Stanford University • October 2012

SIEPR policy brief

CELEBRATING 30 YEARS OF EXCELLENCE

Stanford Institute for Economic Policy Research

on the web: http://siepr.stanford.edu

Patent Pools and Innovation: Evidence From Economic History

By Petra Moser

Patent pools, which allow competing firms to combine their patents as if they were a single firm, have emerged as a prominent policy tool to address a key problem with the current patent system: Poorly defined boundaries of intellectual property right allow multiple firms to own mutually infringing patents for the same technology. Firms then use these patents to threaten litigation and prevent each other from producing new technologies. Patent pools can mitigate this problem by allowing firms to combine their patents in a "pool" that all firms can access to produce the technology and license it to outside firms. For example, pools have been proposed as a mechanism to reduce litigation risks and ensure the adoption of innovations in smartphones, tablet computers, video compression technologies, malaria and HIV drugs, and diagnostic test kits for breast cancer.

Policymakers are generally supportive of pools because they "provide pro-competitive benefits by integrating complementary technologies, reducing transaction costs, clearing blocking positions, and avoiding costly infringement litigation."[1] Moreover, the majority of theoretical models predict that pools encourage innovation. For example, pools may resolve litigation due to overlapping patent rights, when several firms own patents for the same technology, and blocking patents, which obstruct the adoption of technologies. Pools may also reduce transaction costs and licensing fees, by creating opportunities for one-stop shopping and by eliminating double-marginalization, which

continued on inside...

1 U.S. Federal Trade Commission and Department of Justice (1995).

About The Author

Petra Moser Petra Moser is an Assistant Professor in Economics at Stanford, a Fellow at SIEPR, the NBER, and at the Center for Advanced Studies in the Behavioral Sciences (CASBS). She earned an M.A. in International Relations at Yale and a Ph.D. In Economics at Berkeley. Her research centers on the effects of patent policy on innovation. Representative publications include "How do Patent Laws Influence Innovation" in the *American Economic Review*, "Compulsory Licensing" (with Alessandra Voena) in the *American Economic Review*, "Innovation without Patents" in the *Journal of Law and Economics*, and "Do Patent Pools Encourage Innovation?" (with Ryan Lampe) in the *Journal of Economic History*.

occurs when individual firms charge fees that are too high considering the optimal price of the entire technology. Pools may, however, also *dis*courage investments in R&D by pool members because returns to R&D will be shared and members may choose to free ride on other members' research efforts.

Empirical evidence on the effects of patent pools, however, is relatively scarce, because modern pools are too recent to permit long-run analyses of effects on innovation. For example, qualitative evidence for the CD industry indicates an increase in innovation, while qualitative evidence for optical disk drives suggests a decline in innovation (Flamm 2012).

A Pool For Sewing Machines (1856-1877) Discouraged Innovation.

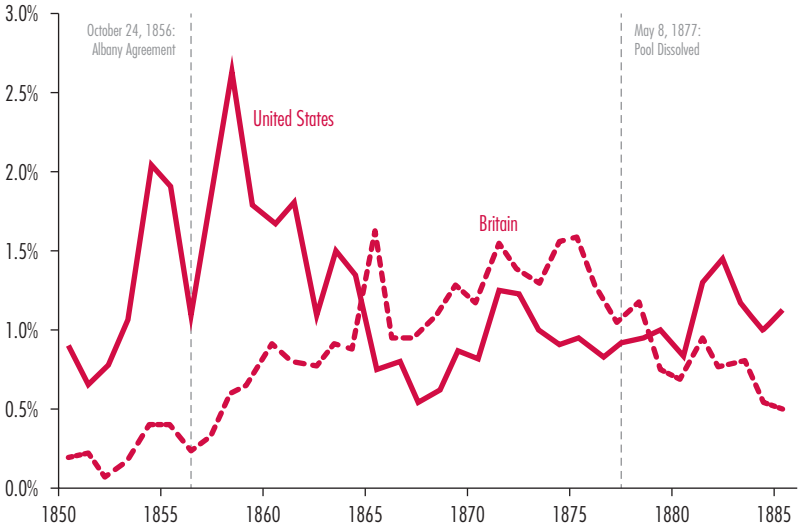
The case of the Sewing Machine Combination (1856-1877), the first patent pool in U.S. history, creates a unique opportunity to examine whether patent pools encourage innovation. One key advantage of the historical setting is that we can observe an industry from its birth to technical maturity, including more than 30 years of data to analyze the long-term effects of a pool. Another advantage is that the sewing machine pool operated in the complete absence of regulation, which allows us to examine how pools behave when regulators give them free rein.

The Sewing Machine Combination also shared key characteristics of pools that theoretical models predict will encourage innovation: It combined complementary patents for a technology and was intended to end litigation during the crippling "sewing machine wars" (1851-1856). Litigation data confirm that the pool lowered litigation risks for its members, but they also indicate that non-members were at a greater risk of being sued while the pool was active; pool members acted as plaintiffs in most of these cases (Lampe and Moser 2010).

The data further indicate that both pool members and outside firms (which accounted for the vast majority of patents) patented less while the pool was active and only began to patent more again after the pool dissolved in 1877. Patents by outside firms spiked just after the pool was established, with an increase from 25 patents in 1856 to almost 100 patents in 1858, but began to decline only two years after the pool had formed. By 1862, the number of patents had fallen to 35 patents per year. The number increased to 149 in 1872 after the Civil War increased demand for sewing machines. Following this peak, the number of patents per year declined again until the pool dissolved in 1877. By 1880, only three years after the pool dissolved, the number of patents per year began to rise again, increasing past 250 patents in 1882.

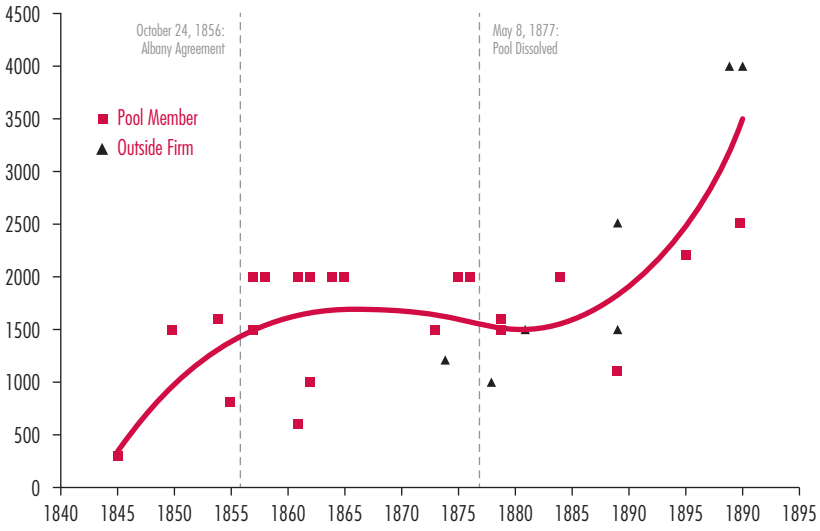
Comparing sewing machine patents as a share of all U.S. patents also indicates that the pool discouraged patenting. An initial increase in the share of sewing machines to 2.5 percent of patents in 1858

Figure 1
Share of Sewing-Machine Patents In All Patents: United States Versus Britain



From Lampe and Moser (2010)

Figure 2
Improvements in Sewing Speed



From Lampe and Moser (2010)

eroded to 0.5 percent by 1867. The share of sewing machine patents recovered after the pool dissolved, reaching nearly 1.5 percent of all U.S. patents in 1882. An additional test compares changes in sewing machine patenting in Britain and the United States. The comparison with Britain is particularly interesting because Britain had no patent pool. It suggests that the decline in innovation during the pool was a purely American phenomenon. British patents followed a more continuous growth path. Sewing machine patents as a share of all British patents continued to increase until the early 1870s and declined after 1874. In contrast with the U.S. case, patenting did not increase in Britain after 1877.

Strategic Patenting or Innovation?

A potential problem with using patents as a measure of innovation is that firms may use patents strategically. For example, the creation of a pool may reduce the need for member firms to create patent thickets by reducing the threat of litigation (Shapiro 2001). The prospect of a pool may also provoke a wasteful race to patent before the creation of a pool, so that patent applications that firms submit leading up to the creation of a pool may be of lower quality.

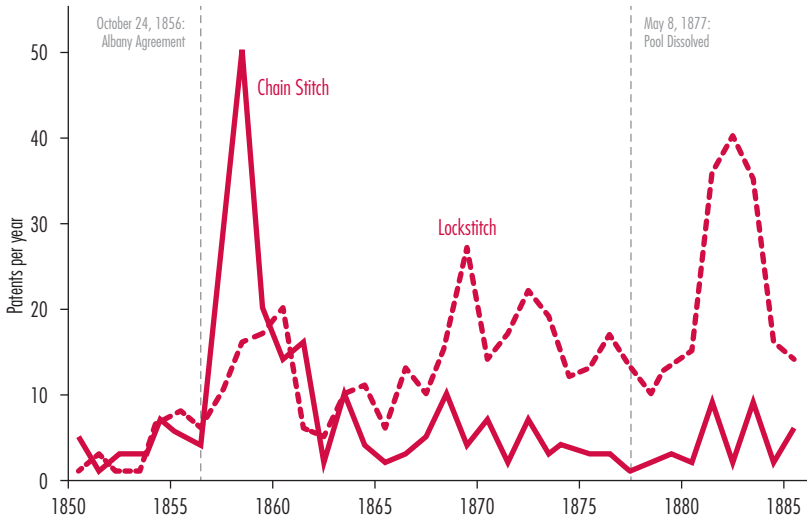
To separate changes in strategic patenting decisions from changes in innovation, we examine data on improvements in sewing speeds as an objectively quantifiable measure of performance. These data confirm that the pool slowed rather than encouraged rates of innovation. From 1845 until 1856, the maximum number of stitches that a lockstitch sewing machine could perform increased from 200 to 2,000 stitches per minute. As soon as the pool was established, improvements came to a halt and sewing speeds stayed roughly constant for the duration of the pool. Improvements began to advance again soon after the pool dissolved in 1877. By 1889 the maximum speed of sewing had increased to 2,500 stitches per minute. Outside firms produced the fastest machines in 1889 and 1890.

Pools May Divert Innovation Toward Inferior Substitute Technologies

In addition to the number of innovations, the creation of a pool may also affect the *direction* of technical change. Regulators' primary concern is that the creation of a pool may discourage innovation in substitute as it " 'risks foreclosing markets to competing patents outside the pool' because a licensee would not purchase both a pool license and a license for a substitute patent, even if that substitute were a superior technology" (Department of Justice and Federal Trade Commission, 2007).

Data for the sewing machine industry, however, suggests that the creation of a pool may encourage innovation in substitutes, as outside firms shift R&D away from

Figure 3
Patents For Lock Stitch Versus Chain Stitch



From Lampe and Moser (2012a)

pool technologies to avoid competition and litigation of the pool (Lampe and Moser 2012a). One of the pools' core patents was U.S.P.T.O. Patent No. 4,750, for the lockstitch, a sturdy and efficient stitch mechanism that continues to be used today. Its most prominent substitute was the chain stitch, which imitated the motion of the human hand but was deemed by its contemporaries as "unsuitable for sewing purposes" (Flint et al. 1871, p. 425).

Patent data reveal a drastic shift toward substitute technologies after the formation of the pool. Until the pool formed in 1856, a comparable number of lockstitch and chain-stitch patents were granted each year. Between 1857 and 1862, nearly twice as many patents were granted for the chain-stitch technology, compared with the lockstitch (pool) technology. Two alternative measures of "patent quality" confirm that the data indicate a shift in innovation. The first measure collects citations to the patents in our data from U.S. patent grants between 1920 and 2002; 618 of the 4,576 patents in our data are cited as relevant prior art by at least one later patent. Analyses of cited patents suggest a strong shift toward chain-stitch invention after the pool was formed. The second measure takes advantage of a curator's selection in 1925 of the most important sewing machine patents to be preserved at the Smithsonian Institution. Smithsonian patents also reveal a significant shift toward chain-stitch invention after the creation of the pool.

Data on 146 of entrants to the sewing machine industry between 1849 and 1885 indicate that the creation of a pool also affected the technology choice of new firms. Until 1856, 8 new firms entered with chain-stitch machines, compared with 20 that entered with lockstitch machines; between 1857 and 1866, 33 new firms entered with chain-stitch machines, compared with 13 that entered with lockstitch machines. New firms continued to enter with the substitute technology even after the pool's specific patent on the lockstitch had expired in 1867. After the pool dissolved in 1877 and pool members reduced the price of lockstitch machines to the level of chain-stitch machines, only 2 of 28 firms entered with the chain stitch.

The New Deal as a Natural Experiment to Examine Pools in the Absence of Antitrust

A caveat for these results is that they are based on a single industry, which may not be representative. To address this issue, we have constructed a new data set of 75,396 patent applications in 20 U.S. industries that formed patent pools under the New Deal (Lampe and Moser 2012b). New Deal policies, such as the National Industrial Recovery Act (NIRA, 1933-35), which exempted the majority of U.S. industries from antitrust in exchange for higher wages, create a unique

continued on flap...

opportunity to investigate pools that would form in the absence of effective antitrust. Under the New Deal, regulators allowed pools to form in the hope that they would facilitate economic recovery from the Great Depression, arguing that "An interchange of patent rights and a division of royalties…are frequently necessary if technical advancement is not to be blocked by threatened litigation."[2] Enforcement of antitrust rules resumed after March 11, 1938, when President Roosevelt appointed Thurman Arnold to reorganize the Department of Justice's Antitrust Division.

Comparisons of changes in patenting per year for 433 pool technologies with a group of 828 related technologies in the same industries reveal a 16 percent decline for pool technologies. This decline is driven almost entirely by technologies in which the creation of a pool combined patents for substitute technologies by competing firms, suggesting that—in the absence of effective regulation—patent pools will discourage innovation by weakening competition among innovators.

2 *Standard Oil Co. of New Jersey v. United States,* 283 U.S. 163, 167-168 (1931).

References

Department of Justice and Federal Trade Commission. "Antitrust Guidelines," Washington, DC: GPO, 1995.

Department of Justice and Federal Trade Commission. "Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition," Washington, DC: GPO, 2007.

Flamm, Kenneth. "A Tale of Two Standards: Patent Pools and Innovation in the Optical Disk Drive Industry." University of Texas at Austin working paper, January 2012.

Flint, C., C. McCay, J. Merriam, T. Kettell, and L. Brocket. *One Hundred Years' Progress of the United States: with An Appendix Entitled Marvels that our Grandchildren Will See; or, One Hundred Years' Progress in the Future.* Hartford, CT: L. Stebbins, 1871.

Lampe, Ryan, and Petra Moser. "Do Patent Pools Encourage Innovation? Evidence from the 19th-Century Sewing Machine Industry," *The Journal of Economic History,* Volume 70, Issue 04, December 2010, pp. 898-920. Working paper at *http://ssrn.com/abstract=1308997.*

Lampe, Ryan, and Petra Moser. "Patent Pools and the Direction of Innovation" *http://ssrn.com/abstract=1468062. 2012a.*

Lampe, Ryan, and Petra Moser. "Do Patent Pools Encourage Innovation? Evidence from 20 Industries in the 1930s," *Stanford Law and Economics Olin* WP No. 417. *http://ssrn.com/abstract=1967246. 2012b.*

Shapiro, Carl. "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting." In Jaffe, Adam, Lerner, Josh, and Stern, Scott (Eds.), *Innovation Policy and the Economy,* Cambridge, MA: MIT Press, 2001.

This brief draws on the findings of collaborative work with Ryan Lampe (Stanford Ph.D. 2009), an assistant professor at DePaul University and a visiting scholar at the Center for Advanced Studies in the Behavioral Sciences.

SIEPR *policy brief*

Stanford University
366 Galvez Street
Stanford, CA 94305
MC 6015

A publication of the
Stanford Institute for
Economic Policy Research

Non-Profit Org.
U.S. Postage
PAID
Palo Alto, CA
Permit No. 28

SIEPR

About SIEPR

The Stanford Institute for Economic Policy Research (SIEPR) conducts research on important economic policy issues facing the United States and other countries. SIEPR's goal is to inform policymakers and to influence their decisions with long-term policy solutions.

Policy Briefs

SIEPR policy briefs are meant to inform and summarize important research by SIEPR faculty. Selecting a different economic topic each month, SIEPR will bring you up-to-date information and analysis on the issues involved.

SIEPR policy briefs reflect the views of the author. SIEPR is a non-partisan institute and does not take a stand on any issue.

For Additional Copies

Please see SIEPR website at *http://SIEPR.stanford.edu*.