

INTELLECTUAL PROPERTY INSTITUTIONS IN THE UNITED STATES:

EARLY DEVELOPMENT AND COMPARATIVE PERSPECTIVE

by

Kenneth L. Sokoloff

University of California, Los Angeles and NBER

and

B. Zorina Khan

Bowdoin College

Prepared for World Bank Summer Research Workshop on Market Institutions
Washington, D.C. July 17-19, 2000

Throughout his adult life Samuel L. Clemens was actively engaged in all dimensions of intellectual property. Though he was the first writer to incorporate and register his pseudonym as a trademark, and copyrights on his best selling books yielded a steady flow of income, his single most profitable property right was to a self-pasting scrapbook he patented in 1873. Some of his greatest disappointments, however, also stemmed from troubles with the intellectual property system, including unsuccessful litigation over piracy of his works and investments in patented technologies which turned sour and contributed to his bankruptcy. Despite his decidedly mixed experience, Clemens remained an ardent believer in systems of intellectual property. Speaking through the Connecticut Yankee in King Arthur's Court, he declared: "...the very first official thing I did, in my administration – and it was on the very first day of it too - was to start a patent office; for I knew that a country without a patent office and good patent laws was just a crab, and couldn't travel any way but sideways or backwards."

Clemens was far from alone among nineteenth-century observers in his view that the U.S. patent system was a significant factor behind the rapid technological progress and great prosperity that the nation enjoyed. The United States dazzled the world with its ingenuity at the Crystal Palace exhibition of 1851. Receiving much comment were the wide range of industries to which American inventors had made technological contributions, the extraordinary creativity displayed in lowering the costs of producing standardized goods, and the broad spectrum of the population involved in inventive activity. Many suggested that its rather distinctive, if not revolutionary, patent laws were especially favorable to invention, and it was no coincidence that Britain, after nearly a quarter century of study by a series of parliamentary committees, approved a major overhaul of its patent system in 1852 to make it more like that of its competitor across the Atlantic. Although opinion remained divided, most countries -- helped along by a series of international conferences that were organized to encourage convergence in treatment of intellectual property -- moved in the same direction by the end of the century.

Then, as now, many questions were raised about the design of systems of intellectual property. At a general level, there were some who doubted the net benefits of awarding property rights in technology at all; indeed, during the so-called patent controversy of the mid-nineteenth century, the Netherlands and Switzerland did away with their patent systems for extended periods. Others, such as those who rationalized the much higher fees and other costs of obtaining a patent that prevailed for most of the century in Britain and much of Europe, argued for limiting grants to inventions that were of major consequence or had required extraordinary talents and resources to discover. Similar sentiments were expressed even in the U.S., where organized groups representing railway companies and farmers lobbied heavily for changes in the law that would have made it more difficult to enforce patents pertaining to inventions that were deemed straightforward incremental extensions of existing technology or "in the air". While Congress was consumed with extended and controversial deliberations about the reforms needed, the Supreme Court took the initiative in the late 1870s and early 1880s that narrowed the enforceable breadth of patents. Finally, there was much discussion of whether and how systems of intellectual property should vary over time, technology, or stage of development, as well as of the returns to harmonizing them across countries. Ironically, the U.S., which became a force behind the movement toward coordinating patent systems, had been something of an intellectual plunderer in the realm of copyrighted material for most of the century and only agreed to modify its laws to allow foreign residents copyrights in 1891.

EARLY HISTORY

The intellectual property clause providing for the patent and copyright systems appears in the very first Article of the U.S. Constitution, whereby Congress was instructed to "promote the progress of science and useful arts by securing to authors and inventors the rights to their respective writings and discoveries". American policymakers did not start with a blank slate.

The grant of exclusive property rights vested in patents had a long history, tracing back to medieval guild practices in Europe. British monarchs had frequently used patents to raise revenue through the sale of, or to reward favorites with, privileges such as monopolies over trade in specified commodities. In 1624 the Statute of Monopolies repealed the practice of royal monopoly grants to all except inventors, but the British patent system retained many features that reflected its origins in royal privilege well into the nineteenth century. Patent rights were regarded as a favor from the Crown, and applications had to win approval from a number of different officials before the monarch signed off through a process that was anything but transparent. In addition to the high transactions costs associated with navigating the labyrinth of the patent review process, extremely high fees were also assessed. Other salient features of the British system were the restriction of access to the specifications of patents until they expired, and a relative lack of attention as to whether the patentee was actually the inventor or an innovator. Britain, like most other nations in Europe, frequently awarded patents to residents who were importing technologies discovered elsewhere.

The framers of the U.S. Constitution and of its early laws were familiar with British precedents, and so it might reasonably be inferred that their innovations in the design of the patent system were self-conscious and deliberate. From what record of their thinking survives, they were intent on crafting a new type of system that would be focused on promoting technological and commercial development and also serve as a repository of information on prior art. Indeed, it can be argued that the result of their efforts was the world's first modern patent institution. One goal was broad access to property rights in technology, which was achieved through low fees (approximately 5 percent of what they were in Britain) and an application process that was impersonal and relied on routine administrative procedures. Incentives for generating new technological knowledge were also fine-tuned by requiring that the patentee be “the first and true inventor” anywhere in the world, and that the specifications of the invention be made available to the public immediately on the issuance of the patent. This latter condition not only sped the diffusion of technological knowledge, but also -- when coupled with strict enforcement of patent rights -- aided in the commercialization of the technology itself.

The American legal system reinforced the effectiveness of the patent system. Within a few decades the judiciary evolved rules and procedures to enforce the rights of “meritorious patentees” (whose novel creations added to the stock of social capital) and their assignees, as opposed to monopolists (who took from the public for their private gain). Supreme Court Justice Joseph Story, the acknowledged intellectual property expert of the early courts, made the perspective clear in *Lowell v. Lewis* (1817): “the inventor has a property in his invention; a property which is often of very great value, and of which the law intended to give him the absolute enjoyment and possession ... involving some of the dearest and most valuable rights which society acknowledges, and the constitution itself means to favor.” Congress was also flexible in adapting the law to improve the system, most notably with the Patent Act of 1836 which introduced the examination system that is still in use today. The previous registration system, modeled on British practices, had left issues of novelty and of validity or appropriate scope in patent applications to be resolved through civil actions, which soon proved to be an inefficient way of resolving competing claims. Beginning on July 4th, 1836, each application was scrutinized by technically trained examiners to ensure that the invention conformed to the law, and constituted an original advance in the state of the art. The change led to a substantial increase in the potential returns facing individuals contemplating investments in inventive activity. Particularly important was the impetus that the strengthening of the property right entailed in a patent grant gave to the evolution of organized trade in patented technologies.

Copyrights, or legal protection of literary products, had been introduced in fifteenth century Venice, after the invention of the printing press made it possible to cheaply duplicate literary and artistic works. In England, similar privileges or monopoly rights in the book trade

were granted to printers' cartels until the passage of the world's first copyright act, the Statute of Anne, in 1710. The first U.S. copyright statute was approved on May 31 1790, "for the encouragement of learning, by securing the copies of maps, charts, and books to the authors and proprietors of such copies, during the times therein mentioned." Authors (broadly defined) were able to obtain copyright protection by registering their works, complying with deposit and notification rules, and paying a nominal fee. Registration initially secured the right to print, publish and sell maps, charts and books for a period of fourteen years, with the possibility of an extension for another term. However, copyrightable subject matter expanded significantly over the course of the nineteenth century to include musical compositions, plays, engravings, sculpture, and photographs. In 1853 Harriet Beecher Stowe was held not to possess the rights to translations of her own novel, but by 1910 the original copyright holder was granted the right to translate literary works into other languages; performance rights; and the rights to arrange and adapt musical works, among others. Congress also lengthened the term of copyright several times.

The U.S. was long a net importer of literary and artistic works, especially from England, which implied that recognition of foreign copyrights would have led to a net deficit in international royalty payments. Despite the lobbying of numerous authors and celebrities on both sides of the Atlantic, the American copyright statutes did not allow for copyright protection of foreign works for fully one century. As a result, the nineteenth century offers a colorful episode in the annals of intellectual property, as American publishers and producers freely pirated foreign literature, art, and drama. The publishing industry was further protected by tariffs on books that ranged as high as 25 per cent. Other countries retaliated and refused to grant American authors copyright protection. As a result of lack of legal copyrights in foreign works, the publishing industry experienced several decades of intense, if not quite "ruinous" competition. By the middle of the nineteenth century, however, the industry achieved relative stability by tacitly colluding to create and recognize synthetic property rights in foreign-authored books. These exclusive rights were tradable, and were enforced by threats of predatory pricing and retaliation. Thus, these practices suggest that legally enforceable property rights were of sufficient importance to publishers that, in their absence, the companies attempted to simulate their effects, albeit at higher costs.

In the case of patents, the rights of inventors, whether domestic or foreign, were widely viewed as coincident with public welfare. In stark contrast, policymakers showed from the very beginning an acute sensitivity to trade-offs between the rights of authors and social rights or welfare. The protections provided to authors under copyrights were as a result much more limited than those provided by the laws in many European countries based on moral rights. Of relevance here are stipulations regarding first sale, work for hire, and fair use. Under a moral rights-based system, an artist or his heirs can claim remedies if subsequent owners alter or distort the work in a way that allegedly injures the artist's honor or reputation. According to the first sale doctrine, the copyright holder lost all rights after the work is sold. If the copyright holder's welfare would be enhanced by nonmonetary concerns, these individualized concerns could be addressed and enforced through contract law, rather than through a generic federal statutory clause that would affect all property holders. Similarly, work for hire doctrines also repudiated the right of personality, in favor of facilitating market transactions. For example, in 1895 Thomas Donaldson filed a complaint that Carroll D. Wright's editing of Donaldson's report for the Census Bureau was "damaging and injurious to the plaintiff, and to his reputation" as a scholar. The court rejected his claim and ruled that as a paid employee he had no rights in the bulletin; to rule otherwise would create problems in situations where employees were hired to prepare data and statistics.

This difficult quest for balance between private and public good is most evident in the copyright doctrine of "fair use" that (unlike with patents) allowed unauthorized access to

copyrighted works under certain conditions. Joseph Story ruled in *Folsom v. Marsh* (1841): “we must often, in deciding questions of this sort, look to the nature and objects of the selections made, the quantity and value of the materials used, and the degree in which the use may prejudice the sale, or diminish the profits, or supersede the objects, of the original work.” One of the striking features of the fair use doctrine is the extent to which property rights were defined in terms of market valuations, or the impact on sales and profits, as opposed to a clear holding of the exclusivity of property. Fair use doctrine thus illustrates the extent to which policy makers weighed the costs and benefits of private property rights. If copyrights were as strictly construed as patents, it would serve to reduce scholarship, prohibit public access for noncommercial purposes, increase transactions costs for potential users, and inhibit learning which the statutes were meant to promote.

The copyright system changed continually throughout the nineteenth century to encompass improvements in technology and changes in the marketplace. New technologies raised copyright questions because they became potential subjects for copyright protection, and because many new technologies in the 19th century, such as photography and lithography, enabled and lowered the costs of infringement of copyrighted works. In *Edison v. Lubin* (1903), the lower court rejected Edison’s copyright of moving pictures under the statutory category of photographs. This decision was overturned by the appellate court: “[Congress] must have recognized there would be change and advance in making photographs, just as there has been in making books, printing chromos, and other subjects of copyright protection.” Many uncopyrightable innovations such as stock market quotations and ticker tape news reports were protected through alternative doctrines, such as unfair competition, in order to further market transactions.

THE DEVELOPMENT OF PATENTING AND PATENT INSTITUTIONS Encouraged by the low costs of filing and the relatively rapid development of mechanisms for enforcement, Americans were from the outset enthusiastic about establishing their claims to intellectual property. By 1810 the U.S. far surpassed Britain in patenting per capita. Patenting exhibited a strongly pro-cyclical pattern throughout the nineteenth century, with the salient exception being the sharp acceleration that occurred during the years just preceding the War of 1812, when the Embargo of 1807 and other barriers dramatically reduced the volume of foreign trade. Such developments would normally be expected to have triggered an economic contraction in the young country which exported agricultural goods and natural resources, but the stimuli to inventive activity provided by the cut off of supplies of manufactures from abroad and the spread of the population westward, along with the associated investments in manufacturing plant and in the transportation infrastructure, may have been sufficient to offset the effects of an aggregate downturn. Patenting rates stagnated during the War of 1812 and the severe worldwide contraction that followed, but resumed their rapid rise early in the 1820s. Except for the sharp drop in the number of patents granted when the examination system replaced the registration system in 1836, and dips during general economic downturns and the Civil War, the trend was steadily upward until peaking in the mid-1880s. The growth in patenting was especially dramatic from the 1840s through the 1870s when the per capita rate increased fifteen times.

Scholars have followed the path blazed by Jacob Schmookler and Zvi Griliches in employing patent records to study the sources and patterns of inventive activity over this crucial period when the U.S. emerged as a world leader in technology and an industrial power. One of the principal implications of their work to date has been that inventors were quite sensitive to so-called demand-side factors. They have created proxies for market access by exploiting the large differences between the costs of transporting goods by water and by land prior to the railroad, and demonstrated that patenting rates varied substantially across geographic areas with access to markets, even after controlling for local industrial composition and degree of urbanization.

Moreover, close examination of what happened in the vicinity of discrete transport projects, such as the Erie Canal, whose routes were chosen through processes exogenous to the state of economic development suggests that rates of patenting rose steeply within a few years of opening. Similar patterns have been noted in early industrial Britain. This close relationship between access to markets and patenting is certainly consistent with the view that inventive activity was responsive to material incentives, as well as to the availability and security of property rights in technology.

Many questions have been raised about whether such evidence is sufficient to sustain the hypotheses that the rate of invention was indeed higher because the expansion of markets had increased the returns to new technologies or because the existence of a well-functioning patent system helped inventors to appropriate some of those returns. Although there remains room for skepticism, these ideas have survived a number of stringent tests of consistency with the record. For example, critics have argued that patent counts are flawed by the inability to distinguish between important and trivial inventions. In order to evaluate the relevance of this problem, systematic data on the efforts of 160 early-nineteenth-century 'great inventors' (whose inventions were presumably more valuable on average than those of all inventors) were collected and analyzed. Virtually all of these 'great inventors' made use of the patent system to appropriate the returns to their efforts. Moreover, their patenting exhibited remarkably similar cyclical patterns to that of ordinary patentees, and their activity was even more concentrated in geographic areas with low-cost access to markets. Such locations must have been particularly attractive to technologically-creative individuals seeking to extract the returns to their talents, and part of the high patenting by 'great inventors' in these locations was due to in-migration. However, since the 'great inventors' were disproportionately born in the same areas, the extent of markets does seem to have had real independent effects on the rates of inventive activity. Overall, the strong association of patenting with the market in the case of both ordinary patentees and (even more) 'great inventors' supports the notion that potential returns played a major role in the processes generating inventions -- big and small.

As the extent of the market for technology expanded over the course of the nineteenth century, creative individuals with a comparative advantage in technology appear to have moved increasingly toward specializing in inventive activity. This tendency was likely reinforced by the increasing importance to inventors of specialized technical knowledge as technology became more complex. The dramatic increase in specialization took place at two levels. First, among individuals, there was a substantial rise in the proportion of all patents that were awarded to inventors who were specialized or very productive at invention over their careers. From the first third of the nineteenth century to the last third, the fraction of cross-sections of patents that went to inventors who received 10 or more patents over their career jumped from less than 5 percent to between 25 and 36 percent. These particularly productive inventors were also distinguished by high rates of assignment (selling off) or licensing to firms or other individuals. Among the above-mentioned 'great inventors' (whose activity was primarily in the first half of the century), roughly two-thirds extracted some of the return to their inventions through these means. Among a random sample of patentees from the late-nineteenth and early-twentieth centuries, patentees who received 5 or fewer patents over their careers assigned away the rights to less than 20 percent of them. In contrast, those who received 20 or more patents over their careers sold off the rights to nearly 60 percent of the patents they received.

The other way in which specialization increased was across organizations. The period of late-nineteenth and early-twentieth century has sometimes been referred to as the 'golden age of independent inventors'. Although specialization at invention across individuals can occur within a single firm, and indeed is often a celebrated feature of many large firms with R & D laboratories, the major changes of the nineteenth century appear to have been realized largely across enterprises through the operation of a market for technology. Naomi Lamoreaux and

Sokoloff have shown that the highly productive patentees of that era were quite entrepreneurial and typically not employees of the firms to which they assigned their patented inventions. The evolution of a market for technology had allowed for a division of labor between individuals or firms who were relatively specialized at invention, and those who focused on commercial development. During the last few decades of the nineteenth century, these highly productive patentees exhibited 'contractual mobility', where the patentees assigned different patents to different assignees. It was only early in the twentieth century that a trend toward long-term attachments between highly productive inventors and particular firms became evident. Even then, these inventors were more likely to have become principals or officers in the firms to which they assigned their patents, rather than employees.

What were the origins of this market for technology? Trade in patented technology appears to have grown rapidly soon after the introduction of the examination system in 1836 strengthened the property right to the technology covered by a patent. This development reduced the transactions costs associated with commerce in technology, and an examination of the registry of the assignment contracts maintained by the Patent Office (where they had to be deposited within three months in order to be legally binding) indicates that already by the 1840s there was a high rate of exchange in patent rights. At first, much of the trade in patent rights consisted of geographic-specific assignments, such as an inventor in Massachusetts selling off the rights to his patent for the state of Missouri and for the state of Illinois to firms in St. Louis and Chicago respectively. In a context in which high transportation costs meant that output markets were regionally segmented, such geographic assignments were an effective way for an inventor to appropriate more of the return to his investment in inventive activity – for it augmented the return he could realize through direct commercial application in his hometown. But as transportation costs fell and a national market developed, sales of patent rights were carried out for the entire country.

Institutional support for trade in patented technologies came from many sources. Most fundamental were the practices of the U.S. Patent Office in promoting knowledge of new inventions. Early in the nineteenth century it began to regularly publish descriptions of patents granted, and maintained offices throughout the country where models of recently patented inventions could be displayed and examined. Public knowledge of new patents and developments in technology was further stimulated when growing legions of patent agents or lawyers materialized soon after the 1836 law, especially in major cities and other localities where rates of patenting were high. Although these agents were focused initially on helping inventors obtain patents under the new system, it was not long before they assumed a major role in the marketing of patented inventions. Many national patent agencies were formed, and they typically published periodicals with the latest news about patents and technology (including extensive sections of classified advertisements encompassing all types of participants in a general market on technology) that attracted large readerships and helped popularize invention as a path for the entrepreneurially minded. Munn and Company, for example, began publishing *Scientific American* in 1846 as just such a newspaper and maintained offices across the country. Over time, intermediation in this market for technology grew ever more articulated in a process not unlike the evolution of financial intermediaries, as patent agents and lawyers became increasingly specialized and drawn into activities such as the provision of advice to inventors about the prospects for various lines of inventive activity, and the matching not only of buyers with sellers of patents but also of inventors with individuals seeking to invest in the development of new technologies.

Near the end of the century, patenting on a per capita basis began a long secular decline, which has only recently shown signs of reversing. This protracted decrease in patenting rates has attracted much attention from scholars of technology, and undoubtedly had diverse sources. Yet, it is intriguing to consider whether this marked shift in the patenting rate may have been related

to the equally dramatic change in the organization of inventive activity that started to emerge at about the same time. In particular, the most productive inventors of the late-nineteenth century were quite entrepreneurial and independent of the firms that commercially exploited their discoveries, but early in the 1900s long-term attachments between them and their assignees, as well as the formation of research laboratories within large-scale businesses organizations, became more prevalent.

What factors accounted for the decrease in patenting, especially by independent inventors? One possibility is that the growing complexity and capital intensity of technology raised the cost of carrying out programs of research and development. In the absence of developed sources of venture capital, these increased costs may have reduced the aggregate amount of inventive activity and led to its concentration in large firms with an advantage in mobilizing capital. Changes in the law may also have been important, as a series of rulings across a broad front led to a narrowing of the scope of patents and a strengthening of the ability of firms to protect trade secrets, enforce restrictive covenants, and obtain the rights to patents awarded to employees. This evolution of legal thinking about the allocation of intellectual property rights was likely encouraged by a growing appreciation of the amount of investments required to support inventive activity, as well as by the relative political influence of parties with material interests. Whatever the basis for, or significance of, these changes in doctrine, the qualitative impact would have been to diminish the relative importance of patenting as a means of extracting the return to inventive activity. Instead, firms increasingly relied on other means of appropriating returns, such as trade secrecy or accelerated product development.

Another important development in the intellectual property rights regime over the late-nineteenth century was the movement to attain more uniformity across countries. Part of the impetus came from the costs of discordant national rules becoming more burdensome as the volume of trade in industrial products grew over time. The first international patent convention was held in Austria in 1873, at the suggestion of the United States, and was followed by other agreements including the International Union for the Protection of Industrial Property in 1884. The efforts of the United States were hampered by a lack of leverage: it was unable (or unwilling) to offer foreign delegations any concessions in exchange for reforms that the latter agreed to adopt, since American policy was already the world's most liberal in granting equal rights to foreign patentees. Nevertheless, since its patent system was recognized as the most successful, it is not surprising that patent harmonization implied convergence towards the U.S. model.

The goal of complete uniformity was not practicable, given the different objectives, ideologies and economic circumstances of participants. For instance, as a protectionist measure, many countries insisted on retaining working requirements or compulsory licenses, despite strong U.S. opposition to these constraints on the rights of patentees. Countries such as Germany were initially averse to extending equal protection to foreigners because they feared that their domestic industry would be overwhelmed by American patents. The U.S. pressed for the adoption of reciprocity (which would ensure that American patentees were treated as favorably abroad as in the United States) but this principle was rejected in favor of "national treatment" (American patentees were to be granted the same rights as nationals of the foreign country). An important aspect of international patent cooperation at the beginning of the twentieth century was the adoption of the right of priority, which meant that a patent grant in one country was recognized in other member countries in which the invention was patentable, and was the first step towards a global patent grant.

In view of the strong protections of inventors under the U.S. patent system, its copyright policies appeared to be all the more reprehensible to foreign observers. The term of copyright grants throughout the history of the system was generally shorter, and rights in general more abridged, than in the rest of the world. Other countries had long recognized the rights of foreign

authors in national laws and bilateral treaties. For instance, France allowed copyrights to foreigners conditioned on manufacturing clauses in 1810, granted foreign and domestic authors equal rights in 1852, and led the movement for international harmonization of copyrights. In marked contrast to its leadership in patent conventions, the United States declined an invitation to a pivotal conference in Berne in 1883, and did not sign the 1886 agreement of the Berne Convention which accorded national treatment to copyright holders. It was not until 1891, when the balance of trade in literary and artistic works was swinging in its favor, that the U.S. reformed its international copyright laws. Even then, the Chace Act included concessions to printers' unions (such as requirements that copyrighted books had to be printed in the U.S. or type set with U.S. plates) which led to the U.S. failure to comply with the terms of the Berne Convention until 1988.

CONCLUSIONS

Whether through wisdom, ideology, or good fortune, the framers of the U.S. patent system fashioned a structure that has had a powerful impact on the patterns of inventive activity and generally worked well. According to Abraham Lincoln – himself a patentee – the system “added the fuel of interest to the fire of genius.” Its attention to the provision of broad access to, and strict enforcement of, property rights in new inventions, coupled with the requirement of public disclosure, was extremely effective at stimulating the growth of a market for technology and promoting technical change. Not that the institution was static. On the contrary, the patent system was from the very start, and remains, in a state of continual evolution, and has undergone a number of fundamental modifications. Much of the change came through the law, either through formal legislative alterations or judicial initiatives and reinterpretation, but also important were the continual adjustments in the structure of the market for patented technologies made by private agents responding to economic opportunities. Indeed, a good deal of the success of the U.S. patent system stemmed from the flexible and constructive responses to changing circumstances that were facilitated by having a market as a central feature.

Some of the changes to the U.S. system of intellectual property, such as the introduction of the examination of patent applications or the extensions in the subject matter of copyrights, implemented what might be thought of as technical improvements. Others however, such as the shift of legal thinking (concentrated in the late-nineteenth and early twentieth-centuries) in favor of the rights of employers to inventions generated by employees of inventors, the evolution of the role of intermediaries, or the extension of copyrights to foreign nationals, involved adaptations that seem related to the stage of development. The implications of the latter cases raise questions about the desirability of applying the same system to all places at all times despite certain undoubted benefits of international harmonization. Skeptics can draw some support from the observation that rules of intellectual property -- like all property rights -- have often been sensitive to the distribution of economic and political power. In short, the historical record suggests that appropriate policies towards intellectual property are not independent of the level of economic development and overall institutional environment.

BIBLIOGRAPHY

Bugbee, Bruce, *The Genesis of American Patent and Copyright Law*, Washington, D.C., Public Affairs Press, 1967.

- Dutton, Harold, *The Patent System and Inventive Activity during the Industrial Revolution, 1750-1852*, Manchester, UK: Manchester University Press, 1984.
- Fisk, Catherine L., "Removing the 'Fuel of Interest' from the 'Fire of Genius': Law and the Employee-Inventor, 1830-1930," *University of Chicago Law Review*, v. 65 (Fall), 1998: 1127-1198.
- Griliches, Zvi, "Patent Statistics as Economic Indicators: A Survey," *Journal of Economic Literature* v. 28 (Dec.) 1990: 1661-1707.
- Khan, B. Zorina, "Property Rights and Patent Litigation in Early Nineteenth-Century America," *Journal of Economic History*, v. 55 (1) 1995: 58-97.
- Khan, B. Zorina, "The Fuel of Interest": Patents and Copyrights in American Economic Development, book manuscript (2000).
- Khan, B. Zorina and Sokoloff, Kenneth L., "Schemes of Practical Utility," *Journal of Economic History*, v. 53 (2) 1993: 289-307.
- Khan, B. Zorina and Kenneth L. Sokoloff, "Two Paths to Industrial Development and Technological Change," in *Technological Revolutions in Europe, 1760-1860*, (eds.) Maxine Berg and Kristine Bruland, London, Edward Elgar, 1998.
- Lamoreaux, Naomi and Kenneth L. Sokoloff, "Long-Term Change in the Organization of Inventive Activity," (NAS Colloquium) *Science, Technology and the Economy* vol 93, Nov. (1996): 12686-92.
- Lerner, Josh, "The Importance of Trade Secrecy: Evidence from Civil Litigation," HBS Working Paper 95-043.
- Levin, Richard, A. Klevorick, R. Nelson and S. Winter, "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity*, vol. 3, 1987: 783-820.
- Macleod, Christine, *Inventing the Industrial Revolution*, Cambridge, UK: Cambridge University Press, 1988.
- Mokyr, Joel, *The Lever of Riches: Technological Creativity and Economic Growth*. NY: Oxford University Press, 1990.
- Penrose, Edith Tilton, *The Economics of the International Patent System*, Baltimore, Johns Hopkins Press, 1951.
- Schmookler, Jacob, *Invention and Economic Growth*. Cambridge, MA: Harvard University Press, 1966.
- Sokoloff, Kenneth L., "Inventive Activity in Early Industrial America: Evidence from Patent Records, 1790-1846." *Journal of Economic History*, v. 48 (4) 1988: 813-50.

Sokoloff, Kenneth L., "Invention, Innovation, and Manufacturing Productivity Growth in the Antebellum Northeast," in Robert E. Gallman and John Joseph Wallis (eds), *American Economic Growth and Standards of Living before the Civil War*, Chicago, US: University of Chicago Press, 1992: 345-78.

Kenneth L. Sokoloff and B. Zorina Khan, "The Democratization of Invention in During Early Industrialization: Evidence from the United States, 1790-1846," *Journal of Economic History*, v. 50 (2) 1990: 363-78.