When the standard was finalized in 1997, several members of this consortium (including AT&T, Dolby, and Sony) identified patents essential to its use. Dolby organized a patent pool and later launched a new company, "Via Licensing Corporation," for the purpose of licensing these patent rights out to manufacturers, collecting royalties, and distributing those royalties to the patent holders.⁹¹ These core operations constituted the MPEG Audio patent pool.

Commenting for this Article, the president of Via reported that four employees were essential to the establishment of the MPEG Audio patent pool: the company's President, its General Counsel, a program manager, and a staff member who helped arrange meetings.⁹² The cost of the work these employees performed can be estimated based upon two figures: each employee's full-time salary and the percentage of their time they put into the project. Our interviewee reported that the President and General Counsel each devoted 20% of their time to establishing the MPEG Audio patent pool during the institution's development.⁹³ Because both employees had an annual salary of about \$200,000, the annual cost attributable to the MPEG Audio patent pool's development was \$40,000 for each employee—or about \$80,000 for both. Because the pool was in development for two years, the total cost for both employees was about \$160,000. The Program Manager, whose annual salary was \$150,000, devoted 65% of his time, yielding a total cost of \$195,000 over the same two-year period.⁹⁴ Using

Piracy (Viking, 2015). The MPEG Audio patent pool administered by Via Licensing began in 1998. "MPEG-2 AAC" at <http://www.vialicensing.com/licensing/mpeg2aac-overview.aspx> (last visited Feb. 1, 2016). The standard is ISO/IEC 13818-7. Id. Technical information on this standard can be obtained from the International Standards Organization at <https://www.iso.org> (last visited Feb. 1, 2016).

⁹⁰ Id.

⁹¹ See Press Release, Dolby Laboratories, "Dolby Laboratories Launches New Patent Licensing Subsidiary" (Nov. 25, 2002) available at [http://www.vialicensing.com/uploadedFiles/US/News_and_Events/News/11_25_2002_Dolby_Laboratories_Launches_New_Patent_Licensing_Subsidary\(2\).pdf](http://www.vialicensing.com/uploadedFiles/US/News_and_Events/News/11_25_2002_Dolby_Laboratories_Launches_New_Patent_Licensing_Subsidary(2).pdf) (last visited Feb. 1, 2016).

⁹² Email interview with Roger Ross, President Via Licensing Corporation (Jul. 15, 2015).

⁹³ Id.

⁹⁴ Id.

the same method, we determined that costs attributable to the events manager equaled \$30,000 (based upon an annual salary of \$60,000 and 25% of full-time employment devoted to the project over 2 years). Adding these figures together yields a total of approximately \$385,000 incurred by Via Licensing on the MPEG Audio patent pool's development.

A similar method allows us to estimate what each patent holder who helped establish the MPEG Audio patent pool spent on its development. According to our interviewee, each of the 14 founding licensors involved with the pool's formation tasked two employees to work on the project.⁹⁵ We assume that each of these employees devoted 10% of their full-time efforts to the pool's development over the course of two years. We also assume that each was paid \$200,000 annually. This yields a total of approximately \$40,000 per employee over the two-year development window. With a total of 28 employees across all of the founders, the total cost to the patent holders of establishing the MPEG Audio patent pool was approximately \$1,120,000.

Our interview subject reported an additional set of costs related to the MPEG Audio patent pool's development: the founding patent holders and representatives from Via Licensing participated in 13 planning meetings in Asia, Europe, and the US, each of which spanned two days.⁹⁶ Each of the 14 founding companies sent two senior professionals to each meeting.⁹⁷ Drawing upon published industry data, travel and lodging for each employee could be estimated at approximately \$2,000 for each meeting, or \$4,000 for both employees.⁹⁸ Thus, the cost to each patent holder was approximately \$4,000 multiplied by 13 meetings, or \$52,000. Multiplying this amount again by the 14 patent holders yields a total cost of \$728,000.

Via also sent its 4 professionals mentioned earlier to these 13 meetings.⁹⁹ Although we have already included their salaries in our estimate, it is appropriate to add on the travel and lodging expenses these employees incurred. Again drawing

⁹⁵ Id.

⁹⁶ Id.

⁹⁷ Id.

⁹⁸ PR Newswire, *Buyers Expect Better Year for Business Travel, but Rising Rates and Tough Negotiations Loom* (Feb. 13, 2013) available at <http://www.prnewswire.com/news-releases/buyers-expect-better-year-for-business-travel-but-rising-rates-and-tough-negotiations-loom-191005381.html> (reporting information from business travel survey) (last visited Jan 29, 2016).

⁹⁹ Email interview with Roger Ross, President Via Licensing Corporation (Jul. 15, 2015).

from industry data on business travel expenses, these costs can be estimated to be \$2,000 per employee for each meeting. For all 4 professionals, then, the total cost of attending 13 meetings was approximately \$104,000.

Finally, our Via interview subject cited two additional setup costs: information technology and administrative systems totaling \$100,000-\$200,000, and fees paid to attorneys to evaluate patents to be included in the pool—e.g., evaluating the essentiality of proposed standard-essential patents.¹⁰⁰ According to the interviewee, an outside law firm charged \$7,500 per patent for this service (a bulk discounted rate).¹⁰¹ The MPEG audio patent pool had a total of 700 patents included at the time of its formation, corresponding to an approximate total cost of \$5,250,000 in attorney fees.¹⁰² The table below tallies the total setup expenses for the MPEG Audio patent pool:

Table 1: Costs of Establishing the MPEG Audio Patent Pool

Expenses (over a two-year period)	Costs to Via Licensing	Costs to 14 Licensors
Employee Salaries	\$385,000	\$1,120,000
Travel & Lodging (14 meetings)	\$105,000	\$728,000
Patent Evaluation Fees	\$5,250,000	
IT and Administrative Costs	\$200,000	
Subtotals	\$5,939,000	\$1,848,000
Total Estimated Costs		\$7,807,000

C. Cost of Establishing HEVC Patent Pool

The High Efficiency Video Encoding Compression (“HEVC”) standard was recently developed by the ISO’s MPEG and Video Coding Experts working groups.¹⁰³ Over the course of two years, patent holders that participated in developing the standard collaborated with MPEG LA to develop a patent pool around the fledgling compression technology.¹⁰⁴ MPEG LA issued a public “call for patents” in June 2012 and the HEVC patent pool launched in September of 2013.¹⁰⁵ At that time, the pool

¹⁰⁰ Id.

¹⁰¹ Id.

¹⁰² Information provided by Via Licensing Corporation (on file with authors).

¹⁰³ See Press Release, MPEG, “MPEG HEVC – The next major milestone in MPEG video history is achieved” (Jan., 2013) available at http://mpeg.chiariglione.org/sites/default/files/files/meetings/docs/w13_253_0.doc (last visited Feb. 1, 2016).

¹⁰⁴ Email interview with Bill Geary, Vice President of Business Development, MPEG LA, LLC (Apr. 9, 2015).

¹⁰⁵ Id.

managed the licensing of 600 patents owned by 23 licensors, including Apple, Samsung, and Fujitsu.¹⁰⁶ As of this writing, the pool contains 2,600 patents owned by 29 patent licensors.¹⁰⁷

To estimate the development costs of the HEVC patent pool, we interviewed MPEG LA's General Counsel and followed a methodology similar to the one detailed in the foregoing discussion of the MPEG Audio patent pool—i.e., we consider factors such as employee salaries, average time spent on pool-related tasks, and travel expenses.

We begin with the cost incurred by the pool's founding members. Thirty-four companies were involved in the process of building the pool.¹⁰⁸ (Some dropped out, which is why the final pool includes only 26 licensors.) Each of these companies sent two employees to work on the project.¹⁰⁹ Their tasks included, for instance, examining their employer's patent portfolio for essential patents, reading and responding to correspondence from other licensors and the pool's administrator, and importantly, attending a set of eight development meetings. According to our interview subject, there was some variety in the type of professional that each patent holder assigned tasks to, and what these people were paid. Korean companies often assigned pool-related tasks to business professionals who received, on average, \$100,000 in annual salary. American companies, meanwhile, usually assigned the work to in-house attorneys whose salaries ranged between \$200,000 - \$400,000. Most companies involved were Korean, but we wish to avoid underestimating costs, so we select an average salary of \$200,000 per year paid by each patent holder to employees involved on pool development.

Our interview subject estimated that the time devoted to these tasks along with time spent in joint meetings likely equaled about four full work weeks per year for each employee. Assuming that each employee received, on average, \$200,000 in annual salary, this amount of time equates to about \$15,400 per year. Multiplying this cost by the number of employees at each company (two) and the number of years spent working on the HEVC pool (two) yields a total cost of about \$62,000 per company. Because thirty-four companies participated in

¹⁰⁶ Press Release, MPEG LA, MPEG LA Offers HEVC Patent Portfolio License (Sep. 29, 2014), <http://www.mpegla.com/Lists/MPEG%20LA%20News%20List/Attachments/91/n-14-09-29.pdf> (last visited Jan. 29, 2016).

¹⁰⁷ See

¹⁰⁸ Email interview with Bill Geary, Vice President of Business Development, MPEG LA, LLC (Apr. 9, 2015).

¹⁰⁹ Id.

developing the pool, the aggregate cost these patent holders devoted to salaries was about \$2,100,000.

Each patent holder also sent its employees to a series of eight meetings held over the two-year development period. As our interview subject explained, these meetings were devoted to negotiating and drafting the pool agreement (usually with different rate options and pool revenue estimates). Non-manufacturer licensors typically pushed for higher royalty rates, while manufacturer-licensors sought lower royalty payments and maximum or “cap” payments. Between thirty-two and thirty-four licensors participated in these meetings, each of whom sent approximately two employees.¹¹⁰ Borrowing the data cited earlier on average business travel expenses, we can estimate that each company spent \$2,000 per employee for each meeting. Multiplying this by the number of employees attending each meeting (two) and the number of meetings (eight), we estimate total travel expenses for each company involved with the development of the pool were \$32,000. If thirty-four companies participated, the total is \$1,088,000—we’ll say \$1,200,00 for convenience. In summary, the 34 licensors involved in establishing the HEVC patent pool spent approximately \$2,100,00 in employee salaries and \$1,200,00 in travel expenses, totaling approximately \$3.2 million.

Turning to the development costs incurred by MPEG-LA, it is notable that there were many employees involved with this patent pool from the very start—eleven in total. These included the CEO, senior executives, financial analysts, and contract administrators. Our interview subject estimated that these employees devoted approximately 4,500 hours to the HEVC patent pool’s development, costing MPEG-LA a total of \$1.4 million over the two years. The following tables summarize the information outlined in this part:

Table 2: Costs of Establishing the HEVC Patent Pool

Expenses (over a two-year period)	Costs to MPEG LA	Costs to 34 Licensors
Employee Salaries	(included in subtotal)	\$2,100,000
Travel & Lodging (14 meetings)	(included in subtotal)	\$1,200,000
Subtotals	\$1,400,000	\$3,200,000
Total Estimated Costs		\$4,600,000

¹¹⁰ A number of companies participating in these meetings were not included in the pool as licensors at launch.

D. Annual Costs of Ongoing Operations

Having estimated the cost to establish the MPEG Audio and HEVC patent pools, we consider the ongoing operational costs of each pool. Our interview subject at Via reported that his company tasks between three and five employees to handle sales and licensing for each patent pool it administers.¹¹¹ Each of these sales employees receives an annual salary of between \$100,000-\$140,000 and devotes about 30% of their time to each pool they work on.¹¹² Adopting the largest of these values (for the sake of argument), we assume 30% of fulltime pay for five employees, each of whom received a salary of \$140,000. This yields a total of \$210,000 in annual salaries paid by Via to sales personnel for each pool it administers.

The interview subject from Via also explained that IT costs related to invoicing and record-keeping for each patent pool are between \$100,000 and \$200,000 annually.¹¹³ We again adopt the high estimate of \$200,000. Via Licensing also sends its sales team to one meeting per year.¹¹⁴ Drawing from the average business travel costs cited earlier, we assume this costs Via \$2,000 per employee for each trip, or approximately \$10,000 total.¹¹⁵

In addition to its sales team, Via Licensing's president, general counsel, and a program manager devote a portion of their time to each patent pool the company administers. Our interview subject estimated that program managers devote 30% of their fulltime efforts to each pool they oversee, while the general counsel and president each devote about 5% of their time to each pool in post-formation years.¹¹⁶ Given the salaries cited earlier, this yields an annual cost of \$45,000 for the program manager and \$10,000 each for the president and general counsel (\$165,000 total). Via also incurs approximately \$75,000-\$100,000 in accounting fees for each patent pool it administers.¹¹⁷

According to our interviewee, patent licensees typically assign one or two professionals to work with Via Licensing to

¹¹¹ Email interview with Roger Ross, President Via Licensing Corporation (Jul. 15, 2015).

¹¹² Id.

¹¹³ Id.

¹¹⁴ Id.

¹¹⁵ See supra note 98 and accompanying text.

¹¹⁶ Email interview with Roger Ross, President Via Licensing Corporation (Jul. 15, 2015).

¹¹⁷ Id.

manage royalty payments and the like.¹¹⁸ We assume that each employee devotes 10% of his or her time to this work. If each employee is paid an annual salary of \$150,000 (also an assumption), this yields a total of \$30,000 per year for each licensee. According to Via Licensing’s website, the total number of licensees is 805.¹¹⁹

Table 3: Annual Costs of MPEG Audio Patent Pool

Expenses	Cost to Via Licensing	Cost to each licensee	Cost to each licensor
Employee Salaries (sales)	\$210,000	\$30,000	
Employee Salaries (other)	\$265,000		
Travel and Lodging	\$10,000		
IT and Administrative Costs	\$200,000		
Totals	\$685,000	\$30,000	N/A

Turning to HEVC, our interview subject estimated that MPEG LA devotes approximately \$2 million every year to supporting the ongoing operation of the HEVC patent pool.¹²⁰ Fleshing the number out a bit, the interview subject explained that MPEG LA employs 9 full-time employees to manage ongoing licensing and sales related to the ten patent pools the company manages.¹²¹ Their work includes dealing with licensors and licensees, a withholding tax group, auditing services, software systems experts to support the program, etc.¹²²

Again, licensees and licensors must devote resources to working with the patent pool as well. Licensees devote most of their ongoing resources to reporting royalty-related data to the patent pool, such as the number of units incorporating the technology they have sold or their revenues from sales. This work takes one or two professionals anywhere from six to ten weeks per year. If we assume an annual salary of \$150,000, this work costs each licensee anywhere from roughly \$20,000 to \$60,000. For the sake of convenience, we settle on a middle value of \$40,000. According to MPEG LA’s website, the total

¹¹⁸ Id.

¹¹⁹ “MPEG-2 AAC Licensees” at <http://www.vialicensing.com/licensing/mpeg2aac-licensees.aspx> (last visited Feb. 1, 2016).

¹²⁰ Email interview with Bill Geary, Vice President of Business Development, MPEG LA, LLC (Apr. 9, 2015).

¹²¹ Id.

¹²² Id.

number of licensees is 34.¹²³ Licensors, meanwhile, must put in more work—having attorneys and patent agents make an ongoing effort to look at patents to add to the pool. Although our subject had no data for this cost, we can estimate that a single patent agent might devote one half of his or her full time work to this. Assuming annual pay of \$150,000, this would equate to \$75,000. According to MPEG LA’s website, the total number of licensors is 66.¹²⁴

Table 4: Annual Costs of HEVC Patent Pool

Expenses	Cost to MPEG LA	Cost to each licensee	Cost to each licensor
Employee Salaries (sales)		\$40,000	\$75,000
Employee Salaries (other)			
Travel and Lodging			
IT and Administrative Costs			
Totals	\$2,000,000	\$40,000	\$75,000

III. Estimating Transaction Cost Savings of Patent Pools

At a high level, our method of estimating the transaction costs that patent pools conserve involves a simple subtraction: we estimate the cost of the next best alternative to a patent pool—denoted as “non-pooling licensing costs” or “NPLC”—and we subtract from this amount the costs that go into setting up and operating a patent pool—termed herein “pooling costs” or “PC.” The forgoing study has given us the second number; in the following paragraphs, we explain our method for obtaining the first. Later in this Section, we calculate a cost estimate how much patent pools conserve.

A. How Much Does “The Next Best Thing” Cost?

The discussion in Section I of the transaction costs that afflict our patent system offers a helpful guide to estimating the costs that would exist in the absence of a patent pool (NPLC). We can begin with the cost that a prospective licensee would incur

¹²³ “HEVC Licensees” at <http://www.mpegla.com/main/programs/HEVC/Pages/Licensees.aspx> (last visited Feb. 2, 2016).

¹²⁴ “HEVC Licensors” at <http://www.mpegla.com/main/programs/HEVC/Pages/Licensors.aspx> (last visited Feb. 2, 2016).

searching for the holders of all patents that cover the underlying technology. This prospective licensee may hold some essential patent rights itself, or it may hold none at all—that is, it would be an “outside licensee” if a patent pool existed. In either case, in the absence of a patent pool, this prospective licensee would need to pay a professional to conduct a freedom-to-operate search. We refer to this search cost as “SCost.”

The prospective licensee will then need to negotiate licenses with each relevant patent holder identified by the search. For outside licensees, we conservatively assume this sum would be the average cost of negotiating and drafting a typical patent license agreement.¹²⁵ We denote this cost as

¹²⁵ This, we emphasize, is a *very* conservative estimate. Compare this very reasonable cost with the actual reported cost licensees incur *each year* in their dealings with the MPEG and HEVC pools: \$30,000-\$40,000 as described infra Tables 3 and 4 and accompanying text. In addition, this estimate does not reflect the possibility that some fraction of licensor-licensee negotiations will break down, resulting in litigation. If for example 1 in 20 negotiations lead to litigation, this adds considerably to the transaction cost estimate. The HEVC pool, for example, with its 66 licensees (see below) might be expected to produce 3 patent litigations. The MPEG pool, with its 800 licensees, would produce 40. Even if only 1 in 100 negotiations fail and lead to court, this represents an estimate of .6 of a patent litigation for the HEVC pool; for the MPEG pool, roughly 8 patent cases in court. Patent litigation rates depend on a number of factors. Though 5,700 total patent infringement cases were filed in 2014, for example, they are not spread evenly across all technology areas. See Price Waterhouse Coopers, 2015 Patent Litigation Study (2015), at 3, available at <https://www.pwc.com/us/en/forensic-services/publications/assets/2015-pwc-patent-litigation-study.pdf> (last visited Feb. 1, 2016). For an analysis of patent litigation rates that takes into account the number of issued patents in force at any time, as well as general economic conditions, see Ron D. Katznelson, A Century of Patent Litigation in Perspective (November 17, 2014), available at <http://ssrn.com/abstract=2503140> (arguing that advent of radical new technologies best explains litigation rate trends). Most patents licensed through the MPEG and HEVC pools cover computer hardware or software. Colleen Chien studied patent litigation generally, and found that 38% of patent infringement suits in the hardware industry in the period were between to large companies (which she calls “sport of kings” litigation, for its high expense). Colleen Chien, Of Trolls, Davids, Goliaths and Kings: Narratives and Evidence in the Litigation of High-Tech Patents, 87 U.N.C. L. Rev. 1571, 1603 (2009). The figure for software was 36%. See *id.* This does not directly help to establish a plausible litigation rate; but it certainly shows that litigation between large companies in the technology areas of our pools is far from unheard of. For the semiconductor industry, which might arguably be the right classification for some of the patents in our pools, see Bronwyn H. Hall and Rosemarie Ham Ziedonis, Patent Litigation in the Semiconductor Industry 1 (July 30, 2008) (unpublished manuscript), available at http://www.econ.berkeley.edu/~bhhall/papers/HallZiedonis07PatentLitigation_AEA.pdf (last visited Feb. 1, 2016) (probability of

“negotiating cost for outside licensees” or “NegCostOL.”¹²⁶ If there are “N” independent patent holders who must be dealt with, and “P” non-patent holding licensees, the total transaction costs that these non-patent holder licensees would incur in the absence of a patent pool may be calculated as follows:

Equation 1: Transaction Costs to Outside Licensees in Absence of Patent Pool

$$TransactionCostsOL = \{SCost + (NegCostOL \times N) \times P\}$$

Licensees who are also holders of essential patent rights, however, are in a slightly different position with respect to licensing: here, we must imagine the resources that two well-situated patent-holders would put into a high-stakes transaction concerning patents essential to a valuable technology. The negotiation would likely be more complicated and protracted than a typical patent licensing negotiation. In addition, the situation presents an opportunity for holdouts, which could lengthen the timespan of negotiations and raise the total cost even higher. In light of these considerations, we select a proxy that more accurately reflects the transaction costs each patent holder would incur to negotiate with every other patent holder: the average cost of a patent lawsuit. We denote this as “NegCostPH.”

Reasonable arguments could be made that the forgoing estimate is either too low or too high. One might argue, for instance, that litigation fees represent the very maximum hypothetical negotiating cost because licensing requires less time and resources than a patent litigation. Two considerations make this argument less persuasive, however: first, our proxy is already adjusted downward because it is based upon *average* patent litigation costs and not the higher costs that would likely result from infringement of a valuable patent essential to a technological standard; second, any additional downward adjustment critics might argue in favor of would be unlikely to disrupt this study’s conclusion.

We use this formulate to estimate the number of cross-licenses needed among N independent patent holders:

semiconductor firm being involved in litigation rose from 0% in 1973 to 10% by 2001).

¹²⁶ Mark A. Lemley, Rational Ignorance at the Patent Office, 95 Nw. U. L. Rev 1495, 1507 (“[A] reasonable estimate of the cost of negotiating a license might be \$50,000 per licensee per patent.”).

Equation 2: Number of Cross-Licenses in Absence of Patent Pool

$$\sum_{n=1}^{N-1} n = \frac{N(N-1)}{2}$$

This result is then multiplied by the cost of each cross-license between the N patent holders as follows:

Equation 3: Transaction Costs to Patent Holders in Absence of Patent Pool

$$\text{TransactionCostsPH} = (\text{SCost} + \text{NegCostPH}) \times \frac{N(N-1)}{2}$$

The total transaction costs that would persist in the absence of a patent pool (“NPLC”), given N independent patent holders and P outside licensees, are given by this formula:

Equation 4: Transaction Costs in Absence of Patent Pool

$$\text{NPLC} = \text{TransactionCostsOL} + \text{TransactionCostsPH}$$

In practice of course, the cost of any patent license will turn on factors that go beyond the sheer numbers of patent holders and outside licensees. The number of patents that each patent holder owns, the relative values of those patents, and many other factors could contribute to overall transaction costs. While such considerations would be important to estimating the cost of an individual patent license, our goal here is to estimate average licensing costs. The forgoing formula serves that limited purpose well.

B. Estimated Transaction Costs Conserved by Patent Pools

Here, we bring together all of our calculations by first estimating the transaction costs that would exist in the absence of the MPEG Audio and HEVC patent pools, and second, by subtracting from these numbers the respective costs of these pools. At the outset, it is helpful to gather all of the information we will need for our calculations, including the numbers of licensors and licensees in each pool, the average cost of a freedom to operate study, and our estimates of patent licensing negotiation costs. We also present our estimates of the average cost of developing and operating a patent pool as detailed in the prior discussion.

Table 5: Transaction Cost Data

Variables	MPEG Audio Standard	HEVC Standard
Number of Patent Holders / Licensors (“N”)	14	32
Number of Patent Licensees (“P”)	805	66
Estimated Search Costs (“SCost”)	\$30,000	\$30,000
Estimated Negotiation Costs for Outside Licensees (NegCostOL)	\$50,000	\$50,000
Estimated Negotiation Costs for Patent Holders (“NegCostPH”)	\$500,000	\$500,000

A few words on the values in Table 5: The numbers of patent holders and patent licensees reported in the table are drawn directly from data published on pool websites published by Via and MPEG LA. These numbers were confirmed by the interview subjects we spoke with. The estimated search and negotiation costs for patent licensees and licensors are drawn from widely published sources and reflect the reasoning presented earlier in this Article.¹²⁷ Finally, the cost of conducting a clearance or freedom-to-operate search presented a few issues: In the absence of a patent pool, some licensees

¹²⁷ One publication reports that the average fee for a patent clearance search can vary between \$5,000 and \$50,000. This cost can vary “on the nature of the invention, how many patents are discovered that require a closer look, and the complexity and litigation behavior in the industry.” George R. McGuire, *IP Strategies with a Focus on Patents*, in *The Best Practices of Leading IP Lawyers* (Aspatore Books, 2007). Another source indicates that a freedom-to-operate opinion would typically cost at least \$10,000, “and sometimes substantially more.” See Jamie Sheridan, 23 *Intell. Prop. & Tech. L.J.* 14, 17-18 (2011) (citing Gene Quinn, “Difference Between Patent Searches & Infringement Clearance,” www.IPwatchdog.com). “[A] reasonable estimate of the cost of negotiating a license might be \$50,000 per licensee per patent.” Mark A. Lemley, “Rational Ignorance at the Patent Office”, 95 *Nw. U. L. Rev.* 1495, 1507 (2001). Richard Kamprath, *Gaming the Patent System: An Empirical Analysis of Litigation Economics and Possible Solutions*, avail. at ssrn.com/abstract=1577906 (2009), at 13, 14 (Reporting figures of \$514,682 for mean cost of single patent litigation, using data from the American Intellectual Property Law Association annual economic survey of patent lawyers; and; and adding that one standard deviation from the mean litigation cost brings the figure to \$3,630,744, which shows the high level of variance in patent litigation costs).

would likely hire an outside law firm to perform this work. Published sources indicate that costs for such work can average from \$5,000 to \$50,000 depending on the complexity of the job. Because the MPEG Audio and HEVC standards include many patents and patent holders, one might assume that the work would be complex and running at the higher end of the scale. At the same time, however, it is possible that some licensees would enlist in-house counsel to perform this work at a lower cost. With these considerations in mind, we selected an average of \$30,000.

By applying the formulas presented in the foregoing Part to the values in Table 5, we calculate the transaction costs that would persist in the absence of the MPEG Audio patent pool as follows:

Calculation 1: Transaction Costs for "Outside Licensees" in Absence of Pool (MPEG Audio)

$$\begin{aligned} TransactionCostsOL &= \{\$30,000 + (\$50,000 \times 14)\} \times 805 \\ &= \$587,650,000 \end{aligned}$$

Calculation 2: Cross-Licensing Transaction Costs in Absence of Pool (MPEG Audio)

$$\begin{aligned} NumCrossLicenses &= \sum_{n=1}^{14-1} n = \frac{14(14-1)}{2} = 91 \\ TransactionCostsPH &= (\$30,000 + \$500,000) \times 91 \\ &= \$48,230,000 \end{aligned}$$

Calculation 3: Total Transaction Costs in Absence of Pool (MPEG Audio)

$$\$587,650,000 + \$48,230,000 = \mathbf{\$635,880,000}$$

The same method yields an estimate of the transaction costs that would persist in the absence of the HEVC patent pool:

Calculation 4: Transaction Costs for "Outside Licensees" in Absence of Pool (HEVC)

$$\begin{aligned} TransactionCostsOL &= \{\$30,000 + (\$50,000 \times 34)\} \times 66 \\ &= \$105,630,000 \end{aligned}$$

Calculation 5: Cross-Licensing Transaction Costs in Absence of Pool (HEVC)

$$\begin{aligned} NumCrossLicenses &= \sum_{n=1}^{14-1} n = \frac{34(34-1)}{2} = 561 \\ TransactionCostsPH &= (\$30,000 + \$500,000) \times 561 \\ &= \$297,330,000 \end{aligned}$$

Calculation 6: Total Transaction Costs in Absence of Pool (HEVC)

$$\$105,630,000 + \$297,330,000 = \mathbf{\$402,960,000}$$

We can now estimate the transaction costs that the MPEG Audio and HEVC patent pools conserve by subtracting the cost of establishing each pool from the transaction costs that would fall upon the licensees and licensors in the absence of a patent pool:

Table 6: Estimated Transaction Costs Conserved by Patent Pools

Description of Transaction Costs	MPEG Audio Standard	HEVC Standard
Transaction costs devoted to search and negotiations in absence of patent pool	\$635,880,000	\$402,960,000
Transaction costs associated with establishing patent pool	\$7,807,000	\$4,600,000
Transaction Costs Conserved	<u>\$608,073,000</u>	<u>\$398,360,000</u>

The foregoing results refer only to transaction costs conserved with respect to initial search and negotiations—not ongoing operations on a day-to-day or year-to-year basis. There is every reason to believe, however, that the two patent pools examined here substantially reduce such ongoing transaction costs as well. The data supplied by MPEG LA and Via Licensing and presented earlier in this Article indicates that licensees incur annual costs of approximately \$30,000-\$40,000 in the course of interacting with the MPEG Audio and HEVC patent pools. These costs go to the salaries of employees who perform administrative tasks related to licensing—for instance, reporting sales figures and other relevant auditing information to the patent pools and tendering royalty payments. These figures reflect what it costs the average licensee to communicate with a *single licensor*—i.e., the patent pool.

Would dealing with, say, ninety licensors in the absence of a patent pool multiply annual costs by a factor of ninety? Probably not. A team of professionals assigned to report sales information and payments to a number of licensors would probably find efficiencies that would prevent ongoing transaction costs from multiplying in this way. It's hard to imagine how dealing with a dispersed set of licensors would not require more time than dealing with a single patent pool,

however. Regardless of whether the cost would be 91 times as much or merely twice as much, the conclusion remains the same: patent pools conserve substantial transaction costs.

The analysis so far assumes that in the absence of a pool every negotiation between licensors would be difficult, and perhaps contentious; we capture this by using the cost of an average patent litigation to estimate the expense of licensor-licensor negotiations. We can relax this estimate somewhat, by assuming instead that only some fraction of licensor-licensor negotiations are this expensive. Although the average cost of a patent license is estimated to be \$50,000, even a friendly deal among large companies would exceed this cost. A reasonable estimate might be that such a friendly license would cost each side say \$150,000, for a total licensing cost of \$300,000.¹²⁸ Assume this applies to 14 out of 15 cross licensing transactions; the fifteenth negotiation breaks down, leading to the \$500,000 litigation-based estimate used above. In the MPEG case, this means that, probabilistically, if the pool had not been formed, of the 91 cross-licenses that would need to take place (see “Calculation 2”), only 6 would cost \$500,000 (“NegCostPH” above); the other 85 would cost \$300,000. Likewise, in the HEVC case, roughly 37 out of the 561 licensor-licensor negotiations would end in litigation.

Does this more moderate estimate affect the results reported earlier? A little, but not much. With these revised figures, the total costs in the absence of a pool are \$618,880,000 (MPEG) and \$310,370,000 (HEVC). Ultimately not much different from the figures reported earlier. Why not? Because a great deal of savings come in the form of licensor-licensee transactions. The MPEG pool shows this best. Compare the 91 transactions required among patent-owning licensors with the 805 licenses from the pool to licensees. Most of the cost savings come here. Even at a moderate cost per license, the availability

¹²⁸ Note in this regard that the Inter Partes Review procedure of the America Invents Act of 2011 (AIA) may act to reduce the cost of a patent dispute when negotiations break down. This administrative patent validity procedure, conducted in the Patent Office instead of the courts, was devised specifically to reduce costs. See, e.g., Changes to Implement Inter Partes Review Proceedings, 77 Fed. Reg. 7041-01, 7057 (proposed Feb. 10, 2012) (to be codified at 37 C.F.R. pt. 42) (estimating average cost of an IPR at \$193,000); Aashish Kapadia, *Inter Partes Review: A New Paradigm in Patent Litigation*, 23 *Tex. Intell. Prop. L.J.* 113, 131 (2015) (“Since 2012 [when the AIA took effect] . . . a picture is developing in which parties strategically manage legal costs by shifting forums from district court to the USPTO.”).

of a standard form “rate schedule” type license lowers the cost of transferring patent rights to licensees by a huge amount.

To summarize all this, it is helpful to keep the focus on the figures we just arrived at. The patent pools we studied saved, we estimate, \$600 million and almost \$400 million, respectively. These are staggering numbers. It has always been presumed that the main benefit of patent pools is that they save on transaction costs. But now we have some actual figures. Of course, the numbers are based on interview data; have not been independently verified; and are also the result of projections and extrapolations. But still: we have shown that the savings from patent pools are really quite remarkable. With this baseline in mind, we can now turn to a discussion of welfare costs. With these two analyses in hand, we can then turn to the bottom line of the exercise: a concrete, numerically-driven cost-benefit analysis of patent pools.

IV. Estimating Consumer Welfare Losses from Pools

As we wrote earlier in this Article, we believe that it takes a number to beat a number. Having estimated the transaction costs that patent pools conserve, we now focus on quantifying the consumer welfare costs they may generate. Contemporary debates over patent pools focus primarily on two consumer welfare concerns: combining substitutes; and grantback arrangements. Each has the potential to reduce consumer welfare, and therefore merits close attention from antitrust authorities.

We should note at the outset that most contemporary pools address—and negate—both of these concerns. The vast majority of contemporary pools require all members to make their patents available independently—i.e., to break them out from the pool if a licensee wants to license them separately. This makes technology suppression through a pool impossible.¹²⁹

Nevertheless, it is conceivable that a pool will be proposed that does not include a requirement that patentees license patents independently. The economic literature on pools often assumes the absence of such licensing; this is where the concern with “lost substitutes” comes from. So in the event it is

¹²⁹ See, e.g., Letter from Joel Klein, Acting Assistant Attorney Gen., Antitrust Div., Dep’t of Justice, to Gerrald R. Beeney, Esq., at 13 (June 26, 1997) [hereinafter MPEG-2 Business Review Letter], available at <http://www.justice.gov/atr/public/busreview/215742.pdf> (MPEG-2 patent pool requires independent licensing) (last visited Feb. 1, 2016). See generally *infra*, section IV.B.1.

necessary, the question becomes: how to evaluate this potential cost from pooling as against the savings in transaction costs? As things stand, the analysis is strikingly qualitative. Antitrust regulators view the two concerns listed (lost substitutes and reduced future incentives from grantbacks) as “marks against” approving a patent pool. How much to weigh them, and how to compare them against the (again qualitative) transaction cost savings of pools—this is left to the ingenuity of the antitrust authority. There is precious little by way of quantitative analysis.

Partly, this is due to the great difficulty of quantifying consumer welfare losses. Most of the costs commentators identify are somewhat speculative, and because they involve predictions about the future, there is a lot of uncertainty. But another reason no one tries to estimate the consumer welfare costs is that the *benefits* of pools have long been described in equally qualitative terms. We believe this symmetry has prevented the discussion from advancing in a meaningful way. Uncertainty on the negative side of the ledger is balanced by uncertainty on the positive side. So we do what we have always done: tote up the “factors,” describe the competing “considerations,” and make a considered judgment as best we can.

But how do things stand now, in light of the specific estimates of cost savings we provided just above? The game, we think, has changed. Now we need some numbers on the negative consumer welfare side. And, in the section after the next one, we provide them. Motivated by the availability of real data on the benefits of pools, we turn to the task of estimating their costs. Before we get to it, however, we must first say a word about the sometimes misunderstood relationship between patents and markets. Getting this relationship right is crucial to estimating actual welfare losses.

A. Mapping Patents onto Markets

We who would estimate consumer welfare losses from patent pools are up against some genuine difficulties. The primary one is that welfare has to do with markets, while patents cover technologies—usually, only *parts* of technologies. Economic models dear to the hearts of antitrust experts often miss this. Of course, economic abstraction is a good thing: in many fields, the “stylized facts” that follow from it have cut through the clutter of particularity and led to clarity and rigor. But like all useful tools, abstraction has its limits. It makes perfect sense to

illustrate monopolies with a discussion of markets for widgets.¹³⁰ But no patent lawyer has ever written a patent application on a widget. In this field, abstraction from the details can obscure at least as much as it illuminates.

Useful antitrust analysis must recognize that patents do not map cleanly onto economic markets. Patents typically cover technological components: small pieces of larger technologies. A patent may cover part of a mobile phone antenna, for instance; or a technique for compressing data to be sent over a network; or a method for encoding location information on a CD (an example we will return to later); or any of millions of other small technological components.

Patents map onto technologies. The invention in an antenna patent may form part of a mobile phone antenna. The compression algorithm may be used in a software program for transmitting digital content such as music, video, or text. The popup menu may be part of a software program that handles calendaring or interfaces with travel-related websites.

Technologies, in turn, map onto products. The antenna is part of a mobile phone. The compression algorithm is part of a data streaming program used by music streaming companies or video websites. The popup menu may be part of a travel website or a suite of software for a mobile or desktop device.

Finally, products map onto markets. The mobile phone containing the antenna is sold in competition with other mobile devices, including phones, tablets, and watches. The data streaming program is incorporated into the software of one of several music streaming companies, or is used by one video streaming service (Netflix, say) that competes with others (Amazon Prime or YouTube, for example). The popup menu may be part of a desktop operating system such as Microsoft Windows, which competes with free operating systems such as Android for mobile; or it may be incorporated into one travel website (Kayak, for example) that competes with others (e.g., Expedia).

This complex, multi-step “mapping” can be summarized in the following simple diagram:

Patents --> Technologies --> Products --> Markets

¹³⁰ See, e.g., Roy J. Epstein, *The Market Share Rule with Price Erosion: Patent Infringement Lost Profits Damages After Crystal*, 31 *AIPLA Q.J.* 1, 6 (2003) (“[S]uppose that in a market for widgets a patent holder sold 800 units and an infringer, the sole competitor, sold 200 units . . .”).

What does this do for us? It moves us away from widgets. It illustrates the attenuated relationship between a patent and a product market. At the practical level, it cautions against over-generalized statements such as “patent A is a substitute for patent B.” To the extent that two patents cover part or all of a particular technology component, we must realize that this component may itself have some substitutes. In the foregoing examples, there may be two patents covering one type of compression algorithm. But there may also be other compression techniques that incorporate other algorithms. These alternative compression technologies may be substitutes for the technology related to the two overlapping patents. Likewise, the data streaming software that includes compression may form part of a product which itself has market substitutes. Music streaming forms only part of the market for music; it competes with music downloads (which may use less efficient but more accurate data compression because the music is not being listened to during the download), as well as old-fashioned music media (CDs, vinyl, terrestrial radio).

The point is this: the more complex the technological and product landscape, the more careful we must be when looking at the “market effects” of a given patent or pair of patents. Antitrust law and theory trains us to think of a tight triadic relationship between “patent-widget-market.” But the setting for most contemporary patent pools is vastly more complex. We must always keep in mind the mapping illustrated above. The effects patents have on markets are not the direct, immediate effects of a complete monopoly on a whole product sold into a single market—they are far more attenuated. The typical patent does not confer a “monopoly” in a “market.” It gives you ownership over one way to do one part of one thing; which is incorporated into a bigger thing; which is sold in competition with other bigger things in an economic market. Big difference.

B. Estimating the Welfare Effects of Lost Substitutes

The basic point of the foregoing mapping analysis is that patents are not usually coextensive with economic markets. Even so, patents over substitute technologies can at times command enough market power that combining them harms consumers. Exclusive rights in one part of one thing, in other words, can and do have market effects. So how much does society suffer when two rival technologies are combined in a patent pool? It depends. The size of the overall market for the two substitutes is the most important factor. It also matters what the next best

alternative to the two substitutes is—i.e., what is the best alternative to the two technologies in question?

These questions were highlighted in a case that raised the lost substitute issue as part of a defense to patent infringement. In 2010, U.S. Philips Corporation brought an International Trade Commission (ITC) action against Princo.¹³¹ In the course of this litigation, Princo argued that Philips should not prevail because it had used its patents to further an anticompetitive scheme. The scheme concerned two methods for marking the positions on compact disks (CDs): One method, devised by Philips, used analog coding, and the other method, devised by Sony, used a digital technique. Philips and Sony pooled their patents for these two technologies—a collaboration that, Princo argued, made Philips' technique the CD standard, and put Sony's alternative on the shelf. As with all deals that suppress competition, Princo argued, consumers were harmed. So Phillips's patent should not be enforced, because it had been "misused."¹³²

The court acknowledged that the suppression of the rival technology might have anticompetitive effects.¹³³ A three-judge panel on an earlier appeal of the case had said that "there are no benefits to be obtained from an agreement between patent holders to forego separate licensing of competing technologies," and that such agreements are "not within the rights granted to a patent holder" and might constitute an antitrust violation.¹³⁴ But whatever the harm might have been, Philips had not engaged in behavior that triggered the patent misuse doctrine. Though the patent suppression in this case did not lead to a win for the infringement defendant, the defendant's argument is a good illustration of the evils of "lost substitutes" resulting from a patent pool.

As the Princo case shows, courts and regulators face some very difficult problems when asked to evaluate whether and to what extent a technology has been suppressed. There are some antitrust cases dealing with the suppression of a

¹³¹ Princo Corp. v. Int'l Trade Comm'n, 616 F.3d 1318 (Fed. Cir. 2010).

¹³² Id.

¹³³ Id at 1329 (Fed. Cir. 2010) ("[W]e have emphasized that the defense of patent misuse is not available to a presumptive infringer simply because a patentee engages in some kind of wrongful commercial conduct, even conduct that may have anticompetitive effects.").

¹³⁴ Princo Corp. v. Int'l Trade Comm'n, 563 F.3d 1301, 1315-16 (Fed. Cir.) reh'g en banc granted, opinion vacated, 583 F.3d 1380 (Fed. Cir. 2009) and on reh'g en banc, 616 F.3d 1318 (Fed. Cir. 2010).

technology, but they are not recent.¹³⁵ Juries did their best to estimate the harm, but the ad hoc analysis falls far short of a reliable and reproducible methodology. Cases such as *Princo* suggest that consumers are injured when companies agree to eliminate technological substitutes.¹³⁶ But the cases provide little to no guidance about how to quantify the harm.

We propose a way to handle this problem. To illustrate, we use data from patent infringement cases. Consumer harm from lost substitutes is not at all what is at issue in an infringement case. But in the course of arguing issues that *are* relevant, the data we need sometimes emerge. This demonstrates that the tools are already at hand to calculate welfare effects in lost substitute cases. The data are not hopelessly complex or overly speculative. If they emerge inadvertently, as it were, in patent infringement cases, surely they can be generated intentionally to measure the cost of lost technological substitutes.

The data are generated because of the nature of damages in patent infringement cases. To explain: Patent damages reward a “deserving monopolist” (the patentee) for the wrongful loss of its monopoly profits. A patent infringer enters the patentee’s market and competes. This reduces the patentee/monopolist’s profits. In a simple case, the patentee and infringer are the only competitors. As damages, the infringer must pay the difference between (1) the patentee’s duopoly profits in the presence of the infringer,¹³⁷ and (2) the

¹³⁵ See, e.g., *McDonald v. Johnson & Johnson*, 722 F.3d 1370 (8th Cir. 1983) (inventors who sold business alleged that purchaser suppressed their technology to protect incumbent market).

¹³⁶ See generally, Christina Bohannon, *IP Misuse as Foreclosure*, 96 Iowa L. Rev. 475, 514 (2011) (noting a potential rival producer’s difficulty in showing a technology “would have come to fruition and would have become commercially successful but for the IP holder’s restraint”); Daniel J. Iden, *Combating Joint Ventures in Suppression: Taking Inventory of the Legal Arsenal*, 96 Minn. L. Rev. 278, 298 (2011) (recommending compulsory licensing for suppressed patents – but begs the question of how to identify them, and how to set a royalty rate for them); Yee Wah Chin, *Unilateral Technology Suppression: Appropriate Antitrust and Patent Law Remedies*, 66 Antitrust L. J. 441 (1998) (noting the difficulty of assessing incidents of suppression).

¹³⁷ Generally speaking, a duopoly is better for consumers than a monopoly even though the price for a good under duopoly may be higher than it would be under perfect competition – i.e., with many competitors and with ease of entry. For an example of a contemporary industry which for various reasons is close to a perfect duopoly, consider the mobile phone operating system market. Between Apple and Google’s Android, these two operating systems have over 95% market share in the U.S. See Comscore Reports June 2015 U.S.

monopoly profits the patentee *would have earned* if the infringer had not been in the market.

This leads us to a new and important insight: Combining two substitute patents in a pool leads to the reverse situation. What should have been a duopoly—two sellers of competing patented technologies—becomes a monopoly. This is the reverse of a standard patent infringement case, where a seller who *should have been* a monopolist is asking for damages resulting from the (wrongful) presence of a competitor. In this reverse situation, the “rightful duopoly” becomes a wrongful monopoly. To summarize: patent infringement cases are about actual duopolists who by rights *should have been* monopolists; whereas “lost substitute” analysis from patent pools is about actual monopolists (the pool members) who *should have been* duopolists (competitors), because they each owned patents on rival substitute technologies.

There are two costs when consumers face a higher (monopoly) price than they should have: first, there is the cost of purchasers who paid too much; second, there is the loss suffered by consumers who would have purchased at the competitive (duopoly) price but did not purchase at the higher monopoly price. (This latter loss is known in economics as “deadweight loss.”) The chief earmark of monopoly pricing is higher margins as compared to a competitive market. Fortunately, patent damages cases sometimes report the margins actually charged in the presence of infringement, together with data or estimates of the margins the patentee charged before infringement, or would have charged in the absence of infringement/competition. This allows us to construct case studies for illustrative purposes.

1. Avoiding the Cost of Lost Substitutes Through Independent Licensing

Substitutes are lost when two rival patented technologies are included in a patent pool.¹³⁸ The owners of the substitute choose one to implement and keep the other on the shelf. This eliminates competition; they split the extra profit.¹³⁹

Smartphone Subscriber Market Share, available at <http://www.comscore.com/Insights/Market-Rankings/comScore-Reports-June-2015-US-Smartphone-Subscriber-Market-Share> (last visited Feb. 1, 2016).

¹³⁸ See Shapiro, Patent Thicket, *supra* note 2 at 119-50; Gilbert, *supra* note 78 at 5 (2004).

¹³⁹ One sophisticated model of patent pools envisions the complement/substitute distinction as a matter of patent pricing. At a low

The scheme falls apart, however, if other companies can get a separate license to the patent on the substitute technology. Licensees can restore competition by taking the substitute technology off the shelf and putting it into practice. Just the threat of this should be enough to restore competition and eliminate the lost substitute problem.

Antitrust regulators understand this. When the DOJ is asked to review a proposed patent pool, this is one of the features they look for. The Business Review Letters issued by the DOJ in the late 1990s and early 2000s highlight this feature as a key to mitigating the anticompetitive threat of patent pools.¹⁴⁰ And historically, pools that are challenged tend to involve substitute patents.¹⁴¹ Before the Business Review Letter era, independent licensing was associated mostly with pools that included predominantly complementary (as opposed to substitute) patents.¹⁴² The overwhelming advice from economists who study pools is that independent licensing largely eliminates the social welfare threat of lost substitutes.¹⁴³

The obvious policy point is: require independent licensing. This eliminates the need to worry about lost substitutes.

2. A Procedure for Calculating the Cost of Lost Substitutes

Companies may nonetheless propose a patent pool that includes some substitute technologies. If they do, how are we to evaluate the social welfare costs of these lost substitutes?

Here, we provide a procedure for estimating the cost of a lost substitute. The basic approach is this: We subtract the

enough price, in other words, a patent will always be a complement to another patent; at a high enough price it will be a substitute. See Josh Lerner and Jean Tirole, *Efficient Patent Pools*, 94 *Am. Econ. Rev.* 691, 694 (2004) (Lerner and Tirole, *Efficient Pools*). But even in this model, “as patents become more substitutable . . . the pool is more likely to decrease welfare.” *Id.*, at 697.

¹⁴⁰ See, e.g., Letter from Joel Klein, Acting Assistant Attorney Gen., Antitrust Div., Dep’t of Justice, to Gerrald R. Beeney, Esq., at 13 (June 26, 1997) [hereinafter *MPEG-2 Business Review Letter*], available at <http://www.justice.gov/atr/public/busreview/215742.pdf>. (last visited Feb. 1, 2016).

¹⁴¹ Lerner et al., *supra* note 65 at 621 (empirical study of 63 pools from 1895 to 2001; finding that “pools which were more likely to have complementary patents . . . were more likely to have independent licensing.”).

¹⁴² *Id.* at 620-21 (examining grant back clauses and independent licensing in patent pools).

¹⁴³ Josh Lerner and Jean Tirole, *Public Policy Toward Patent Pools*, 8 *Innovation Policy and the Economy* 157, 170 (2007) (“Lerner and Tirole, *Policy*”).

profits under a competitive (duopoly) margin from the profits under monopoly. This profit differential represents the first component of welfare loss mentioned earlier: the amount that purchasers overpaid under the wrongful monopoly. (The second component, deadweight loss, is discussed below.)

An accurate estimate of welfare loss would take into account the lower volume of sales under the monopoly. This assumes, as is conventional, a downward-sloping demand curve: people buy less when a product is more expensive. In reality, sometimes sales volumes do not in fact change much under monopoly versus moderate competition; some demand curves are relatively steep, and demand is fairly inelastic over the relevant range of prices. As a consequence, patent damages experts sometimes use a simplified model that holds sales volume constant.¹⁴⁴ This saves the difficulty of estimating the change in sales volume due to the higher monopoly price – a phenomenon known as “price erosion.”¹⁴⁵

Instead of assuming constant demand (sales volume), and estimating the change in the seller’s margin as a measure of damages, we assume a drop in demand when rivals agree to shelve a substitute. The key to the case studies that follow is this: we assume constant total revenue despite an increase in price. We do this to take advantage of revenue data in the reported cases on patent damages we use to illustrate our approach. Of course, in the presence of a price increase, assuming constant revenue means we are also assuming a drop in demand. That’s the key: this drop in demand allows us to estimate the deadweight loss from a lost substitute. We in effect use the data from infringement cases to estimate welfare losses in lost substitute cases.

These welfare loss estimates have two components. First is the amount of overpay by consumers who bought at the competitive (duopoly) price who also would have bought at the higher monopoly price. The second component is the deadweight loss: lost value from consumers who would have purchased at the lower competitive price but who were “priced out of the market” by the higher monopoly price. The first component is easy to estimate: take the price increase due to

¹⁴⁴ See Richard B. Troxel and William O. Kerr, *Calculating IP Damages* § 3:31 (June 2015) (simple model of patent damages multiplies patentee’s margin times infringer’s sales revenue).

¹⁴⁵ See generally David Bohrer, Matt Lynde and Elizabeth M.N. Morris, *The Shifting Sands of Price Erosion: Price Erosion Damages Shift by Tens of Millions of Dollars Depending Upon the Admissibility of Pre-Notice Eroded Prices*, 25 Santa Clara Computer & High Tech. L.J. 723 (2009).

monopolization and multiply by all consumers who would purchase at the monopoly price. It is also not difficult to arrive at the second component. Keeping revenue constant, and using the higher monopoly price, divide total revenue by the price and you get the number of buyers who would buy at the higher price. The difference between this number and the number who actually purchased at the competitive price represents the number of consumers who experienced the deadweight loss. This number multiplied by the price increase gives you deadweight loss: the value these consumers lost by not being able to buy at the competitive price.

At the practical level, our approach uses one more piece of data that is usually available in a patent damages case: the difference in the seller's margin under monopoly versus competitive duopoly. We start with the total revenue received from sales by both patentee and infringer. We multiply this by the selling price of the product to get total revenue. We then use the difference between the monopolist's margin and a more competitive duopoly margin, which is usually set out in damages cases. The key step come next: we use the margin differential reported in damages cases to estimate how much price would increase in an inverse case – a case where the patentee and infringer began as competitors and agreed to shelve one rival technology so as to become a monopolist. We then use this margin-derived estimate of price increase to calculate welfare loss.

A key assumption of our approach is that the margin differential represents a reasonable estimate of the price differential that results from a lost substitute. We assume, in other words, that the margin increase found in patent damages cases can be used as an estimate of the *price* increase that would result from an agreement by pool members to suppress a substitute technology.

The assumption that margins and *prices* increase under monopoly (a shelved substitute agreement) could overestimate the welfare loss from a lost substitute. In reality, margins might increase if a competitor were eliminated from a product market (due to lower marketing costs, less investment in product service, and the like), but the price to consumers might not increase. We are assuming harm to consumers, in other words, by assuming that the higher margin is accompanied by a proportionately higher price. This leads, as we have said, to overpayment by those who buy even at the higher price; as well

as to deadweight loss in the form of consumers who are priced out of the market.

3. Case Studies

To estimate the social welfare losses of patent pools, we can use data from patent infringement cases. In these cases, patentees established how much they lost due to the wrongful competition by an infringer. We use this data to measure the reverse cost: the harm suffered when would-be doupolists combine rival patented technologies to foreclose competition and create a monopoly. We are not suggesting that the numbers in these case studies are somehow representative of *all* lost substitute cases; we use them only to show that it is quite possible to estimate social welfare loss when competing technologies are suppressed. Together with the data on transaction cost benefits shown earlier, this provides a tractable way to conduct cost-benefit analysis for patent pools.

It's helpful to note at the outset that in some cases, the patentee has no effective pricing power. In these cases, patent damages simply re-allocate sales from the infringer to the patentee.¹⁴⁶ Because the patent confers no pricing power, consumers are not really affected at all. The same is true when a "lost substitute" confers no market power. Many cases may fit this description. Earlier, we talked about mapping patents onto technologies, components, products and markets. Sometimes a patent on a part of a component confers little or no pricing power in the ultimate product market. In such a case, the elimination of one substitute in favor of another has no effect on price. Pool members might choose to converge on a single technological alternative for the sake of standardization, convenience, or the like.

The point is that this is the inverse of a patent infringement case where the patentee is credited with the sales made by an infringer, but at the same price as the infringer's actual sales. In other words, lack of power over price means no effect on consumers whether there are two sellers when there should be one (the patent infringement situation) or there is one seller when there might have been two (the lost substitute case). In the patent damages situation, revenue is re-allocated from

¹⁴⁶ See, e.g., *Lam, Inc. v. Johns-Manville Corp.*, 718 F.2d 1056, 1059 (Fed. Cir. 1983) (calculating damages by multiplying infringer's sales during infringement period (which patentee would have made, absent infringement) by standard market price; effectively assuming patentee had no power to increase price).

the infringer to the patentee, but consumers are not affected. In the lost substitute case, revenue is split between would-be competitors, but consumers again are not affected. Both situations re-allocate revenue without impacting consumer welfare.

a. Consumer Electronics Product Patents: Projecting Welfare Loss from Hypothetical Suppression

The foregoing examples are helpful; they illustrate the procedure we advocate, and they set a few data points for consideration. The industries involved, however, are not at the forefront of contemporary debates over patent pools. In light of these example, can we say anything useful about valuing suppressed substitutes in industries of more contemporary interest? We think so. Here we apply our approach to mobile devices, to demonstrate.

At the outset, it is important to realize that the setup for our analysis is perhaps a bit out of place in a component-based industry such as consumer electronics or mobile devices. There, most pools are about platform-building; pool members do not in general seek to maximize revenue from licensing the pooled patents.¹⁴⁷ They want to make some money to be sure, but the pools (and the standards they grow out of) are more about spreading adoption of the platform than profit maximization. Also, ease of administration is important too. These pools typically allocate revenue to pool members on the basis of how many patents they hold as a percentage of the total number of patents in the pool; they do not value individual patents except to screen them for inclusion in the pool.¹⁴⁸ This undercuts some

¹⁴⁷ See *Microsoft Corp. v. Motorola, Inc.*, 2013 WL 2111217, at *79 (W.D. Wash., April 25, 2013), *aff'd* 795 F.3d 1024 (9th Cir. 2015) (“According to Motorola, there are many factors that make patent pools more likely to have rates lower than the rates in bilaterally-negotiated licenses. The main factors are: (1) the principal objective of most pools is not to maximize licensing revenue but instead to minimize royalty exposure and maximize freedom of operation for licensees, which drives down the royalty rate”) (internal citations omitted).

¹⁴⁸ *Id.* at *74-75 (“Patent pools generally—as well as the specific pools at issue in this case, MPEG LA H.264 and Via Licensing patent pools—distribute royalties on a per patent basis as part of a patent-counting system. [T]his structure generally provides equal compensation for any given patent in the pool without regard to the technology of each patent, its merit, its importance, or its contribution to the standard. . . . Pools generally set a fee so participants do not need to negotiate with individual prospective licensees. Once the terms of a patent pool are set, a potential licensor Cannot (sp) go to the pool and renegotiate the deal. This results in fundamental or broad patents being given the same value as weak or narrow patents.”)

of the conditions for revenue-maximizing technology suppression deals. It also renders moot sophisticated models detailing how patent holders will try to maximize the return on each patent in a pool.¹⁴⁹ In addition, as mentioned earlier, these pools permit independent licensing of all patents. This also tends to eliminate technology suppression, as described earlier.

Even so, we can learn a great deal from consumer electronics pools about potential welfare loss from suppression of mobile technologies. Consider this: the average royalty per patent over the life of a 17-year pool, using data derived from the *Motorola v. Microsoft* case, is roughly \$550,000.¹⁵⁰ Assume two such “average” patents are the subject of a suppression agreement. The total return under this arrangement must exceed \$1.1 million per year; otherwise the owners of the patents will not agree to combine them. They make more money licensing them independently.

So what would be the social welfare cost of this two-patent suppression deal? Of course, \$1.1 million is a floor, but not a ceiling. (And it does not take into account deadweight loss, if any.) Precise valuation would require information about the specific technology that was the subject of the suppression arrangement; consumers’ valuation of that technology; and the next best alternative to the suppressed pair of technological options.

A reasonable estimate for one specific product, the Microsoft xBox video game console, would proceed as follows. Begin with current xBox revenue: current price times sales volume. (This figure is, conservatively, \$2.975 billion annually.)

(internal citations omitted). The court notes that patent pool royalty rates were not identical in all cases to FRAND rates, but that under the facts before it the pool rates were a reasonable comparable. *Id.* at *81-82.

¹⁴⁹ See Lerner and Tirole, *supra* note 139.

¹⁵⁰ See 2013 WL 2111217 at *27 (Motorola holds 16 SEPs for the H.264 standard); *id.* at *53: (Motorola holds 24 patents essential to 802.11 standard); *id.* at *101 (setting royalty rate of .555 cents per unit for H.264 and 3.71 cents per unit for 802.11 patents). Based on sales figures, Microsoft reported to the press that these royalty rates added up to a payment of \$1.8 million per year. See Joe Mullin, *Court Shreds Power of Motorola’s Standard-Based Patents: Motorola will get 3.5¢ per Xbox; not the \$4-\$6 per machine it wanted*, April 26, 2013, available at <http://arstechnica.com/tech-policy/2013/04/court-shreds-power-of-motorolas-standard-based-patents/> (“Microsoft’s own calculation says it will owe about \$1.8 million annually under [Judge] Robart’s rules [from the opinion], less than half a percent of what its opponent was asking for.”) (last visited Feb. 1, 2016). Assuming 17 years of payments at \$1.8 million per year, this has a present value of \$21,772, 804, call it \$ 22 million; divided by the 40 total patents at issue in this case, yields \$550,000 per patent.

As described, we will hold this figure constant after the hypothetical patent suppression deal. Given the margin increase from the suppression deal, we estimate the new selling price, then work backward to derive the new (lower) sales volume after the suppression deal. (The price increase is the same as the margin increase, as described earlier.) In the case of the xBox, we use the royalty rate calculated in the patent infringement case as an estimate of the margin increase (and hence price increase) that would result from a patent suppression deal. Press accounts after the Microsoft-Motorola SEP case reported that the royalty rate in the case was such that it added roughly \$.04 to the cost of an xBox console. Although this royalty was set in exchange for a large bundle of Motorola patents, we will make the extremely conservative assumption that a technology suppression deal for a *single* patent would add this amount to the retail cost of an xBox.

Using a conservative estimate of \$250 as the cost of an xBox console before a suppression deal, the post-suppression price would be \$250.04. Holding revenue constant, at this new, higher price, sales volume would drop by 2000 units annually. For consumers who still buy at the higher price, this represents an aggregated overpayment of \$475,920. Using the standard approach to calculating deadweight loss, the users “priced out of the market” by the price increase lose a total of \$40 in value annually. Adding the overpayment and deadweight loss, and taking the present value of this annual amount over an estimated 15-year life of a patent pool, the total estimated social welfare loss for a patent suppression deal here is \$ 5.3 million.

With this estimate in hand, we can make some rough calculations. Imagine that using our estimates from earlier in this paper, one finds that a proposed pool will save \$100 million in transaction costs. Without being certain how many substitutes will be suppressed, and without more, we can say that unless the pool is expected to produce *more than eighteen* lost substitutes (i.e., 18 deals to suppress one of a pair of technologies, so 36 total patent-pairs), it is still likely to be a net positive for social welfare. Even at a valuation five times that of the *Motorola v. Microsoft* data, or \$11.1 million per patent pair, we could tolerate 4 lost substitutes (i.e., 4 suppression deals).

Though the figures are rough, they give an indication of some end points for analysis. It might be difficult to predict precisely how many lost substitutes might emanate from a particular pool. It is less difficult, though, to predict whether 18

or more such deals are likely, or 4 or more at a more conservative methodology.

We return to our old mantra: it takes a number to beat a number. Using the approach provided above, regulators and courts can make ballpark estimates of costs and benefits to evaluate the overall desirability of patent pools. And if the data here is ultimately inadequate to the task, we at least provide a roadmap to the analysis. Better data will yield better predictions. But at least we are dealing here with some actual data, rather than fuzzy qualitative discussions.

b. More Significant Welfare Loss from Suppression in a Large Commodity Processing Market

In other cases, patents confer some small power over price, and this has large consequences. An example is *Grain Processing Corporation v. American Maize Products, Inc.*¹⁵¹ Two companies competed in the market for a commodity food additive, malto-dextrin. Patentee Grain Processing (GP) held a patent on a manufacturing process with very specific parameters. Infringer American Maize (AM) revised its manufacturing process to avoid the GP patent, but it made a mistake: AM used the wrong test to determine a key ratio that was part of the GP patent claims. The resulting AM product infringed the the GP patent. Judge Frank Easterbrook, of Chicago School law and economics fame and the Seventh Circuit, sat on the district court by designation. Judge Easterbrook found that AM could have avoided the GP patent with fairly minimal expense, but could have rationally chosen to license it at a royalty of 3% of sales to avoid this cost. This resulted in a modest award of \$2.5 million in damages for patent infringement.¹⁵²

Grain Processing is not that different from a quite plausible suppressed or lost substitute case. Imagine that the alternative AM process (1) did not infringe the GP patent, and (2) was itself covered by a patent owned by AM. If GP and AM agreed to suppress the AM technology and jointly use or license the GP technology, we would have a suppressed substitute case. How much would consumers be harmed? We could find out using the general method outlined earlier: assuming constant

¹⁵¹ *Grain Processing Corp. v. Am. Maize-Products Co.*, 893 F. Supp. 1386 (N.D. Ind. 1995) (Easterbrook, J.) aff'd in part, vacated in part, 108 F.3d 1392 (Fed. Cir. 1997), on remand, 979 F. Supp. 1233 (N.D. Ind. 1997) aff'd, 185 F.3d 1341 (Fed. Cir. 1999).

¹⁵² *Grain Processing Corp. v. Am. Maize-Products Co.*, 893 F. Supp. 1386, 1397 (N.D. Ind. 1995) aff'd in part, vacated in part, 108 F.3d 1392 (Fed. Cir. 1997).

revenue, take the differential between the monopoly and competitive margins and apply this to price. The increase in margin owed to the patentee/monopolist approximates the percentage increase in price caused by the monopoly. Because the price increased, given constant revenue, the quantity sold would have decreased; this gives us our estimate of deadweight loss.

We start with current market price (\$3.64 per kilo) and estimates of total revenue. The infringer in the case had annual revenue of \$83,300,000; based on market share data, the patentee had estimated revenues of \$641,200,560. Total revenue is therefore \$724,500,560. At current prices this yields total volume of 199,054,000 kilos. The 3% royalty awarded in the case implies that, if one of two patents had been suppressed in this market, it would have led to a 3% increase in the sales price; from \$3.64 per kilo to \$3.75. It is not unreasonable to say the 3% royalty implies a plausible estimate of the margin differential (and hence price increase) in the case. Judge Easterbrook calculated it in part by assessing the cost savings to the licensee that followed from its use of the patented technology.¹⁵³ A suppression deal, in effect, allows the parties to reap the benefits of this cost savings while reducing competition. This leads to the price increase.

Holding revenue constant, the increased price means an estimated drop in sales volume to 193,087,000 kilos. Combined, the two sets of customers overpaid by \$21,208,550. Deadweight loss is \$658,370. Total annual welfare loss is therefore \$21,866,920. This annual loss over a 15 year life for the patent pool yields total welfare loss, in present value terms, of \$243,124,888.

We estimated earlier that some patent pools save \$200 million in transaction costs. The figures here show that, even with these savings, if the welfare loss is great enough, even one “lost substitute” deal inside a pool can overtake the benefits of a patent pool. Notice however that for this to be true, the pool must (as in *Grain Processing*) include patents that cover a very high-volume industry, and provide significant pricing power over products within the industry. What drives the numbers in the *Grain Processing* case analysis is that the seemingly modest

¹⁵³ *Grain Processing Corp. v. Am. Maize-Products Co.*, 893 F. Supp. 1386, 1392 (N.D. Ind. 1995) aff'd in part, vacated in part, 108 F.3d 1392 (Fed. Cir. 1997). Judge Easterbrook actually provides a hypothetical example to ground his discussion; in this discussion the patented technology lowers cost, and this increases margin, by 3%. *Id.*

3% increase in price applies to a very high-volume industry: maltodextrin production occurs at a combined volume of almost 200 million kilos per year. In the Microsoft xBox example, the \$.04 price increase due to the hypothetical suppression deal represented only a .016% increase in the price. At a sales volume of only 12 million units in that example, the result was a much smaller effect on consumer welfare.

c. Implications

These examples are not meant to be definitive. In some ways, the unrealistic assumptions behind them might be misleading. In a high-volume business such as the maltodextrin industry, for example, the pricing power of a single process patent pair seems suspicious. Even a small price rise of 3% in such a competitive field might well drive business to other alternatives that are cheaper than the one offered by the patent-suppressing pair of firms.

Nevertheless, we believe the style of analysis we have shown is a helpful starting point for scholars and antitrust regulators alike. For example, if a patent pool were proposed the maltodextrin industry, or any industry with its characteristics, our lost substitute analysis might be a helpful starting point. Companies proposing such a pool might respond in several ways to a prima facie showing based on the type of analysis we use. The companies could (1) agree to require independent licensing of all process patents; (2) agree to dedicate to the public one of two possible substitute patents; or (3) come forth with better data about the likely consumer welfare effects of a patent suppression agreement inside a pool. (Perhaps, for example, the companies could show that a margin increase will not in fact lead to a one-for-one price increase, due to competition from a third technology that would be more appealing in the face of a price increase from the pool members.)

The point is we have laid out a roadmap for estimating in dollar values the consumer welfare losses possible from patent suppression inside pools. We have moved the baseline from a general, qualitative discussion, and put it on a more tractable, quantitative plane.

C. Estimating the Number of Lost Substitutes from Pooling: Patent Portfolio Mapping Techniques

The analysis so far considers a single patent suppression agreement among pool members. Estimating the welfare loss from this one lost substitute, and comparing it to the benefits

(transaction cost savings) of a pool sets a limit on the number of suppression deals that can be tolerated before a pool becomes a net negative social welfare proposition. But how many potential lost substitutes will a given pool entail? This section gives an approach to answering that question.

The key to this approach is to get an overview of the research activities of each pair of companies proposing to form a patent pool. Using patent data as a proxy for the research interests of the companies, we estimate the number of patent pairs that are proximate enough to each other to trigger concern about potential suppression of substitutes. The approach depends on patent portfolio mapping techniques, to which we now turn.

1. Measuring Research Overlap

Fortunately for our purposes, there has been something of a revolution in the analysis of patent data in recent years. As shown in a recent World Intellectual Property Organization (WIPO) report, the art of finding, classifying, and conceptually organizing patents has experienced a great leap forward.¹⁵⁴ This is very helpful to the task at hand. Organizing patents by research field was difficult in the past, when only official government patent office classifications were available to classify technology. In addition, before the advent of these recent tools, it was difficult to even be sure you knew all the patents that had been assigned to a particular owner. Gaps in the assignment records, together with many different corporate entities typically included in the umbrella of a large corporation made this an uncertain undertaking.

Now, however, the techniques of “big data” have come to the patent world.¹⁵⁵ This makes the task we describe here much

¹⁵⁴ World Intellectual Property Organization, Guidelines for Preparing Patent Landscape Reports, (written by Anthony Trippe of Patinformatics, LLC), available at http://www.wipo.int/edocs/pubdocs/en/wipo_pub_946.pdf, at 8 (“Industry has long used patent landscapes to make strategic decisions on investments, research and development (R&D) directions, and competitors’ activity as well as on freedom to operate in introducing new products. Now, public policymakers are increasingly turning to landscaping to build a factual foundation before considering high-level policy matters”) (last accessed Feb. 1, 2016) (hereafter WIPO Patent Landscapes).

¹⁵⁵ See, e.g., United Kingdom Intellectual Property Office, Eight Great Technologies: A Summary of the Series of Patent Landscape Reports, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360986/Eight_Great_Technologies.pdf (last visited Feb. 1, 2016).

easier than it would have been in the past.¹⁵⁶ Using a variety of natural language searching capabilities, it is easy now to figure out which research areas a particular company is actively pursuing. Patents and patent applications can be searched for based on keywords, keyword variants, and simple degrees of linguistic overlap. Once a company's research activities have been classified, it is simple to determine the degree of overlap between its patent holdings and the patent holdings of any other entity. Various commercial patent landscaping and mapping tools are available for just this purpose. Typically, these techniques are used by the companies themselves as well as investors and scholars who are interested in assembling “heat maps” of highly competitive research areas. We propose to simply deploy the same tools to set an historic baseline against which to assess the concerns that future research overlaps will decline in the presence of a patent pool.

For example, the image below is taken from a merger analysis between two semiconductor chip companies. It is easy to see the many complementarities between the companies; this represents two companies with a very significant historical overlap in research activities:¹⁵⁷

¹⁵⁶ Patent searching is often used to generate “freedom to operate” analyses, which companies request prior to entering a market. Search and classification techniques are used to see whether a new product will tread on significant third party patent rights. See, e.g., *Roche Diagnostics Operations, Inc. v. Abbott Diabetes Care*, 756 F. Supp. 2d 598, 601 (D. Del. 2010) *aff'd sub nom. Roche Diagnostics Operations, Inc. v. Lifescan Inc.*, 452 F. App'x 989 (Fed. Cir. 2012) (holding that it was not breach of contract to use confidential information in a freedom to operate analysis); *Innogenetics, N.V. v. Abbott Labs.*, 578 F. Supp. 2d 1079, 1098 (W.D. Wis. 2007) *aff'd in part, rev'd in part*, 512 F.3d 1363 (Fed. Cir. 2008) (use of freedom to operate analysis in willful patent infringement determination). See generally Jamie Sheridan, *New Product Clearance: Freedom to Operate Search and Analysis*, 23 No. *Intell. Prop. & Tech. L.J.* 14 (2011).

¹⁵⁷ Ray Angers, *NXP/Freescale Merger – A Union of Equals*, *Chipworks Blog* Mar. 5, 2015, available at <https://www.chipworks.com/about-chipworks/overview/blog/nxpfreescale-merger---a-union-of-equals> (last visited January 19, 2016).

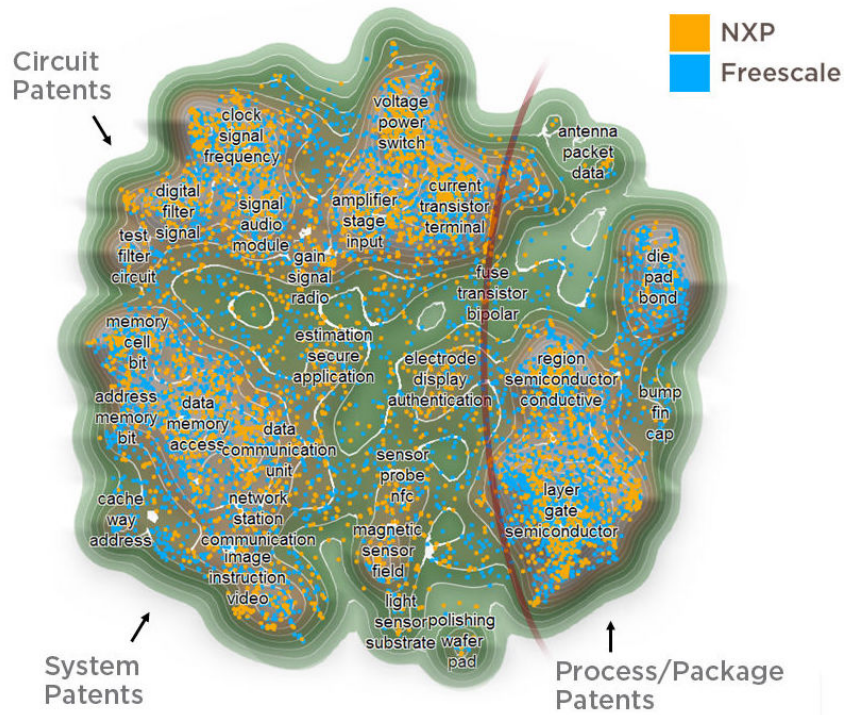


Figure 1: Patent Heat Map of NXP/Freescale Merger

Below is an overlap map showing a much different situation. It is drawn from an analysis of the satellite/commercial space field. Imagine that two firms in this analysis, Airbus and Qinetiq, propose to join a patent pool in the satellite data transmission subfield. As you can see from the map below, these companies have very little overlap in their patent holdings. (Blue dots are Qinetiq patents; red dots are Airbus patents; the labels represent specific technology sub-fields within the satellite field, all pertaining to satellite communications):¹⁵⁸

¹⁵⁸ United Kingdom Intellectual Property Office, Eight Great Technologies: A Summary of the Series of Patent Landscape Reports, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360986/Eight_Great_Technologies.pdf (last visited Feb. 1, 2016).

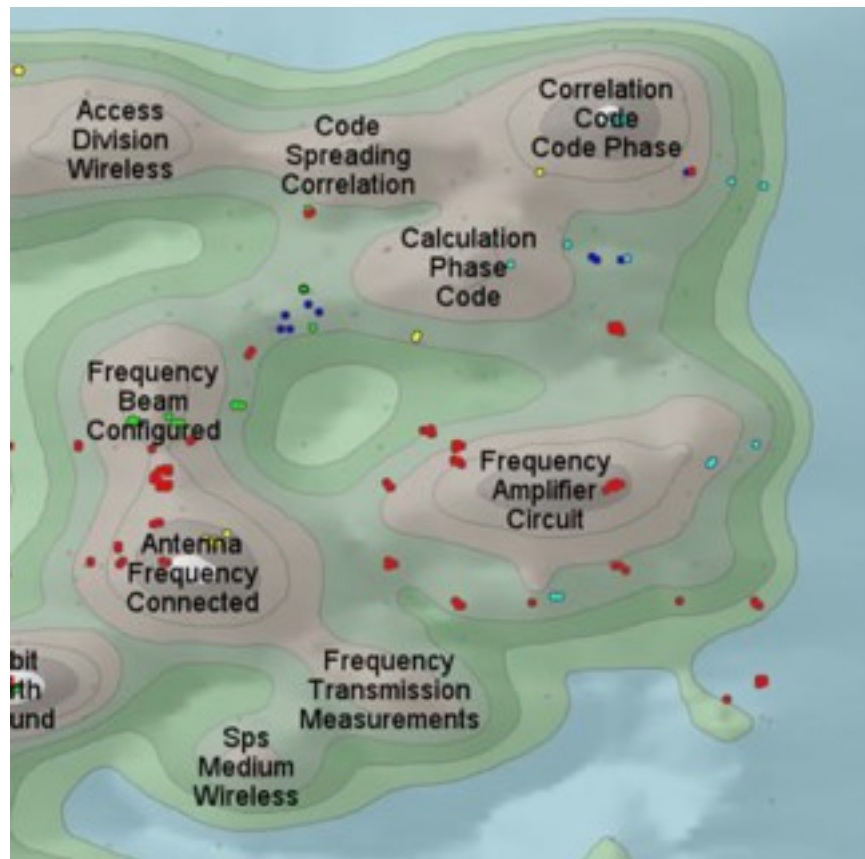


Figure 2: Patent Heat Map of Airbus Merger

Maps like these can be assembled in a number of ways. Date cutoffs can be used to determine only recent overlapping research, published patent applications can be used to show only emerging research areas, and so on.

Again, the idea is to simply establish a baseline. With this in hand, we can assess the possibility of potential foreclosed research options—the number of lost competitive technologies that may be suppressed because of a pooling agreement. If, for example, the two companies of interest have had five overlapping pairs of patents in the past five years in the general technology area of a proposed pool, it would make sense to look carefully at those patent pairs. The goal is to see if they overlap enough to give rise to a concern about potential suppression of substitute technologies.

There are two ways to do this. One is the old-fashioned approach used for essentiality determinations in standard setting. This entails careful reading of the two patents, and a professional determination of whether they claim alternative ways to achieve a certain technical function. The other uses

machine automation and big data techniques to measure patent-to-patent similarity.¹⁵⁹

Probably the best approach is to combine both techniques: use the text analysis-based software of the automated approach to screen patent pairs for similarity, and then require professional evaluation of patents that indicate a very high degree of overlap.¹⁶⁰ When potential substitute patents are identified, analysis can use the techniques described in the preceding section to estimate the welfare loss that would follow from suppression of patented technologies from among these identified patent pairs.

D. Estimating the Welfare Effects of Grantback Clauses: Effects of Pools on “Innovation Markets”

If lost substitutes are the primary social welfare concern arising from patent pools, grantback clauses are right behind. These clauses require pool members to agree to license back to the pool new improvements developed during the course of the pool. The concern is that such arrangements may suppress future competition for new inventions within the scope of the pool. Why work hard to develop a breakthrough if you have agreed in advance to allow your main competitors to use it at a fixed royalty rate? As the DOJ puts it,

An important factor in the Agencies’ analysis of a grantback will be whether the licensor has market power in a relevant technology or innovation market. If the Agencies determine that a particular grantback provision is likely to reduce significantly licensees’ incentives to invest in improving the licensed technology, the Agencies will consider the extent to which the grantback provision has offsetting procompetitive effects, such as (1) promoting dissemination of licensees’ improvements to the

¹⁵⁹ The specific method we describe is reported in Kenneth A. Younge and Jeffrey M. Kuhn, Patent-to-Patent Similarity: A Vector Space Model, Working Paper, Dec. 30, 2015, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2709238 (last accessed Feb. 1, 2016) (hereafter, Younge and Kuhn, Vector Space Model).

¹⁶⁰ The data and analysis software used in Younge and Kuhn, Vector Space Model, are available to the public at <http://www.patrf.org>, the website of a public foundation dedicated to promoting these analysis techniques. (last visited Feb. 1, 2016).

licensed technology, (2) increasing the licensors' incentives to disseminate the licensed technology, or (3) otherwise increasing competition and output in a relevant technology or innovation market.¹⁶¹

In theory, this is a legitimate worry. The problem comes when it is time to evaluate an actual patent pool, however. It is difficult enough to predict how many existing patent pairs may represent substitutes, and therefore how many potential substitute suppression agreements a pool might permit. It is much harder to address the concern raised by grantbacks: *future* possible reduced invention, which might include lost potential substitutes. The cases and commentators are united.¹⁶² This is a very difficult problem.¹⁶³

¹⁶¹ Antitrust Division, U.S. Department of Justice, Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition (April, 2007), available at <http://www.justice.gov/atr/antitrust-enforcement-and-intellectual-property-rights-promoting-innovation-and-competition> (last visited Feb. 1, 2016).

¹⁶² In *Princo Corp. v. Int'l Trade Comm'n*, 616 F.3d 1318, 1338 (Fed. Cir. 2010), cert. denied 131 S.Ct. 2480 (2011), the Federal Circuit noted the lack of “evidence in the record that Sony would have entered and survived to become a significant competitive force in the CD-R/RW market with the Lagadec technology or that, absent the pooling arrangements, the pool licensors would have competed with the Orange Book technology.” See also Phillip W. Goter, *Princo, Patent Pools, and the Risk of Foreclosure: A Framework for Assessing Misuse*, 96 Iowa L. Rev. 699, 730 (2011) (“Furthermore, it is even more unlikely that a downstream producer (Princo) of a product, standardized for interoperability in a networked market, would consider it rational to attempt to insert an alternative, non-conforming product into such a market.” (footnotes omitted)).

¹⁶³ Phillip W. Goter, *Princo, Patent Pools, and the Risk of Foreclosure: A Framework for Assessing Misuse*, 96 Iowa L. Rev. 699, 729 (2011) (footnotes omitted):

A more difficult question arises when future competition (and consumer choice) between a current technology and a nascent technology is restrained. In this case, the court must adjudge “where on the continuum between ‘certainly would have been viable’ and ‘certainly could not have been viable’” the nascent technology lies. The party asserting misuse should be required to demonstrate a reasonable probability that the product or technology would become commercially viable or technically feasible in the absence of the challenged restraint.

Daniel J. Iden, *Combating Joint Ventures in Suppression: Taking Inventory of the Legal Arsenal*, 96 Minn. L. Rev. 278, 293-94 (2011) (footnotes omitted):

Optimally, to deter technology suppression by joint ventures, those injured should have the ability to bring suit.

In the interest of making pool analysis more tractable, we suggest an approach here. Our proposal uses the recent history of pool members as a guideline. By examining overlaps in the patent-related research activities of prospective pool members in the years immediately preceding pool formation, we hope to establish a recent historic baseline. This helps in two ways: First, it establishes an overlap measure heading into the pool—a metric of how much research overlaps between pool members prior to formation of the pool. (We describe this earlier; it is the basis for estimating the number of lost substitutes potentially flowing from a pool.) This sets the terms of analysis. If there has been very little overlap between two prospective members, there may well be very little concern about future lost substitutes as between them. There can be no loss of overlap, in other words, if there never was any to begin with. Second, if there has been a good deal of overlap between the members in the years leading up to the pool, antitrust regulators and pool licensees will have a measure to assess whether the pool while

In antitrust law, a private plaintiff must overcome several difficult hurdles in proving her case. The plaintiff must show both individual harm (standing) and anticompetitive effects to prevail. In the case of tying, though spared a full inquiry of anticompetitive effects under the rule of reason, a successful plaintiff must instead show that the defendant possesses market power in the relevant field. These showings become even more difficult for a plaintiff suing a joint venture that is suppressing a technology. For example, in terms of standing, the party—a licensee, current or potential competitor, or even a member of the public—likely will have a difficult time demonstrating individual harm. The alleged damages often will simply be too speculative to prove an actionable injury. Perhaps this high bar to entry is good, as it likely would prevent frivolous litigation. Since antitrust trials are infamously expensive, the threats of these high costs could enable plaintiffs with attenuated connections to coerce large settlements. The problem is, the individual “injuries” that joint ventures in technology suppression tend to cause are, indeed, more speculative and difficult to quantify: the elimination of a firm’s chance to develop a technology into a viable commercial alternative or the public’s chance to enjoy it. Frustratingly, the advantages of antitrust litigation—keeping out meritless claims—also serve to bar those plaintiffs that would be aggrieved by a harmful joint venture suppressing technology.

See also Christina Bohannon, *IP Misuse as Foreclosure*, 96 Iowa L. Rev. 475, 514 (2011) (noting a potential rival producer’s difficulty in showing a technology “would have come to fruition and would have become commercially successful but for the IP holder’s restraint”).

in operation is actually decreasing overlapping research. It will provide a diagnostic measure against which to assess research activities while the pool is in effect.

We realize full well this not a perfect measure. It cannot capture cases where, without the pool, two formerly non-competitive companies might have showed convergence in their research activities in the absence of a pool. If a pool forms in an area of increasing research interest for example, past overlaps may not be a good predictor of future overlaps. It might be possible to correct for this, by looking at patent applications (which are published eighteen months after filing), which provide a better predictor of where future research is heading. Also, it might make sense to weight recency heavily, so that if historical overlap is low but recent overlap is more significant, the recent patents are scrutinized more closely for measures of patent-to-patent similarity.

Our suggested way to estimate lost substitutes is of course subject to the limitations of patent mapping and classification techniques. Our way does, however, offer one benefit: a concrete measure against which to test the traditional antitrust concern with research-stifling effects of grantbacks. In the absence of any way to measure this concern, it would seem we should welcome any measure, even an imperfect one.

Conclusion

At the heart of U.S. innovation policy is a very old question: If we are to live under a legal regime that grants limited monopolies to inventors, how powerful should those exclusive rights be? This question is deeply relevant not only to policies that shape the patent rights that the government parcels out to inventors, but also to policies that regulate how patent rights may be privately reapportioned through licensing. Because pools are the chief mechanism for this sort of private reapportionment, they have been the subject of policy debate since they first appeared in the 19th Century.

To date, the regulators, courts, and scholars who have examined the merits of patent pooling have dealt in qualitative perceptions. Many have noted that patent pooling is a powerful mechanism for reducing the myriad transaction costs that pervade the patent landscape. (This fact is particularly important in light of the fact that transaction costs are a dominant theme in contemporary patent scholarship.) Other experts, meanwhile, have cited two ways that patent pools may impose costs on society: first, if a patent pool incorporates

patents covering substitutive technologies that should be in competition, consumers could be harmed; second, if a patent pool requires its members to license future patent rights to one another—i.e., a grantback—innovation might be suppressed under certain circumstances.

On balance, the literature presents a sort of schizophrenic diagnosis: patent pools are dangerous, but the transaction costs they cure are harmful too. It is reminiscent of the joke that begins the Woody Allen movie, *Annie Hall*. Two people are complaining about the food service at their resort. One says, “The food here is awful.” The other responds, “Yeah, I know; and such small portions.”

This Article moves the patent pooling debate out of this fog through the clarifying power of numbers. We first provided a method of estimating the transaction costs that patent pools conserve. This involved comparing the cost of establishing and operating a patent pool to the next best alternative—i.e., a series of individual licenses. We put our method to work by feeding it financial data shared with us by two of the most important patent pools in operation today through an original set of interviews.

Our calculations reveal that the transaction costs conserved by an average patent pool are substantial—on the order of hundreds of millions of dollars, conservatively. This finding suggests important modifications to policy and theory. From a theoretical perspective, we believe this Article can advance the scholarly debate concerning patent pools. The majority of recent scholarship on this subject has acknowledged the theoretical benefits of pools but focused more on their theoretical harm. By injecting empirical evidence into the discussion, we hope to encourage theorists to restore transaction costs to the forefront of their analyses.

Not content to quantify (for the first time) the benefits of pooling patents, we also offer innovative methods to estimate their costs. On the crucial question of suppressed substitutes – so central to worries about patent pools over the years – we offer a tractable approach to estimating the number of suppressed or “lost” substitutes a pool might produce. We then use real-world data derived from patent infringement cases to illustrate our approach.

After that, we turned to the second most common objection to patent pools: that grantback clauses will suppress future research competition. We unveiled a methodology for grappling with this issue. Using recent history as a guide, we

propose using patent landscaping techniques to estimate the degree of research overlap between two companies entering into a pool. With this in hand, projecting forward over the life of the patent pool, we provide a useful tool for estimating the potential number of foregone future overlapping patents that might flow from a pool. To estimate the social welfare loss in value, we advocate simply applying the “lost substitutes” methodology from the preceding section to the predicted number of cases of future lost substitutes.

We have introduced no fewer than three innovative methodologies in this Article: interviews to estimate the benefits of pools, in the form of saved transaction costs, a simple profit margin differential measure of social welfare costs from each case of suppressed technological substitutes, and a patent landscape mapping technique for predicting the future effects of grantback clauses in patent pools.

Putting it all together, we recommend the following procedure: Policymakers should begin with transaction cost savings as a baseline for comparison when examining the desirability of a specific patent pool. This amount can then be compared to an estimate of the anticompetitive effects of a pool using the two methods we describe.¹⁶⁴ The result would be a much more rigorous assessment of the overall desirability of a proposed patent pool.

¹⁶⁴ We welcome any critiques of our methodology. If the social costs of patent pools are not within an order of magnitude of the transaction costs they save, however, minor corrections to our approach are unlikely to unsettle our conclusions.