

American Alchemy: The Drive to Turn Ideas into Gold through the Market for Technology

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Abstract

The literature on inventors has traditionally focused, on the one hand, on the achievements of creative entrepreneurs who exploited their ideas in their own firms and, on the other, on the discoveries of researchers in R&D laboratories inside large firms. During most periods of U.S. history, however, it was as much or more common for inventors to sell or license their patent rights to others as to start their own enterprises or work for large firms. The contribution of this paper is to show that the kinds of informational problems that inventors faced in marketing their patents have changed over time along with the structure of the American economy. We first describe the way in which such problems were resolved during the mid-nineteenth century, when both product markets and markets for patent rights were geographically segmented. The heart of the paper then focuses on the new kinds of intermediaries—patent agents and attorneys—who emerged in the last third of the century to help inventors sell patent rights in national markets. Finally, we conclude by sketching out some of the new informational problems that have accompanied the resurgence of the market for patented technology in recent years.

American Alchemy: The Drive to Turn Ideas into Gold through the Market for Technology

It has been aptly said that the products of all the gold, silver, and diamond mines in the world would not equal in value the annual income of American inventors. . . . There are thousands of patents sold outright every year by the patentees of the United States for thousands of dollars; and, to the already long list of successful inventors, each year adds many more, who have become independent through the proper handling of the product of their ingenuity. Indeed there can hardly be conceived a quicker way for the average person to attain independence and wealth than by inventing something of real worth and merit that can be quickly turned into money.

F. A. Cresee, *Practical Pointers for Patentees* (1902)¹

The literature on inventors has traditionally focused, on the one hand, on the achievements of creative entrepreneurs who exploited their ideas in their own firms and, on the other, on the discoveries of researchers in R&D laboratories inside large firms. The general view has been that entrepreneurial inventors dominated in the nineteenth century, but that they gave way to researchers in large industrial research facilities in the twentieth century, when technological discovery required more basic scientific knowledge and also more expensive laboratory equipment.² These two types of inventors have left the most visible traces in the historical record and hence have received the lion's share of the attention. Nonetheless, in most periods of U.S. history it was as much or more common for inventors to exploit their creativity by selling or licensing their patents to others than by starting their own firms or working for

¹ F. A. Cresee, *Practical Pointers for Patentees: Containing Valuable Information and Advice on the Sale of Patents* (New York: Munn & Co., 1902), 13-14.

² Joseph A. Schumpeter, *Capitalism, Socialism and Democracy* (3rd edn.; New York: Harper & Row, 1950); Alfred D. Chandler Jr., *Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass.: Harvard University Press, 1977); Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (New York: Viking, 1989).

others. The one major exception was the mid-twentieth century—the heyday of the industrial research lab—when large firms dominated the U.S. economy and relied mainly on internally generated technologies. During the last quarter of the century, however, large firms suffered declining competitiveness. As their market shares and profit margins dwindled, they sharply reduced their research budgets and turned increasingly to outside sources of technology.³

The starting point for this paper is the idea that talented inventors can benefit from a division of labor that enables them to specialize in generating new technological ideas and to transfer the work of commercializing those ideas to others. This division of labor can occur either in the market or within large firms. Scholars who wrote during the heyday of the industrial research laboratory argued that there were important advantages to be derived from keeping the division of labor within the firm. The exchange of technology in the market, they claimed, was fraught with difficulties. Buyers needed extensive information about the workings of inventions in order to decide whether they were worth buying, but inventors hesitated to provide the necessary details out of fear that the buyers would steal their ideas. At the same time, effective invention often depended on the kind of knowledge about production problems and customers' needs that was generated in the course of the firm's routine business. This kind of knowledge could readily be communicated within the firm through the frequent interactions that occurred among personnel responsible for different functions, but it was much more difficult to transmit across organizational boundaries.⁴

³ Naomi R. Lamoreaux, Daniel M. G. Raff, and Peter Temin, "Beyond Markets and Hierarchies: Towards a New Synthesis of American Business History," *American Historical Review* 108 (April 2003): 404-33; Ashish Arora, Andrea Fosfuri, Alfonso Gambardella, *Markets for Technology: The Economics of Innovation and Corporate Strategy* (Cambridge, Mass.: MIT Press, 2001). See also U.S., Federal Trade Commission, *The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition*, and the accompanying hearings and documentation available at www.ftc.gov/bc/workshops/ipmarketplace/.

⁴ Richard Nelson, "The Simple Economics of Basic Scientific Research," *Journal of Political Economy* 67 (June 1959): 297-306; Kenneth Arrow, "Economic Welfare and the Allocation of Resources for Invention," in *The Rate and Direction of Inventive Activity*, Universities-National Bureau Committee for Economic Research (Princeton:

More recent scholarship has shown, however, that this perspective both understates the informational problems that arise within the firm and overstates the difficulties of those that occur in the market. On the one hand, firms' R&D operations are often geographically isolated from, and out of touch, with employees engaged in production and marketing. Laboratory managers have to worry about how to motivate researchers to work hard at coming up with new ideas and focus their efforts in ways that will improve the firm's bottom line. When they direct employees' creative efforts, moreover, they are much more likely to guide them down paths where the technological payoffs are predictable than to anticipate those that will lead to important new breakthroughs. On the other hand, studies have shown that firms can avoid making expensive bets on the future direction of technological change by building the capacity to track and assess inventions developed outside their boundaries and that they can overcome inventors' reluctance to reveal information about their discoveries by developing a reputation for fair dealing and respect for intellectual property. In addition, throughout U.S. history firms seeking to buy technology on the market have found that intermediaries can resolve many of the problems they face in finding, and negotiating for, externally generated inventions.⁵

Princeton University Press, 1962), 609-625; David J. Teece, "Technological Change and the Nature of the Firm," in *Technical Change and Economic Theory*, eds. Giovanni Dosi et al., 256-81 (London: Pinter, 1988); David C. Mowery, "The Relationship between Intrafirm and Contractual Forms of Industrial Research in American Manufacturing, 1900-1940," *Explorations in Economic History* 20 (Oct. 1983): 351-74; Mowery, "The Boundaries of the U.S. Firm in R&D," in *Coordination and Information: Historical Perspectives on the Organization of Enterprise*, eds. Naomi R. Lamoreaux and Daniel M. G. Raff, 147-76 (Chicago: University of Chicago Press, 1995); Richard Zeckhauser, "The Challenge of Contracting for Technological Information," *Proceedings of the National Academy of Sciences* 93 (Nov. 1996): 12743-48.

⁵ Naomi R. Lamoreaux and Kenneth L. Sokoloff, "Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries," in *Learning By Doing in Firms, Markets, and Countries*, eds. Lamoreaux, Daniel M. G. Raff, and Peter Temin, 19-57 (Chicago: University of Chicago Press, 1999); Joshua Gans and Scott Stern, "The Product Market and the Market for 'Ideas': Commercialization Strategies for Technology Entrepreneurs," *Research Policy* 32 (Feb. 2003): 333-50; Arora, Fosfuri, and Gambardella, *Markets for Technology*; Margaret B. W. Graham, "Entrepreneurship in the United States, 1920-2000," *The Invention of Enterprise: Entrepreneurship from Ancient Mesopotamia to Modern Times*, eds. David S. Landes, Joel Mokyr, and William J. Baumol, 401-42 (Princeton, NJ: Princeton University Press, 2010). See also the introduction and essays in Sally H. Clarke, Naomi R. Lamoreaux, and Steven Usselman, eds., *The Challenge of Remaining Innovative: Lessons from Twentieth Century American Business* (Stanford: Stanford University Press, 2009).

The contribution of this paper is to show that the kinds of informational problems that buyers and sellers face in the market for technology have varied considerably over time as the structure of the American economy has changed. So therefore have the kinds of solutions required to make the market work. We make this argument primarily by documenting the shift in the forms of intermediation that accompanied the growth of national markets in the U.S. over the course of the nineteenth century. We first describe the structure of intermediation that characterized the economy of the early nineteenth century, when both product markets and markets for patent rights were geographically segmented. The heart of the paper then focuses on the new kinds of intermediaries—the patent agents and attorneys—who emerged in the last third of the century to sell patent rights to firms competing to control technological developments in national markets. Finally, we conclude by sketching out some of the new information problems that have accompanied the resurgence of the market for technology in recent years.

Transaction Problems in Geographically Segmented Markets

During the early nineteenth century, the high cost of transporting goods over long distances precluded any single factory from supplying more than a small part of the U.S. domestic market. At the same time, slow communications meant that firms could not manage branch factories in widely dispersed locations. In this environment really the only way inventors could fully exploit the technologies they discovered was by selling or leasing geographically restricted patent rights to manufacturers in different parts of the country. Thomas Blanchard, inventor of a lathe that could turn out irregularly shaped objects, was a master of this strategy. As Carolyn Cooper has shown, he operated his own gunstock factory in Massachusetts, but he also sold local rights to use his lathe to an extensive network of producers that stretched as

far west as the Kansas territory and as far south as Arkansas.⁶ Gordon Winder has shown that Obed Hussey and Cyrus McCormick similarly exploited their reaper and mower inventions, manufacturing farm equipment for sale in their own factories but also selling patent rights to other producers in different parts of the farm belt.⁷

Owners of patents often assigned (that is, sold) patent rights for particular states or regions, but assignments could cover much smaller areas. In 1855 Stephen C. Mendenhall of Wayne County, Indiana, sold W.K. Abbott, Isaac Bowers, and Levi Whistler of Shenandoah County, Virginia, for \$500 the “exclusive right and liberty of making, constructing, using and vending to others to be used” his invention of an improved hand loom for the county in which they resided “and no other place or places.”⁸ That same year John T. Clark paid \$325 for the rights to an improved seed planter for the county of Fayette, Iowa; W. R. Abbott, Isaac Bowers, and Levi Whistler paid \$500 for a hand-loom invention for Shenandoah County, Virginia; and Nathaniel Waterbury \$5,250 for a “Portable Saw Mill” for four Wisconsin counties and part of a fifth.⁹

When added up over all the states (or counties) in the United States, the amounts that could be earned from subdividing patent rights in this way could be substantial. But to earn these profits inventors had to find buyers for their patents in many distant locations. How did they do it? How, for example, did the patentee in Indiana and the assignees in Virginia find each other? In this particular case, we do not know. It is possible, though not very likely, that the

⁶ Carolyn C. Cooper, “Social Construction of Invention through Patent Management: Thomas Blanchard’s Woodworking Machinery,” *Technology and Culture* 32 (Oct. 1991): 978-80.

⁷ Gordon M. Winder, “Before the Corporation and Mass Production: The Licensing Regime in the Manufacture of North American Harvesting Machinery, 1830-1910,” *Annals of the Association of American Geographers* 85 (Sept. 1995): 530-31.

⁸ Manuscript patent assignments, Liber Patent Transfer Volumes 1836-, Vol. W-3, p, 295, Records of the Patent and Trademark Office, Record Group 241, National Archives II.

⁹ Manuscript patent assignments, Liber Vol. W-3, pp. 9, 335-36. Some assignments covered areas as small as a township.

assignees simply read about the invention and contacted the patentee on their own initiative. It is also possible that the inventor himself sought out potential buyers for his patent across the United States. However, given that selling patent rights in this way would have been extremely time consuming and would have taken the inventor away from his primary activities, and given too that people who were skilled at technological discovery were not always adroit salespersons, a more likely possibility is that the inventor turned to agents to market his patent in different parts of the country.

Certainly, from the earliest years of the patent system new kinds of entrepreneurs had stepped forward to profit from handling the sale of intellectual property. When, for example, Paul Pilsbury of Newbury, Massachusetts obtained a patent in 1803 for a corn shelling machine, he quickly found three local men, Paul Adams, Thomas Burnham, and Joseph Lord, eager to buy the invention and earn returns from selling off the patent rights.¹⁰ However, whether they were the original patentees or assignees who purchased patents for the purposes of resale, owners of patents had to contract with distant agents in order to market patents across the broad expanse of the United States. After William Easby of Washington, DC, invented a method of transforming fine coal into solid lumps, he made A. N. Hart of Philadelphia his agent for the purpose of selling his patent in the states of Pennsylvania and Ohio. Similarly, James M. Struell, Daniel Brown, and John H. Zeh, owners of a patent awarded to Bradford Rowe for a machine that split and stretched leather, appointed Curtis L. Van Buren of Niagara County, New York, their agent for the states of Ohio, Michigan, Illinois, and Indiana.¹¹ Alternatively, inventors could hire itinerant agents

¹⁰ "Corn Shelling Machine," *Useful Cabinet* 1 (1 Feb 1808): 40.

¹¹ Manuscript patent assignments, Liber Vol. G-2, pp. 319-320, 420-21.

who drove wagons loaded with models of inventions from town to town seeking buyers for the patent rights.¹²

Either way, these arrangements were plagued with informational problems that created opportunities for unscrupulous operators. Owners of patents had little ability to check whether the agents to whom they entrusted the marketing of their patents in distant locations were really working hard on their behalf, whether they were remitting all the funds they took in, and whether they were representing the inventions accurately to potential buyers. The first two of these problems could be solved at least to some degree contractually—by paying agents a share of the proceeds rather than a fixed fee and by “providing, in the power of attorney, that all cash received shall be deposited to the joint order of the agent and the inventor, and that all notes taken shall be to their joint order.”¹³ The third problem was much more serious, and the historical record is full of accounts of fraudulent behavior by itinerant agents.

The most common charge was that agents exaggerated the value of the inventions they were hawking. For example, several prominent farmers in Mohawk, New York, succumbed to a sales pitch and purchased stock in a hay-loader patent. They later claimed that the agent’s fast talk kept them from realizing that the patent was worthless—that “there was no saving of labor between the machine and pitching by hand.”¹⁴ An Indiana man tried to void a contract to buy a patent for a lamp on the grounds that that the seller misrepresented the lamp’s capabilities, asserting that it “would burn, by one filling with oil, for the space of six hours, whereas, in truth, it would burn for a space of time less than three hours and thirty minutes; and that it would cost

¹² For a picture of one such wagon from a somewhat later period, see Cooper, “Social Construction of Invention,” 963.

¹³ William Edgar Simonds, *Practical Suggestions on the Sale of Patents with Forms of Assignment, License, Contract, Power of Attorney to Sell Rights, &c. Many of them Original, and Instructions Relative Thereto, with Hints Upon Invention, and the United States’ Census* (Hartford, Conn.: privately printed, 1871), 28-29.

¹⁴ See “Patent Rights, and the Way Farmers are Humbugged,” *Transactions of the New York State Agricultural Society* (1868): 501-3.

but 16 cents to construct one of said lamps, whereas, in truth, it would cost 37 ½ cents.”¹⁵ Two Connecticut brothers contended that they paid \$400 for the rights to manufacture and sell a sewing machine in Middlesex County after the seller falsely promised that the machine “would work well and would not drop stitches, and would do the promiscuous sewing of a family.”¹⁶ An Illinois man attempted to get out of a contract giving him local rights to a patented shingle machine by charging that the seller had misrepresented the invention as capable of “manufactur[ing] shingles without checking or splitting them.”¹⁷

Sometimes itinerant agents bilked unsuspecting buyers by marketing patents they had no right to sell. A resident of Charlton, New York, for example, paid \$700 in 1867 for rights to “Spoor’s Patent Gate” for ten counties to someone who claimed (falsely, it turned out) to be the agent of the owner of the patent.¹⁸ Sometimes, moreover, agents sold patents that did not even exist. Thus a man in Arkansas paid \$800 for local patent rights to a medicine known as “Newsom’s Vegetable Tonic,” but no patent had ever been granted for this concoction.¹⁹ A Massachusetts businessman agreed to buy a patent for a particular kind of elastic horseshoe, but the patent the seller delivered was for another device altogether.²⁰

Legitimate sellers of patents worried about the consequences of this “lemons” problem²¹—worried that the “grossly false representations” of fraudulent agents would bring the whole business of the “traveling salesman of patents into disrepute.”²² Beginning in 1868 several states enacted legislation that aimed to prevent agents from selling patents that were

¹⁵ *Hardesty v. Smith*, 3 Ind. 41 (1851).

¹⁶ *Galpin v. Atwater*, 29 Conn. 93 (1860).

¹⁷ *Adams v. Johnson*, 15 Ill. 345 (1854).

¹⁸ “In the Matter of Hon. Platt Potter and Winsor B. French, Esq.,” Appendix: Breach of Privilege Cases, *Reports of Cases in the Supreme Court of the State of New York*, Vol. 55, 665-66.

¹⁹ *Brown v. Wright*, 17 Ark. 9 (1856).

²⁰ *Foss v. Richardson*, 81 Mass. 303 (1860).

²¹ The classic study of the lemons problem is George A. Akerlof, “The Market for ‘Lemons’: Quality Uncertainty and the Market Mechanism,” *Quarterly Journal of Economics* 84 (Aug. 1970): 488-500.

²² Simonds, *Practical Suggestions on the Sale of Patents*, 28.

invalid or for which they had no power of attorney. For example, Indiana passed a statute in 1869 that required an agent to file a copy of the patent “duly authenticated” with the county clerk along with an affidavit that “the letters patent are genuine, and have not been revoked or annulled; and that he has full authority to sell or barter the right so patented.”²³ This law, however, was almost immediately overturned by a federal circuit court, which ruled that the Constitution granted Congress the power to create a patent system and that Congress had exercised that power by passing legislation that “directed the manner in which patents shall be obtained, and when obtained how they shall be assigned and sold.” The states had no authority to interfere.²⁴ Because the case never came before the Supreme Court, the decision had force only within that circuit. Some states nonetheless repealed their statutes in light of the decision. In others the laws remained in effect, though it is doubtful they were seriously enforced.²⁵

Even if they were enforced, however, such statutes could not remedy the problem of exaggeration or outright misrepresentation of the capabilities of the invention. Purchasers of patent rights who thought they had been defrauded could sue the seller, assuming he did not abscond. Such suits were costly. Moreover, they were unlikely to be successful because the courts generally followed a rule of caveat emptor. As one judge wrote, “The simple fact that the improvement . . . was of no utility, is not sufficient” to find in favor of the buyer.²⁶ In another case, a judge acknowledged the worthlessness of the patent (“no doubt the plaintiff parted with his property most foolishly”) but refused to undo the sale on the grounds that there is no fraud

²³ *Supplement to the Statutes of Indiana in Force 1870*, Vol. III, 364-5. For a list of states passing such laws, see Cresee, *Practical Pointers for Patentees*, 88-91.

²⁴ *Ex parte Robinson*, 20 F. Cas. 961 (1870).

²⁵ Cresee, *Practical Pointers for Patentees*, 88-91. The Supreme Court later ruled that a state could impose licensing requirements on sellers of patented articles so long as it did not discriminate in favor of residents of the state. “The right conferred by the patent laws of the United States to inventors to sell their inventions and discoveries does not take the tangible property, in which the invention or discovery may be exhibited or carried into effect, from the operation of the tax and license laws of the State.” By the time of this decision, however, geographic patent assignments were no longer of much importance. See *Webber v. Virginia*, 103 U.S. 344 (1881) at 347.

²⁶ *Hardesty v. Smith*, 3 Ind. 41 (1851).

“when a buyer of an article which he finds in market has a full opportunity to examine it, and when the means of information relative to facts and circumstances affecting the value of the commodity are equally accessible to both parties.”²⁷ Many courts were unwilling to rescind contracts made on the basis of false statements, even when the misrepresentations involved claims about “the durability and probable sale of the patented articles,” if the seller’s claims could reasonably have been checked by the buyer, if they could be considered matters of opinion, or if there was no evidence that the vendor knew they were false.²⁸ Plaintiffs were only likely to be victorious if they were able to show that the seller was deliberately deceptive and that they had been completely dependent in deciding to purchase the patent on information from private sources available only to the seller.²⁹

One way in which inventors attempted to solve the lemons problem was to create organizations that would provide buyers with credible assessments of the value of patents. An ambitious attempt was the founding of the Inventors’ Institute in Perth Amboy, New Jersey in 1847. The Institute aimed to help inventors exploit their intellectual property by appointing committees “to examine ... all new inventions, and plans of improvements that may be offered, and select those which are thought worthy of being constructed or manufactured.” The Institute also proposed “to furnish pecuniary aid to inventors who require it, and facilities for perfecting their plans and inventions.” In addition, it planned to “procure patents, and manufacture such

²⁷ *Rockafellow v. Baker*, 31 Pa. 319 (1862).

²⁸ *Miller v. Young’s Administrator*, 33 Ill. 355 (1864); *Gatling v. Newell*, 12 Ind. 99 (1859); *Bond v. Clark*, 35 Vt. 577 (1863). In *David v. Park*, 103 Mass. 501 (1870), however, the court ruled that an action could be maintained when the seller made “a distinct statement of such a fact ..., knowing it to be false, and with intent to deceive the buyer, ... even if the buyer might have discovered the fraud by searching the records of the patent office.” For a summary of the case law, see William C. Robinson, *The Law of Patents for Useful Inventions* (Boston: Little, Brown, and Co., 1890), Vol. 3, 659-70.

²⁹ *Gatling v. Newell*, 12 Ind. 99 (1859). For other grounds on which assignments claimed to be fraudulent were upheld, see *Adams v. Johnson*, 15 Ill. 345 (1854); *Myers v. Turner*, 17 Ill. 179 (1855); *Jolliffe & Holland v. Collins*, 21 Mo. 338 (1855); *Galpin v. Atwater*, 20 Conn. 93 (1860). Courts did not always side with sellers. For contrary decisions, see *McClure v. Jeffrey*, 8 Ind. 73 (1856); *Bierce v. Stocking*, 77 Mass. 174 (1858); *Pierce v. Wilson*, 34 Ala. 596 (1859); *Lester v. Palmer*, 86 Mass. 145 (1862); *Clough v. Patrick*, 37 Vt. 421 (1865).

newly invented articles as are suitable, and send patent rights by territory or otherwise, paying to inventors one half of the profits, or occasionally buying outright the inventions, paying such prices as may be mutually agreed upon.”³⁰

Although there is no indication that this or any other such comprehensive scheme for helping inventors market patents ever got off the ground, numerous organizations took responsibility for vetting the value of patents. State and local agricultural societies sought to protect their members against hawkers of worthless patents by conducting trials to assess the merits of new farming technologies.³¹ Mechanics’ associations held regular exhibitions, enabling owners of worthy patents to distinguish themselves in the eyes of potential purchasers by winning prizes. The Massachusetts Charitable Mechanic Association, for example, instructed its judges that only a “very valuable invention, or improvement possessing great merit” should receive a gold medal.³² The Franklin Institute not only held similar exhibitions but also conducted special examinations of particular technologies. Inventors who wanted to establish the merits of their devices could request such assessments. In addition, the Institute sponsored ad-hoc contests to select the best inventions in particular areas. Later in the century the career of

³⁰ “Inventors’ Institute,” *Mechanic’s Advocate* 1 (11 Mar. 1847): 117.

³¹ “Patent Rights, and the Way Farmers are Humbugged,” *Transactions of the New York State Agricultural Society, 1868*, 504-5. The New York society published evaluations of new technologies in its annual *Transactions*. For other examples, see *Annual Report of the Ohio State Board of Agriculture for 1850*; *Transactions of the [Michigan] Agricultural Society for 1855*; *Annual Report of the Transactions of the Pennsylvania State Agricultural Society for 1856*; “Reports of the Committees of Award at the Fifth Annual Fair and Cattle-Show of the California State Agricultural Society.”

³² Massachusetts Charitable Mechanic Association, *The Seventh Exhibition of the Massachusetts Charitable Mechanic Association at Faneuil and Quincy Halls, in the City of Boston, September, 1853* (Boston: Demrell & Moore and George Coolidge, 1853), vi. For an analysis of the Massachusetts Charitable Mechanic Association’s competitions and the advertising value of the prizes, see B. Zorina Khan, “Promoting the Useful Arts: Technological Innovation Outside the Patent System, 1790-1880,” unpublished paper (2009). As Khan has shown, the prizes do not seem to have gone necessarily to the most meritorious inventions.

arc-lighting pioneer Charles Brush got a major boost when his dynamo won a Franklin Institute competition.³³

Another way for sellers of patents to solve the lemons problem was to invest in reputation. The Albany Agricultural Warehouse and Seed Store published advertisements decrying the practice of hawking rights to worthless patents “about the country ... for what they could get,” avowing that “our own course has ever been, to sell or recommend only such articles to the farming public, as we know from our long experience ... to be well worthy.”³⁴ The store also tried to secure favorable notice for the inventions it was marketing in journals that potential purchasers were likely to read. When its proprietor H. L. Emery purchased the rights for several states to Adams’ Patent Wood Pump, for example, he advanced his cause by getting the *Mechanic’s Advocate* to declare it “one of the most simple and convenient pumps we have seen.” The *Advocate* noted that “several are in use in this city, and give the best satisfaction” and went on to “commend” the pump “to the notice of those interested in making, setting, selling, or using pumps generally.”³⁵

Because of the reputational value of such notices, important sellers of patent rights sometimes started their own periodicals in order to expand the market for inventions and at the same time induce inventors to entrust them with their patents. The U.S. Patent Right Association, for example, used the pages of its *Patent Right Gazette* to tell inventors that it was the best agent to choose “if you wish to dispose of a Patent with the greatest possible certainty, in

³³ Bruce Sinclair, *Philadelphia’s Philosopher Mechanics* (Baltimore: Johns Hopkins University Press, 1974), 60-65, 85-107, 139-40, 151, 248-89. For an example of an exhibition, see “Report of the Twentieth Exhibition of American Manufacturers,” published as an appendix to the *Journal of the Franklin Institute* 20 (1850). On Brush, see Naomi R. Lamoreaux, Margaret Levenstein, and Kenneth L. Sokoloff, “Financing Innovation during the Second Industrial Revolution: Cleveland, Ohio, 1870-1920,” in *Financing Innovation in the United States, 1870 to the Present*, eds. Lamoreaux and Sokoloff (Cambridge, Mass.: MIT Press, 2007), 47-48.

³⁴ “A New Patent Compressing Churn,” *The Cultivator* 7 (Feb. 1850): 94.

³⁵ “Adams’ Patent Wood Pump,” *Mechanic’s Advocate* 2 (4 Nov. 1848): 355.

the shortest time and at its full value.”³⁶ Similarly, the American Patent Agency heavily advertised the patent selling arm of its business in its *American Inventor*, crowing that it was “the only Agency for the sale of patents in America that has two PRINCIPAL OFFICES and permanent branch offices in all the prominent cities of the Union.”³⁷ Neither of these publications stayed in business very long, but other publications started by agencies with different business models did better. Brown, Coombs and Company’s *American Artisan* lasted more than a decade, and Munn and Company’s *Scientific American*, founded in the 1840s, is still being published, albeit in different form.

Indeed, by skillfully exploiting the popularity of *Scientific American*, Munn and Company grew to become the number one patent agency in the country by the middle of the nineteenth century. Most patents merited only brief descriptions in the journal, but the editors sometimes added favorable commentary in order to call specific inventions to readers’ attention. For example, they appended to a brief description of a machine for cutting ornamental molding the statement that the machine, “we are told, will last longer, do more work and of a better quality, than any machine of the kind now known,” concluding that “we regard it as an excellent improvement.”³⁸ Similarly, they followed their account of a pressure stopper for chain cables with an explanation of why the invention was useful, ending with the assessment that “this is a very cheap, simple, and effective invention.”³⁹ Inventors were more likely to secure such notice if Munn handled their patents. As the company advertised, “all inventions patented through our establishment, are noticed, *at the proper time*, in the SCIENTIFIC AMERICAN. This paper is read by not less than 100,000 persons every week, and enjoys a very widespread and substantial

³⁶ See, for example, the cover of *Patent Right Gazette* 3 (July 1872).

³⁷ See, for example, *American Inventor* 6 (Jan. 1883): 23.

³⁸ *Scientific American* 11(6 Oct. 1855): 26.

³⁹ *Scientific American* 11 (6 Oct. 1855): 26.

influence.”⁴⁰ Munn and Company had to walk a fine line in order to maintain the integrity of its publication and at the same time attract the business of inventors through this promise of favorable publicity, but it seems to have succeeded. *Scientific American* rose to become the preeminent journal in the field, and at the same time, inventors flocked to have their patents handled the agency. We estimate from records maintained by the Patent Office that Munn and Company alone filed approximately 15 percent of all the patent assignments in the United States during the years immediately following the Civil War.⁴¹

There is no evidence that Munn and Company was functioning as an intermediary in the sense of matching inventors with buyers for their patents. Unlike other agencies that published journals, Munn advertised its expertise in procuring patents, not in selling patent rights. The notices in which it called attention to meritorious patents typically referred potential buyers to the patentee or to nother agent. Rather than serving as an intermediary, Munn seems mainly to have made its money by processing applications for patents in large volume. By publicizing the validity and utility of the patents it handled in *Scientific American*, however, Munn and Company helped to make the market for technology work, facilitiating the efforts of those who were seeking to sell off these inventions. As we have seen, there were other solutions to the information problems that plagued this market—most notably the prize competitions held at technological exhibitions and agricultural fairs. Such competitions occurred only sporadically, however, and the results were for the most part disseminated only locally. Trade journals made possible the continuous assessment of patents appearing on the market and also the transmission

⁴⁰ *Scientific American* 11 (6 Oct. 1855): 31

⁴¹ This figure is based on an examination (for patentees whose surnames began with the latter “B”) of the correspondents recorded as handling patent assignments in the manuscript Digests of Assignments, Records of the Patent and Trademark Office, Record Group 241, National Archives. For a history of Munn and Company and its use of *Scientific American*, see Michael Borut, “*Scientific American* in Nineteenth Century America,” unpublished Ph.D. dissertation, New York University, especially Ch. 3.

of the findings over wide geographic areas. With its large national readership and its weekly publication schedule, *Scientific American* filled an important need and, in the process, helped expand the market for technology.

Transaction Problems and Intermediaries in National Markets

The dominance of Munn and Company's patent agency would not last long, however. The growth of the nation's transportation and communications network in the years following the Civil War dramatically changed the market for technology. Manufacturers could now sell their products in national markets, and they wanted the patent rights they purchased to have a similar geographic scope. As Table 1 shows, the proportion of assignments that were restricted to particular regions plunged from about 70 percent of the total during the early 1850s to less than a quarter by the 1870s and under 5 percent by the 1890s. There was also less buying of patents for the purpose of resale; the first buyers of patent right were increasingly the final ones, the firms that intended to use the patents in their own businesses.⁴² As the table indicates, the proportion of assignments that were secondary—that is, made by a previous assignee rather than the patentee—fell from 43.6 percent in 1851 to 16.4 percent in 1891. Moreover, because securing rights to valuable patents could be an important source of competitive advantage, firms sought to acquire patents before information on them became publicly available. The proportion of assignments made before the patent had even been issued increased dramatically from 12.0 percent in 1851 to 53.9 percent by 1891. If firms waited until an invention had been evaluated at a fair or described in a publication like *Scientific American* before seeking to purchase it, they would not have any more or better information than anyone else who might be interested in the

⁴² It should be noted, however, that it is not possible systematically to observe licensing, so final buyers of patents may subsequently have licensed the technologies they acquired.

patent. Not surprisingly, therefore, Munn and Company's share of assignment contracts plummeted—to nearly 5 percent by the early 1870s and to negligible levels by the 1890s.⁴³

As a result of these changes, inventors faced a much starker choice about how to exploit their intellectual property than they had earlier in the century. Whereas previously they could use their patents in their own enterprises and at the same time sell off rights to producers operating in other parts of the country, now they had to decide whether to exploit their patents themselves by founding their own enterprises or capture the returns by selling off (or licensing) the full national rights. They could no longer easily do both because that would mean competing head-on with their own assignees and licensees.⁴⁴ Although inventors followed a variety of career paths in the late nineteenth century, more of them seem to have preferred to maintain their independent status rather than tie their future to particular business ventures. F. A. Cresee, a contemporary writer of advice manuals for inventors, estimated that only about one fifth of inventors wanted to manufacture their devices themselves, whereas the rest wanted to make money by selling off their patents rights.⁴⁵ Other information suggests that Cresee's estimate, though perhaps a bit exaggerated, was basically on target. Zorina Khan studied "great inventors" (inventors whose technological achievements were sufficiently important to earn them coverage in the *Dictionary of American Biography*) and found that those born between 1846 and 1865—that is, those whose inventive careers spanned the last third of the nineteenth century—most frequently exploited their intellectual property by selling off or licensing the rights. Inventors

⁴³ Again, this figure is based on an examination (for patentees whose surnames began with the letter "B") of the correspondents recorded as handling patent assignments in the manuscript Digests of Assignments at the Patent Office.

⁴⁴ They could still follow both strategies internationally, exploiting their patents themselves in their home market and selling off the rights in foreign markets or selling patent rights in different countries to different parties.

⁴⁵ Cresee, *Practical Pointers for Patentees*, 15.

who founded their own businesses accounted for less than a quarter of the cohort's patents, and inventors who were employees in someone else's business only about 10 percent.⁴⁶

The changes in the market for technology after the Civil War stimulated a whole host of new, would-be intermediaries to compete to sell patents on behalf of inventors. The technical journals of the time were full of their advertisements:

Inventors and Capitalists will find it to their mutual advantage to call at this Agency, which is established for the purpose of bringing into contact those who have important inventions which they desire to bring into notice, and those who have capital at command which they desire to invest in profitable business.⁴⁷

This Firm is reliable and well worthy of confidence, and possesses superior facilities for the Sale of Patents. The Records of the Patent office show that they have paid as high as Seventeen Thousand Dollars for an ordinary Patent. Patentees will find it for their interest to employ this Agency in the Sale of their Inventions.⁴⁸

We have a large number of good patents for sale and would be pleased to have you call attention to this fact in your paper. We have thoroughly investigated all the articles in our possession and consider them to be of great value and money makers.⁴⁹

⁴⁶ B. Zorina Khan, "Premium Inventions: Patents and Prizes as Incentive Mechanisms in Britain and the United States, 1750-1930," unpublished paper (2009). For earlier cohorts of great inventors, see also Khan and Kenneth L. Sokoloff, "'Schemes of Practical Utility': Entrepreneurship and Innovation among 'Great Inventors' in the United States, 1790-1865," *Journal of Economic History* 53 (June 1993): 289-307. Naomi R. Lamoreaux and Kenneth L. Sokoloff obtained similar results for a sample of ordinary inventors in "Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries," in *Learning By Doing in Firms, Markets, and Countries*, eds. Lamoreaux, Daniel M. G. Raff, and Peter Temin, 19-57 (Chicago: University of Chicago Press, 1999).

⁴⁷ Advertisement for Inventors' Agency, *American Artisan and Patent Record* 1 (24 May 1865), 31.

⁴⁸ Advertisement for C. B. Colton & Co., *Scientific American* 31 (10 Oct. 1874), 235.

⁴⁹ Advertisement for International Patent Promotion Co., *The Patent Record and Monthly Review*, New Series 3 (Mar. 1902), 9.

According to advice manuals written for inventors, intermediaries who advertised in this way were often unscrupulous. Writers warned that inventors should not be taken in by their slick sales pitches because most such agencies “seek only to get what money they can from the patentee.”⁵⁰ Although their solicitations were “attractive and temptingly prepared,” as a matter of fact “very few of these concerns [had] any facilities whatever for selling patents.” They were little more than schemes for extracting money from patentees in the guise of fees for advertising circulars and other marketing expenses.⁵¹

It is difficult to assess the validity of these charges, but they are certainly plausible on logical grounds. Most patentees obtained only one or two patents over their careers, had little business experience, and had even less experience selling patents. They were easy prey for agencies touting the riches they had secured for other inventors. The threat of losing repeat business probably mattered little to such advertisers because patentees who got burned were unlikely ever to have another patent to sell and also were unlikely to have extensive connections with other inventors. The charges are also plausible on empirical grounds. In order for assignments of patent rights to be legally binding, the contracts had to be recorded at the U.S. Patent Office in Washington, DC. We have collected samples of these contracts and have found no examples of assignments handled by agencies with the advertised (or similar) names.⁵²

Advice manuals recommended that inventors shun these intermediaries and take charge of selling their patents themselves. But inventors who lacked the skills needed to run a business successfully also tended not to be good at selling their intellectual property. Moreover,

⁵⁰ W. B. Hutchinson, *Patents and How to Make Money Out of Them* (New York: D. Van Nostrand, 1899), 162.

⁵¹ Cresee, *Practical Pointers for Patentees*, 41-42. For similar warnings, see Simonds, *Practical Suggestions on the Sale of Patents*, 7-9; and An Experienced and Successful Inventor. *Inventor's Manual: How to Work a Patent To Make It Pay* (Rev. edn.; New York: Norman W. Henly & Co., 1901), 61.

⁵² For a description of our samples, see Table 3.

marketing patents, like running a business, took inventors away from what they really wanted to do, which was work on new technological ideas. The enormous amount of time (and other resources) that selling patents consumed can be seen from the procedures that the manuals advised inventors to follow in order to market their patents. The first step, “if the inventor [could] afford it,” was to have the invention “illustrated and described in one or more of the scientific and mechanical publications of the day.” If the inventor did not have sufficient resources, it was still effective, the manuals claimed, to place a notice in the “regular advertising columns,” especially if one took care to choose specialized publications that would “meet the eye of the class or classes of persons to whom the invention [would be] of special interest.”⁵³ Patentees should also prepare circulars describing their inventions and their potential markets, procure a list of businesses most likely to be interested in the inventions, and mail the circulars to these firms. Most importantly, they should follow up the circulars with personal solicitations, tramping from one manufacturer to the next to describe or demonstrate the invention and try to interest someone in buying it.⁵⁴

This way of marketing a patent time was not only time consuming, it also entailed the risk that one of the manufacturers would benefit from the information the inventor revealed without buying the device. Although the patent system offered protection against outright theft of the inventors’ ideas, imitators could sometimes find ways to invent around a device without actually infringing. For example, Jacob D. Cox, founder of the Cleveland Twist Drill Company, traveled to Cincinnati in 1893 to examine a socket for twist drills invented and patented by a Mr. Andrew. Cox concluded that the invention had merit but that Andrew’s \$10,000 asking price

⁵³ Simonds, *Practical Suggestions on the Sale of Patents*, 24-25.

⁵⁴ Simonds, *Practical Suggestions on the Sale of Patents*, 19-28; Hutchinson, *Patents and How to Make Money Out of Them*; An Experienced and Successful Inventor, *Inventor’s Manual*; Cresee, *Practical Pointers for Patentees*, 46-52.

was too steep relative to the tool's value. His response was to devise "a grip socket different from Andrew's, and in most respects superior to it," for which he applied for a patent himself.⁵⁵

Inventors who took the advice manuals' warnings about intermediaries seriously but did not want to sell their patents themselves turned to people they knew well and trusted for help with the marketing. Sometimes inventors sought assistance from local merchants or manufacturers whose business acumen they admired, even though these people had little or no experience in the relevant area of the technology. For example, when James Edward Smith, a machinist and professional inventor, designed a cigar machine, he approached George E. Molleson, owner of a granite quarry and agent for marble producers, for help in getting "a practical moneyed man who understood the manufacture of cigars to take an interest in Mr. Smith's cigar machine." Smith had earlier had dealings with Molleson that encouraged his trust. Indeed, Molleson had previously advanced him money to develop a patent letter box.⁵⁶ That other inventors made similar choices is suggested by reports in the AT&T archives of patents submitted to the company. The records include patents submitted by intermediaries whose primary activities were as diverse as textile manufacturing and engineering consulting.⁵⁷

The problem with inventors' using trusted local businessmen as agents was that they were unlikely to be known to potential purchasers of patents, and so the latter had no particular reason to trust their expertise or honesty. By contrast, there was another type of local businessman who was well situated to earn the trust of both sellers and buyers of inventions—

⁵⁵ Jacob Dolson Cox, Jr., *Building an American Industry: The Story of the Cleveland Twist Drill Company and Its Founder* (Cleveland: Cleveland Twist Drill Co., 1951), 143-44. The story took an interesting turn because Cox attempted to sell the device before he patented it, and Andrew got a copy of the circular and filed for a patent on essentially the same device. Cox won the ensuing litigation.

⁵⁶ "Testimony Taken on Behalf of James Edward Smith," *Hammerstein v. Smith* (1890), 62-68, Case 13,618, Box 1,868, Interference Case Files, 1836-1905, Records of the Patent and Trademark Office, Record Group 241, National Archives.

⁵⁷ T. D. Lockwood, Reports of Inventions (Not Approved), 1904-8, Box 1383, AT&T Corporate Archives.

patent agents and attorneys.⁵⁸ The ranks of this profession had begun to grow after the establishment of the patent examination system in 1836, when initially high rejection rates for patent applications encouraged inventors to seek expert assistance. The earliest practitioners were former patent examiners or other Patent Office employees who saw that there was money to be made helping inventors secure more favorable judgments on their applications.⁵⁹ Very quickly, however, the profession spread outward from Washington, and new entrants with backgrounds in science and engineering swelled its ranks. By the early 1880s the Patent Office's list of approved agents included about 540 names. Slightly more than half of these agents resided in the New England and Middle Atlantic states, almost a quarter in the District of Columbia, another fifth in the Midwest, and the rest were scattered through a few southern and western locations. Over the next several decades the numbers of these practitioners would multiply more than a dozen times, though patent agents would continue to be most densely concentrated in old industrial regions of the country (see Table 2).⁶⁰

Patent Agents as Intermediaries

We can observe the increasing importance of these patent attorneys in the market for technology by analyzing the records of patent assignments kept by the Patent Office. Clerks

⁵⁸ In the discussion that follows we use these terms interchangeably. Standards for entry to the legal profession were quite lax in this period, and some practitioners who hung out shingles as patent attorneys had little formal training in the law. In order to do business with the Patent Office, however, patent agents and attorneys had to register there. From time to time, the Patent Office “disbarred” attorneys, probably because of malfeasance. The Patent Office published regularly published lists of registered and disbarred attorneys. On professional legal standards in the nineteenth century, see Maxwell Bloomfield, *American Lawyers in a Changing Society, 1776-1876* (Cambridge, Mass.: Harvard University Press, 1976); and Bloomfield, “Law: The Development of a Profession,” in *The Professions in American History*, ed. Nathan O. Hatch, 33-50 (Notre Dame, Ind.: University of Notre Dame Press, 1988).

⁵⁹ Robert C. Post, “‘Liberalizers’ versus ‘Scientific Men’ in the Antebellum Patent Office,” *Technology and Culture* 17 (Jan. 1976): 29-30.

⁶⁰ The table probably overstates the rate of growth during the 1880s. The Patent Office had just begun to compile its list of registered agents, and it is likely that some of this growth represents an increase in the proportion of agents who were registered rather than in the number of agents themselves.

copied the contracts into huge ledgers called libers in the order they were received. So that they could readily find particular assignments, the clerks also maintained digests that contained summary details of each assignment contract, as well as references to the appropriate liber volume and page.⁶¹ These summaries also included the name and address of the person to whom all correspondence concerning the assignment was to be sent. As Table 3 shows, the proportion of assignments handled directly by parties to the contract (the assignor or the assignee) fell quite dramatically over time. For primary assignments (that is, cases where the assignor was the patentee), the proportion dropped from 34.9 percent in 1871 to 24.6 percent in 1891 to 11.0 percent in 1911. Over the same years, the share of primary assignments in which the correspondent was a patent agent or attorney increased sharply from 34.4 to 60.4 to 79.0 percent, whereas the proportion handled by other third parties fell from 28.9 to 13.1 to 9.9 percent.⁶² The pattern was similar for assignments that were national in scope and for assignments to companies. In other words, patent agents and attorneys seem increasingly to have handled the kinds of assignments that were growing in importance as a result of the development of national product markets in the late nineteenth century. Our hypothesis is that their share of assignments was growing because they were functioning effectively as intermediaries.

Patent agents and attorneys had advantages in this market over other potential intermediaries because in the course of their regular business they obtained a great deal of information about both buyers and sellers of patents, and both buyers and sellers also learned a lot about them. On the demand side, manufacturers learned about patent agents when they hired them to evaluate the merits of inventions they thought they might want to purchase or when they

⁶¹ These digests, along with the original liber volumes, can be found in Records of the Patent and Trademark Office, Record Group 241, National Archives.

⁶² Because our first list of registered agents is for 1883, the table probably understates the importance of patent agents and attorneys in 1871.

used them to conduct research at the Patent Office. For instance, the patent attorney Edward Van Winkle had a background in engineering, and business people employed him for a variety of technical tasks, including assessing the value and originality of patents. Thus Frank P. Parker and Frederick J. Bosse brought Van Winkle a “non-refillable bottle” and several other devices invented by John L. Adams, and requested that he test the inventions and assess their patentability. When Van Winkle reported positively, the men engaged him to process Adams’s patent applications and also papers assigning the patents to themselves.⁶³ Similarly, executives of the Waltham Watch Company asked Arthur H. Brown, a patent attorney in the firm of Wright, Brown, Quinby & May, to provide them with a detailed technical assessment of an instrument they were considering manufacturing under an exclusive license.⁶⁴ Later the executives again turned to the firm to request copies of all patents “now in force covering self winding watch and clock devices, especially those operated by electricity” and to find out whether a particular solution they had developed for a problem with their chiming hall clocks infringed on patents owned by a rival manufacturer.⁶⁵

Through these kinds of tasks patent attorneys earned manufacturers’ respect and trust. They also gained knowledge about the manufacturers’ businesses and the kinds of patents they might be interested in purchasing—information that put them in a better position to sell patents. For example, after reporting the results of a search of agricultural machine patents undertaken on behalf of Rollin H. White of the White Motor Company, the Cleveland patent agency of

⁶³ See the entries in Van Winkle’s business diary for 12 Jan., 2, Feb. 22 Mar., 23 Mar., 29 Mar., 6 Apr., 20 Apr., 28 Apr., and 16 Aug. 1905, Edward Van Winkle Papers, Ac. 669, Rutgers University Libraries Special Collections. On 29 Dec. 1905, the same two men brought Van Winkle a soap shaving machine invented by a Mr. Luis to examine and evaluate.

⁶⁴ See the 22 July 1912 letter from Conover Fitch, vice president of the Waltham Watch Company to Wright, Brown, Quinby & May, and Brown’s report of 27 July 1912, Wright, Brown, Quinby & May Correspondence Files, Waltham Watch Company, 1854-1929, Mss. 598, Case 2, Baker Library, Harvard Graduate School of Business Administration.

⁶⁵ Letters of 25 January 1915 and 18 September 1917 from the Waltham Watch Company, Wright, Brown, Quinby & May Correspondence Files.

Thurston and Kwis added, “It occurred to us that perchance you might desire to control the Landrin patent #1,055,765. Perhaps the construction disclosed in this patent would never be used by you, but ... it might serve your purpose to control it so as to prevent others from making it.”⁶⁶ Similarly, Van Winkle took advantage of his ongoing work with Parker to tell him “how to make some money with the Murphy block [signal],” another patent he was promoting.⁶⁷

Van Winkle’s papers reveals that businessmen who were interested in patents stayed in frequent contact in order to gain advance information about new technologies, appearing over and over again in the pages of his business diary. One of the most striking things about these men was the wide variety of technologies in which they displayed an interest. A Mr. Richardson, for example, was involved in patents for hat-frame formers, rails for high-speed railroads, electric railroad systems, and pliers.⁶⁸ Another businessman, Arthur DeYoung, was in frequent contact to discuss technologies as diverse as coin counters, arc lamps, and dry mounting processes for photographs.⁶⁹ The most intriguing case is a man who is identified in the records only as Mr. Oliver, although he was closely associated with Van Winkle in a number of important deals. Oliver’s investments spanned the full gamut of technologies, from envelopes to drills to arc lamps to sewing machines to signaling systems for railroads.⁷⁰

The wide variety of patents in which these men were interested suggests that they were not primarily manufacturers seeking to improve the efficiency of their enterprises or expand their product lines. To the contrary, they seem to have been functioning more than anything else like modern day angel investors or venture capitalists. Richardson, himself an inventor, provided

⁶⁶ Letter of 31 August 1914 from Thurston and Kwis to Rollin H. White, Container 1, Folder 4, Rollin H. White and Walter C. White Papers, Ms. 4734, Western Reserve Historical Society.

⁶⁷ See 10 May 1905, Van Winkle Diary.

⁶⁸ See, for examples, 30 Jan., 16 Mar., 17 Mar., 1 Apr., 1 May, and 7 May 1905, Van Winkle Diary.

⁶⁹ See, for examples, 6 Jan., 28 Jan., and 13 Jun. 1905, Van Winkle Diary.

⁷⁰ See, for examples, 1 Jan., 4 Feb., 16 Feb., 23 Feb., 7 Apr., 11 May, 20 May, and 6 Sept. 1905, Van Winkle Diary. Oliver also financed the invention of a cloth guide for sewing machines by Van Winkle himself. See entries for 24 Aug. and 29 Aug. 1905.

funds to help other inventors patent their devices in exchange for a share of the intellectual property.⁷¹ Sometimes he also helped the inventor work out the technological details, getting his name on the patent as a co-inventor.⁷² De Young seems to have been primarily interested in participating in companies formed to exploit particular inventions, for example a coin-counting machine.⁷³ Oliver operated in a variety of different ways. In one transaction he agreed to provide Van Winkle himself with capital to develop an invention, presumably in exchange for a share in the patent.⁷⁴ He also bought patents outright, for example offering an inventor named Peters a note for \$100,000 in exchange for a patent for a wireless receiver that he planned to market to the U.S. government.⁷⁵ In addition, Oliver worked with Van Winkle in at least two efforts to organize companies, the Simplex Machine Company and the Automatic Security Signal Company, both based on inventions patented by an inventor named William M. Murphy.⁷⁶

On the supply side, inventors developed long-term associations with the agents or attorneys who filed their patent applications. Inventors with lots of patents might use a number of different attorneys over their careers, but most ultimately settled into a relationship with what we are calling a “preferred agent,” who then handled the bulk of their patent applications. Table 4 examines the importance of these relationships for a sample of inventors from the late nineteenth century. The table understates the extent of loyalty in these relationships because patentees with long careers often had extensive dealings with several different lawyers

⁷¹ See, for examples, 3 Feb., 21 Mar., and 17 July 1905, Van Winkle Diary.

⁷² See 30 Jan., 7 May, and 18 July 1905, Van Winkle Diary.

⁷³ See 6 Jan., 28 Jan., and 21 Oct. 1905, Van Winkle Diary.

⁷⁴ See 24 Aug. 1905, Van Winkle Diary.

⁷⁵ See the diary entry for 20 May 1905. Oliver and Peters subsequently had some disagreement about the terms of the arrangement, and it is not clear from the diary whether the deal actually went through. See also 21 Jan., 24 Jan., 25 Feb., 28 Feb., 2 Mar., 13 May, 22 May, and 27 May 1905, Van Winkle Diary.

⁷⁶ See 27 Feb., 7 Mar., 8 Mar., 24 June, 26 June, 26 July, 6 Sept., 8 Sept., and 17 Nov. 1905, Van Winkle Diary. Disagreements developed in this case too between Oliver and the inventor. See, for example, 21 July, 31 July, 8 Aug., 17 Aug., 22 Nov. 1905, Van Winkle Diary.

sequentially. However, even if we force ourselves to treat each patentee as having had just one preferred attorney ever, the proportion of patents handled by this single agent is impressive. On average, more than 60 percent of the patents received by members of the most productive group of inventors (those with 20 plus patents) were handled by just one attorney. Moreover, most of these inventors entrusted their preferred agents with more than three quarters of the patents they obtained subsequent to hooking up with them.

The relationships that developed through these repeated dealings encouraged inventors to use their attorneys as sounding boards for new technological ideas, as well as to file patent applications. When Joseph Arbes, a fur manufacturer and sewing-machine inventor in New York City, came up with an idea for a blind stitching machine that used a flat-sided needle, he immediately dispatched a sketch of the needle to his attorney, William E. Knight, for a judgment as to its potential patentability—even before he had tried it out on a sewing machine. Knight apparently thought that the invention was not promising, so Arbes experimented with the needle for a few more months before trying it out on Knight again.⁷⁷ Edward Van Winkle similarly advised James Eichel, an inventor who showed him a prototype for a new type of pliers, that he should wait to apply for a patent “until he had progressed further.”⁷⁸ While Van Winkle was in the midst of processing a patent for a drop-head sewing machine for another inventor named Stephen A. Davis, the inventor sought his evaluation of a process for purifying chicle that he and a colleague were developing.⁷⁹

When patent agents filed applications on behalf of inventors, and even more when they acted as inventors’ sounding boards, they acquired knowledge of promising technologies long

⁷⁷ See “Testimony on Behalf of Joseph Arbes,” 10, 22-23, 26, *Arbes v. Lewis* (1900), Case 20,049, Box 2,715, Interference Case Files, 1836-1905.

⁷⁸ 7 May 1905, Van Winkle Diary.

⁷⁹ See May 4, June 5, June 8, July 14, August 2, 1905, Van Winkle Diary.

before they came on the market. This knowledge was valuable in and of itself.⁸⁰ But it was particularly advantageous when the agents were functioning as intermediaries, because firms wanted to beat out their competitors in securing rights to important new technologies. The evidence from the assignment digests suggests that patent agents did indeed improve the speed with which patents were assigned. Table 5 reports breakdowns of assignments by the interval of time that elapsed between the issue and assignment of a patent and by the type of correspondent.⁸¹ Focusing on primary assignments (the bulk of the cases), we can see that patent agents handled the vast majority of the assignments that were contracted before the patent was issued—81.1 percent in 1891 and 89.3 percent in 1911. Patent agents also handled a disproportionate number of the contracts for which we lack information on the date of issue of the patent. Most of these cases were assignments recorded before issue for which the patent office neglected to go back and add the patent number. In other cases, however, the assignment was for an invention that never made it through the approval process for a patent.⁸² The latter cases are useful reminders that assignees who contracted for patents before the date of issue could not be certain that the patent would ever be allowed, which made their faith in the quality of the patent attorney's assessments all the more important.

The greater speed of assignment for patents handled by patent agents and attorneys can be seen from the regressions in Table 6. Here we restrict the analysis to primary assignments

⁸⁰ For example, the Waltham Watch Company asked its patent attorney to collect copies of patents issued to a competitor, adding "If there is any way for us to find out regarding any patents that they have applied for but not yet been granted, we would like very much to have that information." Letter of 20 August 1915 from the Waltham Watch Company to Wright, Brown, Quinby & May, Wright, Brown, Quinby & May Correspondence files.

⁸¹ The assumption that underpins the analysis that follows is that the third parties who were listed as correspondents were often functioning as intermediaries. To the extent that this assumption is incorrect, it should be harder for us to find support in the data for our hypothesis that patent agents improved the functioning of the market for technology.

⁸² After searching for these patents in the Lexis-Nexis and Google patent databases, we concluded that the former possibility was more common in 1871 and 1911, when many more patents were missing dates of issue. In the 1911 digests there are annotations for many of these patents that indicate that the patentee had "filed" or "applied" or even that he or she was "to apply."

made in 1891 and 1911 for which we know the identity of the correspondent. The dependent variable is a dummy for whether the assignment occurred before issue. The independent variables of interest are the dummies for the type of correspondent (the omitted category is the assignor—that is, the patentee). The other independent variables include dummies for the region in which the inventor resided (the omitted category is the Middle Atlantic) and for the degree of urbanization of the inventor’s county (the omitted category is counties whose largest city contained less than 25,000 people). One might worry that patent agents’ apparent advantage in selling patents may simply have been an artifact of their tendency to reside in cities and in regions where there were lots of inventors and also lots of manufacturers—that is, in places where it was relatively easy for patentees to find buyers for their inventions. The dummies aim to control for these locational advantages. We also include a dummy for contracts that were recorded in 1911. The Patent Office took longer to examine patent applications in 1911 than in 1891, so it is possible that more patents were assigned before issue in the former year simply because of this longer processing time. Finally, because it might be easier to find buyers for inventors who obtained lots of patents and might already be well known to potential buyers, we add two variables to capture the extent to which the patentee had specialized in inventive activity. For each patentee involved in an assignment, we collected the number of patents he or she received in the two years before the year of the contract and the two years after (the omitted category is patentees who obtained less than two patents in these four years).

Although the results in Table 6 cannot confirm causality, they are consistent with our hypothesis that patent agents improved the speed at which patents were assigned. Assignments before issue were strongly and significantly associated with using a registered patent agent, even after controlling for the region of the patentee, whether the patentee resided in an urban location,

and also the year of the assignment. Although patentees who obtained more than three patents in the two years immediately before and after the date of the observation were more likely to assign their patents at issue, the agents' advantage persisted when we controlled for this characteristic. Indeed, the marginal effects suggest that the probability of assigning a patent before issue was almost 30 percent greater if the assignment was handled by a registered agent than if it was handled by one of the parties to the transaction.⁸³

Of course, not all patent lawyers who functioned as intermediaries were skilled at marketing patents. And not all deserved inventors' trust. Just as advice manuals cautioned inventors not to use intermediaries who advertised in trade publications, there were warnings to be wary of unscrupulous patent agents and attorneys. Indeed, some patent attorneys themselves took the extreme position that it was improper for members of their profession to function as intermediaries. Thus H. W. Boardman & Company announced in a pamphlet promoting the firm's services that it was "a rule rigidly adhered to in this establishment, never to take contingent interests in applications for Patents, nor to negotiate sales of Patent rights, or become the owners in whole or in part of them." As the pamphlet explained, such activity potentially put the interests of the patentee in conflict with those of his attorney: "If an attorney become a dabbler in Patents (as many do), how is it possible for an Investor to be assured that he is not disclosing his secret to the very party who will be the most interested in defeating his application?"⁸⁴

⁸³ The reported results include patents for which we lack an issue date, but the results are the same when we drop these observations.

⁸⁴ H. W. Boardman & Co., *Hints to Inventors Hints to Inventors and Others Interested in Patent Matters* (Boston: privately printed, 1869), 13. Practitioners in this wing of the profession also warned inventors that if they entrusted their inventions to agents who were primarily intermediaries rather than legal specialists, they risked obtaining patents that would not withstand scrutiny by the courts. "The result is, that out of the numerous patents which have been litigated since the foundation of our Patent System, not one in ten has been sustained by the courts without being reissued to cure defects." See A. H. Evans & Co., *A. H. Evans & Co., Solicitors of American and Foreign Patents* (Rev. edn.; Washington, DC: privately printed, n.d.), 1.

Certainly, patent solicitors who “dabbled” in patents may have put their own interests before those of either the patentee or the assignee. In this respect the market for technology was much like today’s real estate market, where an agent’s primary goal is a sale, and where buyers and sellers alike face a great deal of uncertainty about whose interest the agent is truly representing. Although these kinds of conflicts of interest have been mitigated in the case of real estate by a combination of regulation and self-policing, during the late nineteenth and early twentieth centuries the market for technology was essentially unregulated, and professional organizations like bar associations were extremely weak.⁸⁵ In such a context, one would expect to see reputational mechanisms playing an increasingly important role and to observe that successful patent agents and lawyers were those who made substantial investments in cultivating reputations for fair, as well as insightful, dealing.⁸⁶

There is no question that patent agents’ work sometimes put them in situations where there was a clear conflict of interest. For example, one of the businessmen with whom Van Winkle regularly dealt wanted an option to buy out inventor Edward A. Howe’s interest in some patents. Van Winkle recorded the offer as follows: “He will give \$3000 to 4000 for the last two patents and give me a commission of 10%. If I can get the patents for less, will receive a larger fee.”⁸⁷ Van Winkle called on Howe and “had a hard fight to get Howe to accept terms.” Ultimately, however, after a session that lasted two and a half hours, Howe agreed to the deal, “provided R [the assignor] will give him a free hand in all future patents.”⁸⁸ Somehow, throughout all of these negotiations, Van Winkle managed to be completely above board with the

⁸⁵ As mentioned above, the Patent Office maintained a list of patent agents certified to practice before it, and small numbers of agents were from time to time disqualified. On the weakness of bar associations, see Bloomfield, “Law.”

⁸⁶ For a more formal analysis of an analogous case, see Asher Wolinsky, “Competition in a Market for Informed Experts’ Services.” *Rand Journal of Economics* 24 (Autumn 1993): 380-98. See also Mark Garmaise and Tobias Moskowitz, “Informal Financial Networks: Theory and Evidence.” *Review of Financial Studies* 16 (Winter): 1007-40.

⁸⁷ 16 May 1905, Van Winkle Diary.

⁸⁸ 16 May and 17 May 1905, Van Winkle Diary.

inventor about his interest in the deal. He maintained excellent relations with Howe, who continued to do business with him for the rest of the period of the diary. Indeed, after the buyer later decided not to take up the patents, Howe confided to Van Winkle that he had “only signed option so that I [Van Winkle] could collect my fee.” Although this statement probably should not be taken at face value, it is an indication of the strength of the relationship that Van Winkle had been able to build with this inventor.

From Van Winkle’s business diaries we can observe the enormous amount of time he devoted to cultivating these kinds of personal relationships—not just with inventors but also with businessmen interested in investing in patents. Van Winkle spent the bulk of each day receiving visitors, calling on people, and talking business over lunch and dinner at the Columbia Club or other similar places. This constant round of face-to-face meetings helped him secure the trust of parties on both sides of the market. In addition, they were an important source of tips about potential buyers for inventions, new technologies he should explore, and clients he might attract to his practice. Thus when Van Winkle was handling an elevator safety invention for Pratt, he received information from a friend with whom he often dined “that C. L. C. Howe of the N.Y. Life Co was looking for a safety for Elevators.” Van Winkle called on Howe that very afternoon, noting in his diary that “There might be something doing later.”⁸⁹ On another occasion, he lunched with Charlie Halsey, who “said he had some cigarette machine patents + papers which he would bring to my office and let me look over.”⁹⁰ A similar lunch with Robert E. Booream, an inventor whose work embraced electric bridge hoists, washers for gold mining, and methods of roadway construction, yielded the notation that the two men had “lightly touched

⁸⁹ 31 Mar. 1905, Van Winkle Diary.

⁹⁰ 8 Aug. 1905, Van Winkle Diary.

on business. We will no doubt be associated.”⁹¹ Van Winkle’s use of the word “associated” suggests that he envisioned his work with Booram to encompass more than simply filing patent applications,” and the diary entries show him later putting Booram in contact with a mining engineer.⁹²

The networks that attorneys like Van Winkle built through their daily round of meetings were primarily local, but patent agents also developed connections with colleagues in other parts of the country (and the world). Some of these links were formal. For example, Boston patent lawyer Frederick Fish took on a partner, Charles Neave, in 1893. Two years later Fish sent Neave to New York City to open a branch office.⁹³ Similarly, after Samuel S. Fisher, U.S. Commissioner of Patents during the Grant administration, returned to private practice in Cincinnati, he took in Samuel A. Duncan as a partner and almost immediately packed him off to New York to open an office for the firm there.⁹⁴ Other links derived from familial connections or simply from letters of introduction and repeat business. The Boston firm of Wright, Brown, Quinby & May had ties with a Chicago firm established by the brother of one of the partners. It also funneled its Philadelphia business through a firm with which the partners had no apparent personal connections except through long association.⁹⁵

That these links to agents in other locations could be used to market patents is suggested by a letter from one intermediary to “friend Jenks” (Lemuel Jenks, a patent lawyer in Boston) asking for Jenks’s assistance in marketing the device: “We have offered said Patent so far to the B&O and NCR Comps. . . . We intend to sell it to one person for the six New England States

⁹¹ 24 Jan. 1905, Van Winkle Diary. See also 5 Mar., 7 Jun., and 12 Jun. 1905.

⁹² 7 Jun. And 8 Jun. 1905, Van Winkle Diary.

⁹³ John E. Nathan, *Fish & Neave: Leaders in the Law of Ideas* (New York: Newcomen Society, 1997), 13, 19.

⁹⁴ *In Memoriam: Samuel S. Fisher* (Cincinnati: Robert Clarke & Co., 1874), 23-24.

⁹⁵ See the Wright, Brown, Quinby & May Correspondence Files for letters among patent agents in different cities. In addition, virtually all agents had regular dealings with at least one attorney in Washington, who assumed responsibility for conducting searches of patent records and also represented them in preliminary interviews with examiners in the Patent Office.

and I therefore wish you would give me your opinion in that matter: to viz what price you think we should ask; what would we have to pay you for your assistance [sic] in carrying out and effecting a sale.”⁹⁶ A patent solicitor in London wrote members of the firm of Blatchford, Seward & Griswold, calling their attention to a rust-prevention patent in which “an old and much esteemed client of ours” held an interest and asking the partners “whether you can find us a purchaser of the American patent” for a commission of 5 percent.”⁹⁷ After a businessman named Kendall let Van Winkle “have the foreign patents in melting furnaces,” Van Winkle forwarded the information to an agent in another city named Zappert.⁹⁸ Zappert returned the favor, sending Van Winkle details of new technologies, for example “specimens + literature” about a dry adhesive photographic mounting process. Van Winkle in turn shopped the photographic invention “around to Chas Walsh + he thought it would be a valuable thing to control, he is going to get ideas on the matter and see what he can do towards making some money out of the scheme [sic].”⁹⁹

Nonetheless, these connections in other cities do not seem to have been as effective in selling patents as the deep local networks that agents like Van Winkle worked so hard to develop. The last two columns in Table 6 compare the correlates of the speed with which patents were assigned for transactions in which the patentee and the assignee resided in the same state and for those in which they resided in different states. The coefficient on the dummy for whether the correspondent was a patent agent is large and significant when the patentee and assignee

⁹⁶ Letter of 30 April 1870 from Aug. H. [last name not legible] to Jenks, Box 3, Folder 59, Lemuel Jenks, 1844-1879, Mss. 867, Baker Library, Harvard Graduate School of Business Administration.

⁹⁷ Letter of 12 July 1877 from Roger Cartwright of London to Blatchford, Seward & Griswold, Box 5, Folder 243, Records of Blatchford, Seward & Griswold, 1841-1910, Archives and Special Collections, Massachusetts Institute of Technology.

⁹⁸ 28 Apr., 9 May, 1 Jun., and 2 Jun. 1905, Van Winkle Diary.

⁹⁹ 27 Mar. 1905, Van Winkle Diary.

resided in the same state, but it shrinks in size and loses significance when the patentee and assignee were in different states.

Intriguingly, therefore, it seems that though geographically segmented patent rights were sold over long distances in the middle of the nineteenth century, in the late-nineteenth century *national* patent rights were most effectively bought and sold in *local* markets where patent agents functioning as intermediaries could cultivate personal relationships with both inventors and business people seeking to buy patents. These markets were densest in regions where patent agents tended to concentrate, and not surprisingly inventors located in such areas were able to sell off their patents more quickly than those in other parts of the country. As Table 7 shows, the proportion of patents assigned by the time of issue was generally greatest where the share of patent agents was largest relative to the share of population. Inventors as a group were highly mobile geographically, and evidence from the sample of great inventors collected by Khan and Sokoloff indicates that they tended to migrate to the regions that were most densely served by patent agents. In the case of the cohort whose careers spanned the late nineteenth century, about 60 percent of the patents obtained by great inventors resident in the Middle Atlantic region went to those born in other parts of the country.¹⁰⁰

Patent agents charged for their services, and one might wonder whether inventors' dependence on their assistance in selling patents enabled them to earn supra-normal returns at the patentees' expense. The number of patent agents increased so dramatically in the late nineteenth century, both in absolute terms and relative to the size of the population, that it is likely that any excess returns agents may have been able to extract in the early years of the market for

¹⁰⁰ See Naomi R. Lamoreaux and Kenneth L. Sokoloff, "The Rise and Decline of the Independent Inventor: A Schumpeterian Story?" in *The Challenge of Remaining Innovative: Lessons from Twentieth Century American Business*, eds. Sally H. Clarke, Naomi R. Lamoreaux, and Steven Usselman (Stanford: Stanford University Press, 2009), 57-59.

technology were soon competed away. Certainly, no patent agent ever attained a dominance in the last quarter of the century comparable to that of Munn and Company in the years immediately following the Civil War. The top attorney in our 1871 sample accounted for 5.5 percent of the patent assignments and the top four attorneys 13.5 percent. Those percentages dropped steadily until by the 1911 sample the top attorney handled only 1.3 percent of the assignments and the top four only 4.6 percent.¹⁰¹

One might also wonder if the development of the market for technology created opportunities for what today would be called trolls—that is, entrepreneurs who bought patents with the sole aim of extracting licensing fees from businesses who inadvertently infringed on them. Certainly, there were businessmen who functioned like trolls in the nineteenth century. A prominent example was Thomas Sayles, who bought rights to three overlapping patents for “double-acting” brakes that were originally issued by the patent office to three different sets of inventors. Whenever a railroad used one of the patents under what they thought was a legitimate license, Sayles hit it with a lawsuit for infringing on one of the others.¹⁰² Nonetheless, trolls do not seem to have been a significant problem in this period. Unlike today, the media paid little attention to the subject, and we have not found evidence of troll-like behavior in our sources. The businessmen who gathered around Van Winkle, for example, seem to have been primarily concerned with getting the patents they were investing in used—either by reselling the technology to producers or founding companies to exploit them directly. There are no references

¹⁰¹ It would be desirable to know whether patent agents and attorneys benefitted patentees by securing them better prices for their inventions. Unfortunately, the data do not allow us to explore this possibility because when lawyers took charge of handling assignments, the contracts they recorded in the Patent Office became increasingly standardized and uninformative. Whereas earlier contracts often contained detailed information about the remuneration paid to the patentee, by the late nineteenth century they typically specified that the assignment was in exchange for one dollar and other consideration.

¹⁰² Steven W. Usselman, *Regulating Railroad Innovation: Business, Technology, and Politics in America, 1840-1920* (New York: Cambridge University Press, 2002), 108-10; and Usselman, “Patents Purloined: Railroads, Inventors, and the Diffusion of Innovation in 19th-Century America,” *Technology and Culture* 32 (Oct. 1991):1062-64.

in Van Winkle's diary to searching out infringers, let alone searching them out with the aim of extracting licensing fees. As already noted, the market share held by the most prominent intermediaries had diminished to trivial levels by the late nineteenth century. Moreover, there was little concentration on the assignee side of the market either. Table 8 reports data for a sample of assignees taken from the *Annual Reports of the Commissioner of Patents*. Assignees that acquired more than ten patents in 1891 accounted for only about 5 percent of assignments. In 1911 the proportion was a lot larger (about 25 percent), but the assignees accumulating patents were enterprises like General Electric, American Telephone and Telegraph, and Westinghouse that were engaged in production. They were not what today are called "non-practicing entities," or trolls.

Epilogue: The Recent Resurgence of the Market for Technology

Although market trade in patented technology fell off during the heyday of the large industrial research laboratory, it surged again during the last third of the twentieth century. Several different trends fed the increase in the number of patents offered for sale or license.¹⁰³ One was a reassessment on the part of large-scale businesses of the value of in-house research. Laboratory facilities were expensive to operate, and managers were not sure how much they actually contributed to their firms' bottom lines. In the face of growing international competition, many large firms sharply cut their research budgets or even shut down their labs.¹⁰⁴

¹⁰³ We have analyzed the growing importance of industrial R&D in the middle third of the twentieth century in Lamoreaux and Sokoloff, "The Rise and Decline of the Independent Inventor"; and Lamoreaux, Sutthiphisal, and Sokoloff, "The Reorganization of Inventive Activity in the United States in the Early Twentieth Century," in *Understanding Long-Run Economic Growth: Geography, Institutions, and the Knowledge Economy*, ed. Dora L. Costa and Naomi R. Lamoreaux (Chicago: University of Chicago Press, 2011), 235-74.

¹⁰⁴ The share of large firms (defined as those with more than 25,000 employees) in non-federal R&D dropped from about two-thirds in 1980 to about one-third in 2005. Ashish Arora and Alfonso Gambardella, "The Market for Technology," in *Economics of Innovation*, eds. Bronwyn H. Hall and Nathan Rosenberg (Amsterdam: North-

Others determined to try to make R&D pay by licensing patents in their portfolios.¹⁰⁵ Ashish Arora and Andrea Fosfuri estimate that leading firms in the chemical industry were able to recoup about 10 percent of their R&D expenditures in this way. In some parts of the industry, moreover, the percentage was much greater. At BP Chemicals, for example, the licensing of polyethylene technology became so lucrative during the 1980s that revenues from this source amounted to about two thirds of R&D expenditures.¹⁰⁶ In electronics, Texas Instruments began around 1985 to adopt a more aggressive strategy to exploit its intellectual property, challenging firms that were infringing on its patents and insisting that they sign cross-licensing agreements. These agreements served the dual purpose of helping the company monetize its large portfolio of patents at the same time as they prevented it from being foreclosed from markets by other firms' intellectual property. The strategy proved so effective that in 1992 the company earned about 40 percent more from licensing patents than from its other operations.¹⁰⁷ Similarly, IBM began in the 1990s to challenge firms that were infringing on its patents with the aim of forcing them to license the technology. By 2003 its licensing revenues amounted to over a billion dollars a year.¹⁰⁸

At other large firms managers moved in the opposite direction—toward the demand rather than the supply side of the market for technology. They adopted a deliberate strategy of relying less on internally generated technology and instead redirected some of their research

Holland, 2010), Vol. 1, Ch. 15. See also the essays in Richard S. Rosenbloom and William J. Spencer, eds., *Engines of Innovation: U.S. Industrial Research at the End of an Era* (Boston: Harvard Business School Press, 1996).

¹⁰⁵ There is now a growing literature advising managers on how to monetize their firms' patent portfolios. See, for prominent examples, Kevin G. Rivette and David Kline, *Rembrandts in the Attic: Unlocking the Hidden Value of Patents* (Boston: Harvard Business School Press, 2000); and Julie L. Davis and Suzanne S. Harrison, *Edison in the Boardroom: How Leading Companies Realize Value from Their Intellectual Assets* (New York: John Wiley & Sons, 2001).

¹⁰⁶ Arora, Fosfuri, and Gambardella, *Markets for Technology*, 19-22, 53.

¹⁰⁷ See Rivette and Kline, *Rembrandts in the Attic*, 125; Peter C. Grindley and David J. Teece, "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics," *California Management Review* 39 (Winter 1997): 8-41; Colleen V. Chien, "From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System," *Hastings Law Journal* 62 (issue 1, 2010-11), 297-356.

¹⁰⁸ Chien, "From Arms Race to Marketplace," 306.

capabilities to the task of evaluating and commercializing technologies developed outside the enterprise. Procter & Gamble, for example, announced in 2000 that its aim henceforth would be to secure half of its innovative ideas from the market. By 2009 the company actually exceeded that goal. According to the firm's general counsel for intellectual property, as a result of the change in policy "our innovation success rate is more than doubled while the cost of innovation has fallen."¹⁰⁹ In the pharmaceutical industry, large firms increasingly relied on small startups with expertise in recombinant DNA and other cutting-edge technologies to generate new drugs, which they then commercialized and shepherded through the approval process at the Food and Drug Administration (FDA). By the late 1990s, the vast majority of the three hundred or so biotechnology-based drugs in clinical trials had been invented by these so-called Dedicated Biotechnology Firms (DBFs)—that is, firms that specialized in the generation of new technologies which they sold off or licensed to established pharmaceutical companies rather than bringing them to market themselves.¹¹⁰ Business writers observed these trends in pharmaceuticals and other industries and wove them into a new conventional wisdom. Large firms, they asserted, could best meet the challenge of remaining innovative by becoming "aggressive followers"—using their technological know-how to keep abreast of ideas developed outside their labs, plugging into networks of entrepreneurs and scientists, organizing collaborative ventures, and acquiring high-tech startups rather than emphasizing in-house research.¹¹¹

¹⁰⁹ U.S., Federal Trade Commission, Hearings on "The Evolving IP Marketplace: The Operation of IP Markets," 18 March 2009, 149, <http://www.ftc.gov/bc/workshops/ipmarketplace/>.

¹¹⁰ Louis Galambos and Jeffrey L. Sturchio, "Pharmaceutical Firms and the Transition to Biotechnology: A Study in Strategic Innovation," *Business History Review* 72 (Summer 1998): 250-78; Alfonso Gambardella, *Science and Innovation: The U.S. Pharmaceutical Industry during the 1980s* (New York: Cambridge University Press, 1995), esp. Ch. 7; Arora, Fosfuri, and Gambardella, *Markets for Technology*, 63-66.

¹¹¹ Robert Buderer, *Engines of Tomorrow: How the World's Best Companies Are Using Their Research Labs to Win the Future* (New York: Simon & Schuster, 2000). See also Richard S. Rosenbloom and William J. Spencer, "Introduction: Technology's Vanishing Wellspring," in *Engines of Innovation*, eds. Rosenbloom and Spencer, 3-6.

At the same time as large firms were turning to externally generated technologies, small firms were stepping up their inventive activity. Silicon Valley's semiconductor industry, of course, led the way in demonstrating the contributions that small startups could make to technological development.¹¹² Although the Valley's startups did not initially attribute much importance to patenting, over time that changed, and they began to patent assiduously. In 1970 small firms obtained only about five percent of the patents issued anywhere in the world, but by the late 1990s the proportion was closer to a third.¹¹³ In part the change was a response to large firms' shift in strategy, but other factors helped to make it possible. The growth in the numbers of firms providing angel and venture capital meant that financing was potentially available to inventors with promising ideas.¹¹⁴ The technologies of the third industrial revolution also proved to be much less capital-intensive than those of the second. Indeed, in the case of software all that was really needed to be an effective innovator was a computer, the cost of which plummeted over time. The price of high-tech machine tools also dropped so dramatically that students at engineering schools like MIT could have sophisticated milling machines in their dorm rooms alongside their computers.¹¹⁵

As in earlier periods, many inventors of new technologies sought to sell or license their patents through the market rather than exploit them in their own enterprises. Carlos J. Serrano used the Patent Office's electronic database of assignments to estimate that 12.4 percent of all patents were successfully sold by their original owners at some point during their terms (19

¹¹² Annalee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass.: Harvard University Press, 1994).

¹¹³ G. Steven McMillan and Diana Hicks, "Science and Corporate Strategy: A Bibliometric Update of Hounshell and Smith," *Technology Analysis & Strategic Management* 13 (Dec. 2001): 497-505; and Hicks et al., "The Changing Composition of Innovative Activity in the U.S.—A Portrait Based on Patent Analysis," *Research Policy* 30 (Apr. 2001): 681-703.

¹¹⁴ Samuel Kortum and Josh Lerner, "Assessing the Contribution of Venture Capital to Innovation," *RAND Journal of Economics* 31 (Winter 2000): 674-92.

¹¹⁵ Justin Lahart, "Tinkering Makes Comeback Amid Crisis," *Wall Street Journal*, 13 Nov. 2009, A14, <http://online.wsj.com/article/SB125798004542744219.html>.

percent if the patents were weighted by citations as a measure of their importance). The proportions were highest for individual inventors (16.2 percent unweighted and 24.1 percent weighted) and small companies (17.5 and 24.0). The proportion of patents assigned also varied by industry. For small companies, not surprising, the percentages were greatest in high-tech sectors like computers and communications (23.9 percent unweighted) and drugs and medical (20.1 percent unweighted).¹¹⁶

How did firms with patents to sell or license find potential buyers or licensees?

Certainly, in many industries large firms' R&D laboratories played an important role. As the firms began to acquire technology from external inventors, one of their laboratories' main functions became to keep abreast of technological developments outside the enterprise and assess inventions offered for sale or license. In biotech these efforts were facilitated by academic networks that linked scientists in universities (often the major figures in DBFs) with scientists employed in the labs.¹¹⁷ Venture capital firms, like those clustered along Sand Hill Road in Palo Alto, also provided matching services. Inventors deluged them with business plans, and their job was to sift out the most promising ideas and then work their networks to find ways of putting

¹¹⁶ Carlos J. Serrano, "The Dynamics of the Transfer and Renewal of Patents," *RAND Journal of Economics* 41 (Winter 2010): 686-708. In another study Serrano estimated that about 23 percent of the patents obtained between 1981 and 2001 by small firms (those with less than 500 employees) were successfully sold (assigned) by their original owners. Using renewal data, he calculated that the patents that were sold were on average about three times more value than those that were not. Serrano, "Estimating the Gains from Trade in the Market for Innovation: Evidence from the Transfer of Patents," NBER Working Paper 17304 (Aug. 2011).

¹¹⁷ Louis Galambos, *Networks of Innovation: Vaccine Development at Merck, Sharp & Dohme, and Mulford, 1895-1995* (New York: Cambridge University Press, 1995); Walter W. Powell, Kenneth W. Koput, and Laurel Smith-Doerr, "Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology," *Administrative Science Quarterly* 41 (March 1996): 116-45; Lynn G. Zucker, Michael R. Darby, and Marilyn B. Brewer, "Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises," *American Economic Review* 88 (March 1998): 290-306; and Zucker, Darby, and Jeff S. Armstrong, "Geographically Localized Knowledge: Spillovers or Markets?" *Economic Inquiry* 36 (Jan. 1998): 65-86; Zucker, Darby, and Armstrong, "Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology," *Management Science* 48 (Jan. 2002): 138-53; Arora, Fosfuri, and Gambardella, *Markets for Technology*, 66-70.

them to profitable use.¹¹⁸ Sometimes the best way to exploit a technology was to earn returns from licensing or selling off the patent rights in the market for technology. Sometimes it was to found a production company with the aim of profiting from taking it public down the road. Of course, some of the startups founded in this way inevitably failed, but the intellectual property they held was still valuable and could be sold on the market to recoup the investment.

In addition to these well-known players, many new kinds of intermediaries have appeared in recent years as the market for patented technology has expanded. These entrants include agents who specialize in assisting patent owners in finding licensees, brokers who match owners of patents with potential buyers, merger and acquisition specialists who help buyers of startups assess the value of the target firm's patent portfolio, and auction houses that specialize in selling off the patent portfolios of failed enterprises. But they also include other entities whose business it is to amass large patent portfolios with the aim of profiting from licensing revenue. The most aggressive of these companies have earned the label "troll" because they sue (or threaten to sue) companies that unknowingly infringe on their patents and in that way extract licensing fees.¹¹⁹

Trolls have gotten a lot of media attention, but until recently there has been little serious scholarly effort to assess their impact.¹²⁰ Thanks, however, to the creation of the Stanford Litigation Clearinghouse, a database that includes every patent lawsuit filed since the beginning of 2000, it is possible to get a better sense of the magnitude of the problem. John Allison, Mark

¹¹⁸ On the networks among firms and venture capitalists in Silicon Valley, see Annalee Saxenian, *Regional Advantage*; Emilio J. Castilla, et al., "Social Networks in Silicon Valley," in *The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship*, eds. Chong-Moon Lee, et al. (Stanford: Stanford University Press, 2000), 218-47; Dimitris Assimakopoulos, Sean Everton, and Kiyoteru Tsutsui, "The Semiconductor Community in the Silicon Valley: A Network Analysis of the SEMI Genealogy Chart (1947-1986)," *International Journal of Technology Management* 25 (Nos. 1/2, 2003): 181-99.

¹¹⁹ For a list of the various types of intermediaries operating in the early twenty-first century market for technology, see Raymond Millien and Ron Laurie, "Meet the Middlemen," *Intellectual Asset Management Magazine* 28 (Feb.-Mar. 2008): 53-58, www.iam-magazine.com.

¹²⁰ For an example of media attention, see the episode "When Patents Attack!" of "This American Life," <http://www.thisamericanlife.org/radio-archives/episode/441/when-patents-attack>.

Lemley, and Joshua Walker (hereafter ALW) have isolated the set of frequently litigated patents (that is, those that are the subject of at least eight legal filings) and compared them to a random sample of patents that show up in the litigation records only once.¹²¹ They find that most (nearly three fourths) of the patents involved in frequent litigation were in technological areas where patenting has only recently been allowed—most notably, computer software and business methods.¹²² Because the texts of patents awarded in these areas are particularly opaque, it is difficult for practitioners even to know what a patent covers, let alone judge its merits or the likelihood that a court will find them to have infringed. In other words, here we have another case where changes in the structure of the economy (in this case, the development of entirely new industries) afflicted the market for technology with new kinds of information problems.

Intriguingly, ALW's work indicates that the owners of frequently litigated patents were not primarily firms who specialized in acquiring large portfolios of patents (the group conventionally considered to be trolls). Entities of this type accounted for only 12 percent of the frequently litigated patents. Ownership of the rest was almost evenly divided between established companies engaged in production (44 percent of all frequently litigated patents) and inventor-owned startups (41 percent). One of the latter, however, behaved like a troll. Ronald S. Katz Technology Licensing LLP, an inventor-owned startup, obtained 20 of the most frequently litigated patents in its own name and acquired 7 others.¹²³ Even if one moves Katz's 27 patents to the troll category, the trolls' 37 percent of frequently litigated patents is still less than the 44 percent owned by production companies. Moreover, production companies owned fully 80

¹²¹ John R. Allison, Mark A. Lemley, and Joshua Walker, "Extreme Value or Rolls on Top? The Characteristics of the Most-Litigated Patents," *University of Pennsylvania Law Review* 158 (Dec. 2009): 1-38; and ALW, "Patent Quality and Settlement Among Repeat Patent Litigants," *Georgetown Law Journal* 99 (March 2011): 677-712.

¹²² ALW, "Extreme Value or Rolls on Top?" 17-18. In a similar study, Josh Lerner collected patents for financial innovations awarded between 1976 and 2004 and identified all lawsuits involving patents in his dataset. He also found that patents for these business methods were much more likely to be litigated than other patents. See Lerner, "The Litigation of Financial Innovations," *Journal of Law and Economics* 53 (Nov. 2010): 807-31.

¹²³ ALW, "Extreme Value or Rolls on Top?" 23, 26.

percent of the patents in the control sample of those litigated only once.¹²⁴ In other words, production companies were the dominant plaintiffs in patent litigation. Although their ownership share of once-litigated patents was much higher than their share of frequently litigated patents, that difference might simply have resulted from the demonstrated power of their deep pockets, so that winning a case against one defendant might have been a powerful incentive for others to settle. Regardless, the finding that production companies played such a major role in patent litigation is not at all surprising when one recalls the growing efforts of firms like Texas Instruments and IBM to monetize their patent portfolios in the last couple decades of the last century.

Perhaps more important, if and when cases involving frequently litigated patents reached the courts, the owners of these patents were much more likely to lose than were the owners in cases involving patents litigated only once. Owners of frequently litigated patents won only 10.7 percent of their cases, compared to 35.6 to 47.3 percent for patents in the once-litigated sample (depending on whether default judgments are included in the totals). Moreover, software patents were particularly likely to be invalidated. Whether the patents were in the frequently litigated group or were once litigated, owners of software patents won only 12.9 percent of their cases, as opposed to 37.1 to 51.1 percent for non-software patents. Moreover, trolls were particularly likely to lose in court. Product companies won 40.0 to 50.0 percent of their cases (again depending on whether default judgments are included in the figures), but even combining all categories of non-practicing entities together the win rate was only 8.0-9.2 percent.¹²⁵ Of

¹²⁴ If one looks the numbers of lawsuits involving frequently litigated patents, Katz alone accounted for 60 percent. Companies involved in production accounted for 18 percent, other inventor-owned startups 14 percent, and other entities specializing in acquiring patents 7 percent. ALW, “Extreme Value or Rolls on Top?” 23, 26. Lerner found that lawsuits involving financial innovations were disproportionately likely to be instigated by patent holding companies as well as by small entities. See “The Litigation of Financial Innovations.”

¹²⁵ ALW lumped together as non-practicing entities, firms whose business is acquiring patents and inventor owned startups, as well as a number of other categories that play on a minor role in litigation, such as “failed startup,”

course, trolls could still do a lot of economic damage just by threatening litigation. As ALW point out, most of the filings involving frequently litigated patents were settled before the courts reached a verdict, and threats to sue that were settled before filing did not make it into the database.¹²⁶ The terms of the settlements are not known, but it is possible, as the media has charged, that firms chose to pay substantial licensing fees rather than bear the costs of litigation or the risk of having to shut down production of a lucrative product. It is important to bear in mind, however, that we do not have systematic evidence on the source of most threats to sue, let alone on the settlement amounts. If the data on involvement in litigation is any indication, production companies are likely to be a big part of the story, and there is good reason to believe that at least the largest among them have deeper pockets than trolls.

Given trolls' low win rates and the frequency with which the courts' have invalidated software patents, whatever level of fees they are currently extracting from legitimate innovators is unlikely to be an equilibrium result. To the contrary, one might expect that both settlement amounts and litigation rates will decline over time as defendants revise their assessments of the probability of losing in court.¹²⁷ Already today we can see the emergence of a myriad of new entities that aim to profit from bolstering the bargaining position of defendants, ranging from the companies specializing in probabilistic assessments of patents' validity, to consortiums and "libraries" that collect patents to use in countersuing trolls, to litigation clearinghouses and specialist law firms. Recent changes in Patent Office procedure as a result of the passage of the "America Invents Act" in 2011 may also work to mitigate the problem.¹²⁸

"startup, pre-product," "industry consortium," and "university/government/NGO." See "Patent Quality and Settlement Among Repeat Patent Litigants."

¹²⁶ ALW, "Patent Quality and Settlement Among Repeat Patent Litigants."

¹²⁷ Lerner actually found that the number of lawsuits in his dataset peaked in the late 1990s, but he thought that his dataset was subject to truncation bias and adjusted the data in ways that eliminated the declining trend. See "The Litigation of Financial Innovations."

¹²⁸ For descriptions of some of these entities, see Millien and Laurie, "Meet the Middlemen."

Certainly, the problems of asymmetric information posed by the opacity of patents in areas like software and business methods offer opportunistic predators scope to operate, but it is not at all clear that these problems are more serious than the informational problems that afflicted the market for technology in the past.¹²⁹ In each period of history, when the market exchange of patents grew or changed in important ways, new problems developed that encouraged predatory behavior. Although these problems were never completely resolved, in each case intermediaries emerged to improve the workings of the market, enabling inventors to exploit their intellectual property by selling it off. Of course, only time will tell whether the current situation will be as amenable to such a solution, but in the meantime it is important be wary of cures that are potentially worse than the disease. Critics of trolls often include in that category individual inventors who seek to exploit their intellectual property by selling it or licensing it, rather than by forming production companies. For example, according to Daniel P. McCurdy, chief executive officer of Allied Security Trust and the chairman of PatentFreedom (two organizations that have emerged to profit from helping firms bolster their defenses against trolls),¹³⁰ the behavior of individual inventors in the market for technology “at first glance may not seem to be as egregious. After all, they are at least seeking to profit from their own ideas, rather than the ideas of others. Yet,” he went on, such inventors were little better than trolls, because they were “using a patent system designed to promote the economic development of a nation through the creation of new products and services to, alternatively extract profits from new products and services developed by other companies, potentially harming both consumers

¹²⁹ Some observers are very pessimistic about the scale of the information problems associated with software patents. See for example, Christina Mulligan and Timothy B. Lee’s claim that because software patents are not “indexable,” “patent clearance by all firms would require many times more hours of legal research than all patent lawyers in the United States can bill in a year” (“Scaling the Patent System,” unpublished paper [2012]). But such assessments are not the only way potentially to solve the problem, as the appearance of the new organizations described in the preceding paragraph suggests.

¹³⁰ See the firms’ websites at <http://www.alliedsecuritytrust.com/> and <https://www.patentfreedom.com/>.

and competition.”¹³¹ Such a charge is belied by two centuries of experience with inventors who transformed ideas into gold through the market for patents, sometimes enriching themselves but more importantly encouraging thousands and thousands of others to follow their footsteps and, in the process, shift out the technological frontier.

¹³¹ Interestingly, McCurdy was director of business development for IBM Research in the early- to mid-1990s. See Daniel P. McCurdy, “Patent Trolls Erode the Foundation of the U.S. Patent System,” *Science Progress* 1 (issue 2, 2009): 78-86.

Table 1. Trends in Types of Patent Assignments

	1851	1871	1891	1911
Percent of assignments that were geographic	71.4	22.8	4.6	1.2
Percent of assignments that were secondary	43.6	27.8	16.4	12.0
Percent of assignments made after issue	88.0	72.2	44.1	36.5
Total number of assignment contracts	133	794	1,373	1,869

Source: Our sample consists of all assignment contracts filed with the U.S. Patent Office by assignors resident in the United States during the months of January 1851, January 1871, January 1891, and January 1911. These contracts are recorded in “Liber” volumes stored in the National Archives, Record Group 241, Records of the Patent and Trademark Office. Geographic assignments are grants of patent rights that are limited to specific subregions of the United States. Secondary assignments involve patent rights that have previously been assigned to the assignor.

Table 2. Registered Patent Agents by Region

Region	1883	1889	1910
Panel A: Number of Registered Patent Agents Per Million People			
New England	22.4	89.3	99.2
Middle Atlantic	18.6	112.4	116.5
East North Central	8.8	72.8	76.7
West North Central	2.1	51.2	61.0
West	4.0	29.7	79.1
District of Columbia	715.0	1,072.1	2,386.2
Delaware and Maryland	4.6	39.6	40.1
Other South	0.2	10.1	16.3
United States	10.7	61.5	74.5

Panel B: Regional Distribution of Registered Patent Agents (Column Percent)

New England	16.7	10.9	9.5
Middle Atlantic	36.2	37.0	32.9
East North Central	18.4	25.5	20.4
West North Central	2.4	11.8	10.4
West	1.3	2.3	7.9
District of Columbia	23.6	6.4	11.5
Delaware and Maryland	0.9	1.2	0.9
Other South	0.6	4.8	6.6
United States	100.0	100.0	100.0

Notes and Sources: U.S. Patent Office, *Roster of Registered Attorneys Entitled to Practice Before the United State Patent Office* (Washington, DC: Government Printing Office, 1883, 1889, and 1907); and U.S. Patent Office, *Attorneys Admitted to Practice Before the United States Patent Office from January 2, 1907, to March 15, 1910* (Washington, DC: Government Printing Office, 1910). State population figures are from the U.S. Census Office, *Census of Population, Reported by States* (Washington, DC: Government Printing Office) for the 1880, 1890, and 1910. New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; the Middle Atlantic New Jersey, New York, and Pennsylvania; the East North Central Illinois, Indiana, Michigan, Ohio, and Wisconsin; the West North Central Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; the West Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; and the Other South Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

Table 3. Categories of Assignment Contracts Broken Down by Type of Correspondent

(Column Percent)

Type of Correspondent	Total Contracts	Primary Assignment	Secondary Assignment	National Assignment	Geographic Assignment	Assigned to Company	Assigned to Individual
Panel A: 1871							
Assignor	3.9	4.6	2.9	4.3	3.8	4.9	3.6
Assignee	31.7	30.3	38.6	23.9	57.7	19.7	35.0
Registered patent agent	28.5	34.4	8.6	40.2	6.4	34.4	26.9
Other third party	28.9	28.7	31.4	31.0	32.1	24.6	30.0
Unknown	7.0	2.1	18.6	0.5	0.0	16.4	4.5
<i>Total no. of contracts</i>	<i>284</i>	<i>195</i>	<i>70</i>	<i>184</i>	<i>78</i>	<i>61</i>	<i>223</i>
Panel B: 1891							
Assignor	3.4	2.8	5.8	4.3	0.0	4.2	2.9
Assignee	21.6	21.8	21.7	18.8	50.9	13.8	26.9
Registered patent agent	53.9	60.4	30.4	63.4	23.6	59.3	50.2
Other third party	14.1	13.1	17.4	13.2	25.5	14.4	13.9
Unknown	7.0	1.9	24.6	0.3	0.0	8.4	6.1
<i>Total no. of contracts</i>	<i>412</i>	<i>321</i>	<i>69</i>	<i>325</i>	<i>55</i>	<i>167</i>	<i>245</i>
Panel C: 1911							
Assignor	2.3	2.4	4.3	2.4	6.1	3.3	1.3
Assignee	8.3	8.6	17.0	7.9	33.3	8.7	7.8
Registered patent agent	66.8	79.0	55.3	79.7	24.2	79.9	53.9
Other third party	9.9	9.7	23.4	9.7	36.4	7.7	12.1
Unknown	12.7	0.2	0.0	0.2	0.0	0.3	24.8
<i>Total no. of contracts</i>	<i>605</i>	<i>453</i>	<i>47</i>	<i>493</i>	<i>33</i>	<i>299</i>	<i>306</i>

Notes and Sources: The sample consists of all assignment contracts recorded in the assignment digests of the U.S. Patent Office (stored at the National Archives in Record Group 241, Records of the Patent and Trademark Office) during the first three months of 1871, 1891, and 1911 for inventors whose surnames began with the letter “B.” The table includes only patents granted to U.S. residents. We classified each assignment contract (and the patents it included) by the identity of the correspondent. We first distinguished those contracts for which the correspondent was a party to the contract—that is, either the patentee (or other assignor) or the assignee. Then, working with lists of patent agents and lawyers authorized to conduct business with the Patent Office for 1883, 1889 and 1907-10 (see Table 2.3), we categorized the correspondents we found on these lists as a separate class of intermediaries. A third category consisted of correspondents who were not parties to the contract but who did not appear on any of the lists of registered agents. Finally, we included in an “unknown” category cases where no correspondent was reported in the digest. Not all contracts could be classified as involving primary versus secondary assignments or national versus geographic. Contracts that were missing this information are excluded from the breakdowns. The 1871 panel understates the role of registered patent agents because we were not able to find a list of agents close to the date of the sample. For definitions of the types of assignments, see Table 1.

Table 4. Loyalty of Inventors to Preferred Patent Agents

No. of Career Patents	No. of Inventors	Number of Attorneys the Inventor Tried Before Finding the Preferred Attorney (percent of total inventors in row)			Percent of Patents Handled by the Preferred Attorney after the Inventor Found Him (percent of total inventors in row)			Average Percent of Inventor's Patents Handled by Preferred Attorney
		0	1-2	3+	< 50	≥50 and < 75	≥75	
1-2 patents	55	92.7	7.3	0.0	0.0	10.9	89.1	89.1
3-9 patents	65	58.5	40.0	1.5	12.3	30.8	56.9	64.2
10-19 patents	27	40.7	44.4	14.8	22.2	25.9	51.9	55.2
20+ patents	33	27.3	39.4	33.3	18.2	24.2	57.6	61.1
Total	180	60.6	30.6	8.9	11.1	22.8	66.1	69.9

Notes and Sources: The inventors in this table consist of all patentees from a random sample of patents from the *Annual Reports of the Commissioner of Patents* for the years 1890-1891 whose last names began with the letter B. We collected all of the patents these inventors obtained in the twenty-five years before and after 1890-91 and then retrieved the name of the patentee's attorney from the drawing submitted with the patent. The preferred attorney is defined as the attorney who handled the largest fraction of the patentee's inventions.

Table 5. Assignment Contracts Broken Down by Type of Correspondent and Timing of the Assignment
(Column Percent)

Type of Correspondent	Primary Assignment					Secondary Assignment				
	Missing Date of Issue	Before Issue	Within		Number of Contracts	Missing Date of Issue	Before Issue	Within		Number of Contracts
			5 Years of Issue	6+ Years After Issue				5 Years of Issue	6+ Years After Issue	
Panel A: 1871										
Assignor	2.4	33.3	5.0	11.1	4.6	0.0	0.0	3.4	0.0	2.9
Assignee	7.2	33.3	49.0	33.3	30.3	0.0	0.0	39.0	44.4	38.6
Registered patent agent	60.2	0.0	16.0	11.1	34.4	100.0	100.0	6.8	0.0	8.6
Other third party	30.1	33.3	27.0	33.3	28.7	0.0	0.0	32.2	33.3	31.4
Unknown	0.0	0.0	3.0	11.1	2.1	0.0	0.0	18.6	22.2	18.6
<i>Total no. of contracts</i>	<i>83</i>	<i>3</i>	<i>100</i>	<i>9</i>	<i>195</i>	<i>1</i>	<i>1</i>	<i>59</i>	<i>9</i>	<i>70</i>
Panel B: 1891										
Assignor	0.0	1.6	4.2	3.6	2.8	0.0	0.0	5.3	10.0	5.8
Assignee	18.5	10.7	28.5	39.3	21.8	0.0	16.7	28.9	15.0	21.7
Registered patent agent	55.6	81.1	48.6	35.7	60.4	0.0	66.7	26.3	35.0	30.4
Other third party	14.8	6.6	17.4	17.9	13.1	0.0	0.0	23.7	15.0	17.4
Unknown	11.1	0.0	1.4	3.6	1.9	100.0	16.7	15.8	25.0	24.6
<i>Total no. of contracts</i>	<i>27</i>	<i>122</i>	<i>144</i>	<i>28</i>	<i>321</i>	<i>5</i>	<i>6</i>	<i>38</i>	<i>20</i>	<i>69</i>
Panel C: 1911										
Assignor	0.0	2.1	4.4	8.0	2.4	0.0	0.0	4.2	12.5	4.3
Assignee	6.7	4.7	15.4	28.0	8.6	0.0	0.0	29.2	12.5	17.0
Registered patent agent	86.5	89.3	54.9	40.0	79.0	83.3	88.9	37.5	50.0	55.3
Other third party	5.8	3.9	25.3	24.0	9.7	16.7	11.1	29.2	25.0	23.4
Unknown	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
<i>Total no. of contracts</i>	<i>104</i>	<i>233</i>	<i>91</i>	<i>25</i>	<i>453</i>	<i>6</i>	<i>9</i>	<i>24</i>	<i>8</i>	<i>47</i>

Notes and Sources: For a description of the sample and definitions of the various types of correspondents, see Table 3.

Table 6. Regressions on Whether Patents Were Assigned Before Issue

	(1)	(2)	(3)	(4)
	Entire Sample		Location of Patentee and Assignee	
			Same State	Different State
Year is 1911	0.197 (4.57)***	0.222 (5.02)***	0.198 (4.05)***	0.284 (3.30)***
Correspondent was assignee	-0.105 (0.81)	-0.108 (0.82)	-0.065 (0.47)	-0.084 (0.37)
Correspondent was registered patent agent	0.277 (2.32)**	0.270 (2.22)**	0.305 (2.27)**	0.090 (0.41)
Correspondent was other third party or unknown	-0.192 (1.42)	-0.183 (1.34)	-0.210 (1.32)	-0.099 (0.43)
Patentee's county had city with population $\geq 25,000$ but $< 100,000$	0.152 (2.33)**	0.108 (1.60)	0.001 (0.02)	0.213 (1.45)
Patentee's county had city with population $\geq 100,000$ but $< 250,000$	0.128 (1.80)*	0.078 (1.05)	0.016 (0.19)	0.185 (1.34)
Patentee's county had city with population $\geq 250,000$	0.083 (1.42)	0.031 (0.52)	0.010 (0.14)	-0.042 (0.35)
Patentee resided in the West	-0.002 (0.02)	0.000 0.00	0.001 (0.01)	0.051 (0.30)
Patentee resided in the West North Central	-0.159 (1.96)**	-0.139 (1.70)*	-0.056 (0.57)	-0.259 (1.97)**
Patentee resided in the East North Central	0.084 (1.53)	0.078 (1.42)	0.087 (1.52)	-0.080 (0.70)
Patentee resided in New England	0.098 (1.49)	0.092 (1.37)	0.059 (0.86)	0.061 (0.40)
Patentee resided in Delaware or Maryland	-0.194 (1.35)	-0.216 (1.49)	-0.040 (0.22)	-0.271 (1.49)
Patentee resided in the District of Columbia	0.226 (1.55)	0.222 (1.51)	0.226 (1.64)	0.105 (0.43)
Patentee resided in the Other South	-0.150 (1.55)	-0.119 (1.23)	0.060 (0.57)	-0.310 (2.28)**
Patentee obtained 2-3 patents in the two years before and after		0.070 (1.30)	-0.018 (0.29)	0.221 (2.08)**
Patentee obtained > 3 Patents in the two years before and after		0.187 (3.58)***	0.112 (1.97)**	0.218 (2.00)**
Number of observations	634	634	428	175

Notes and Sources: * significant at 10%; ** significant at 5%; *** significant at 1%. Absolute value of z statistics in parentheses. The estimates are probits, and the reported figures are marginal effects. For a description of the sample and definitions of the various types of correspondents, see Table 5. For definitions of the regions, see Table 2. We include only primary assignments from the 1891 and 1911 samples in the analysis and drop observations that did not include information about the identity of the correspondent. The dependent variable is a

dummy variable that takes a value of 1 if the assignment occurred before the patent was issued. Cases for which the date of the patent's issue is missing are treated as assignments before issue. The omitted categories are: for the correspondent dummies, that the correspondent was the assignor (patentee); for the urbanization dummies, that the patentee's county did not have a city of at least 25,000 people; for the regional dummy, that the patentee resided in the Middle Atlantic; and for the inventor's patenting record, that the inventor had one or zero patents in the two years before and after the sample year. We collected the patent counts by looking up the patentee in the *Annual Reports of the Commissioner of Patents* for the two years before and after the sample observation.

Table 7. Patents, Patent Agents, and the Propensity to Assign Patents at Issue, by Region

Region and Variable	1870-71	1890-91	1910-11
New England			
Patents per million people	775.8	772.0	534.3
Patent agents per million people	----	89.3	99.2
Percent of all patents assigned at issue	26.5	40.8	50.0
Percent of assignments that were before issue	29.6	68.8	69.9
Middle Atlantic			
Patents per million people	563.4	607.0	488.6
Patent agents per million people	----	112.4	116.5
Percent of all patents assigned at issue	20.6	29.1	36.1
Percent of assignments that were before issue	29.1	56.6	62.1
East North Central			
Patents per million people	312.3	429.9	442.3
Patent agents per million people	----	72.8	76.7
Percent of all patents assigned at issue	14.7	27.9	32.3
Percent of assignments that were before issue	22.3	51.5	67.2
West North Central			
Patents per million people	146.5	248.7	272.0
Patent agents per million people	----	51.2	61.0
Percent of all patents assigned at issue	9.0	21.8	17.5
Percent of assignments that were before issue	22.6	51.4	57.4
South			
Patents per million people	85.8	103.1	114.4
Patent agents per million people	----	16.0	19.2
Percent of all patents assigned at issue	6.4	25.0	22.7
Percent of assignments that were before issue	25.6	57.7	51.8
West			
Patents per million people	366.7	381.6	458.4
Patent agents per million people	----	29.7	79.1
Percent of all patents assigned at issue	0.0	25.4	21.4
Percent of assignments that were before issue	40.9	42.6	64.0
All patents, including foreign			
Patents per million people	325.4	360.4	334.2
Patent agents per million people	----	61.5	74.5
Percent of all patents assigned at issue	18.5	29.1	21.4
Percent of assignments that were before issue	27.7	55.9	63.5

Notes and Sources: The table excludes Washington, DC. For the sources of patent agents per million people, see Table 2. Patents per million people and the percentage of patents assigned at issue were computed from three random cross-sectional samples (totaling almost 6,600 patents) taken from the Annual Report of the Commissioner of Patents for the years 1870-71, 1890-91, and 1910-11. For the sources of the percent of assignments before issue, see Table 1.

Table 8. Distribution of Patents Assigned at Issue by the Assignee's Number of Assignments
(Row Percent)

Year	1 Assignment	2-3 Assignments	4-5 Assignments	6-10 Assignments	> 10 Assignments
1870	63.4	19.9	5.4	2.6	8.7
	(795)	(250)	(68)	(32)	(109)
1891	54.8	23.5	8.1	8.3	5.3
	(2,097)	(898)	(310)	(316)	(203)
1911	41.5	19.0	7.3	6.5	23.7
	(2,536)	(1,160)	(446)	(396)	(1,572)

Notes and Sources: Numbers of observations are in parentheses. These estimates of the distribution of assigned patents were calculated by collecting the number of assignments received by assignees that appeared on every other page of the lists of assignees in the *Annual Report of the Commissioner of Patents* for 1870, 1891, and 1911. Because we ran over onto the off pages in order to get a complete accounting of all the patent assignments received by the assignees sampled, our procedure is likely to overstate the concentration of patent assignments across assignees.