2005

Lessons for Patent Policy from Empirical Research on Patent Litigation

Michael Meurer
Boston Univeristy School of Law

LESSONS FOR PATENT POLICY FROM EMPIRICAL RESEARCH ON PATENT LITIGATION

JAMES BESSEN
MICHAEL J. MEURER

LESSONS FOR PATENT POLICY FROM EMPIRICAL RESEARCH ON PATENT LITIGATION

by
James Bessen[*]
Michael J. Meurer[**]

This Article reviews empirical patent litigation research to reveal patent policy lessons. First, the Article presents facts about patent litigation. Next, it analyzes the patent premium. Patent litigation research reveals little about the magnitude of the patent premium, but the research reveals the strategies firms use to capture the patent premium and the patent policy instruments that determine the patent premium. Next, the Article evaluates the patent prosecution process and notes that making efforts to refine a patent application can affect the value of the patent. The Article then identifies reforms for improving PTO performance. Finally, the Article discusses policy changes that patent litigation research suggests would improve procedural fairness and reduce patent litigation costs.

---

[*] Lecturer in Law, Boston University School of Law, jbessen@researchoninnovation.org.

[**] Professor of Law, Michaels Faculty Scholar, and Director, Institute for Business, Law & Technology, Boston University School of Law, meurer@bu.edu.

 We thank Mark Lemley and participants at the Lewis & Clark Law Review Fall Forum, "*Markman v. Westview Instruments*: Lessons from a Decade of Experience," for their helpful comments. We also thank Sean Chao, Walead Esmail, and Debbie Koker for able research assistance.

I. INTRODUCTION

We explore lessons for patent policy that can be learned from empirical research on patent litigation. After presenting some salient facts about patent litigation, we turn first to analysis of the patent premium, the increment in profit from invention that flows from the rights conferred by a patent grant. Patent litigation research does not tell us much about the size of the premium, but it does shed light on what strategies firms use to capture the premium and what patent policy instruments determine the premium. Next, patent litigation research helps us evaluate the patent prosecution process. Specifically, we comment on the power of applicants to affect the value of a patent through their efforts to refine their applications. We also comment on reforms that might improve the performance of the Patent and Trademark Office (PTO). Finally, we discuss some policy changes that patent litigation research suggests might improve procedural fairness and reduce the expected cost of patent litigation.

II. FACTS ABOUT PATENT LITIGATION

Patent litigation has been called the sport of kings; it is complex, uncertain, and expensive.[1] There is a significant risk that a patent will be invalidated at trial,[2] but that danger appears to be declining over time.[3] There also appears to be significant uncertainty about the scope of patent claims and whether a particular defendant is infringing.[4] For patent suits with less than $1 million at risk, the median estimated cost of discovery is $290,000 and the median estimated total litigation cost is $500,000; for suits with $1–$25 million at risk, the median estimated cost of discovery is $1 million and the median estimated total litigation cost is $2 million; for suits with more than $25 million at risk, the median estimated cost of discovery is $2.5 million and the median estimated total litigation cost is $3.995 million.[5]

In 2000, the United States PTO granted about 180,000 patents. The same year about 2,000 patent suits were filed involving about 3,000 patents.[6] About

---

[1] Douglas J. Kline, *Patent Litigation: The Sport of Kings*, TECH. REV., Apr. 28, 2004, *at* http://www.technologyreview.com/articles/04/04/wo_kline042804.asp.

[2] John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 205 (1998) (54% of patents were found valid in a population of 300 final validity decisions).

[3] *See id.* at 206.

[4] *See* Kimberly A. Moore, *Are District Court Judges Equipped to Resolve Patent Cases?* 15 HARV. J.L. & TECH. 1, 2–3 (2001) [hereinafter Moore, *Patent Cases*] ("[D]istrict court judges improperly construe patent claim terms in 33% of the cases appealed to the Federal Circuit.").

[5] AM. INTELLECTUAL PROP. LAW ASSOC., REPORT OF THE ECONOMIC SURVEY 2003, at 22 (2003).

[6] KIMBERLY A. MOORE, WORTHLESS PATENTS 1–2 (George Mason Law & Econ. Working Paper Series, No. 04-29, 2004), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=566941.

4% of the patent suits that terminated in fiscal year 2000 reached trial.[7] The number of patent suits filed doubled over the decade of the 1990s, but the number of cases terminating during or after trial has remained roughly constant.[8] Thus, the fraction of suits ending in trial declined. Nevertheless, the fraction of patent cases that go to trial is still relatively high compared to civil cases in general; only 1.9% of the federal civil cases terminated in the fiscal year 2000 went to trial.[9] The trend in filing of patent suits is similar to the trend in trademark suits. In contrast, filing of copyright suits has been relatively flat, and filing of antitrust and contract suits declined over the 1990s.[10]

Patent holders win slightly more than half of their cases.[11] The 58% win rate reported by Kimberly Moore in patent cases is less than the 64% win rate achieved by corporate plaintiffs facing corporate defendants in contract cases.[12] Interestingly, the win rate is sensitive to the presence of a jury. Juries are more likely than judges to uphold patent validity,[13] and patent owners are more likely to win a suit tried to a jury than a suit tried to a judge. Outcomes are close to fifty-fifty in patent cases tried before a judge.[14]

These data possibly reflect a growing burden from patent litigation: the trial rate is double the average of federal civil litigation, patent trials are especially expensive, and filings are increasing rapidly. Simple trial rates, outcome measures, and trends in filing are not terribly informative, however, about the normative impact of patent litigation. Thus, researchers engage in more sophisticated analysis of patent litigation data. The following sections review some of that analysis and connect it to patent policy issues.

Before we begin that review, we need to explain why simple litigation statistics are hard to interpret and hard to link to policy analysis. The main

---

[7] The estimate is based on cases reported to the Federal Judicial Center. We accessed the data through the web site created by Cornell law professors Theodore Eisenberg and Kevin M. Clermont. Of the 2221 patent cases that terminated in the 1999 fiscal year, 85 terminated during or after trial. THEODORE EISENBERG AND KEVIN M. CLERMONT, JUDICIAL STATISTICAL INQUIRY FORM, *at* http://teddy.law.cornell.edu:8090/questata.htm; *see also* Kimberly A. Moore, *Judges, Juries, and Patent Cases—An Empirical Peek Inside the Black Box*, 99 MICH. L. REV. 365, 383 (2000) [hereinafter Moore, *Black Box*] (noting that 6.9% of patent suits go to trial).

[8] EISENBERG AND CLERMONT, *supra* note 7, at http://teddy.law.cornell.edu:8090/questata.htm.

[9] Kevin M. Clermont & Theodore Eisenberg, *Litigation Realities*, 88 CORNELL L. REV. 119, 136 (2002).

[10] EISENBERG AND CLERMONT, *supra* note 7, at http://teddy.law.cornell.edu:8090/questata.htm; *see also* Marc Galanter, *Contract in Court; or Almost Everything You May or May Not Want to Know About Contract Litigation*, 2001 WISC. L. REV. 577, 590 (analyzing the decline in contract litigation over the 1990s).

[11] *See* Moore, *Black Box*, *supra* note 7, at 385 (the patentee won 58% of the cases). *But see* Jean O. Lanjouw & Mark Schankerman, *Protecting Intellectual Property Rights: Are Small Firms Handicapped?* 47 J.L. & ECON. 45, 59 (2004) (win rates are close to 50% in patent cases).

[12] *See* Theodore Eisenberg & Henry S. Farber, *The Litigious Plaintiff Hypothesis: Case Selection and Resolution*, 28 RAND J. ECON. S92, S103 (1997).

[13] Allison & Lemley, *supra* note 2, at 213.

[14] Moore, *Black Box*, *supra* note 7, at 368.

problem is that patent suits probably constitute a small and uncharacteristic subset, drawn from the set of all patent disputes. Certainly, patent trials constitute a small and uncharacteristic subset of filed patent suits. A selection bias distorts inferences based on statistics like patent holder win rates at trial. Similarly, a selection bias may distort inferences based on studies of patent lawsuit filing.[15]

Proper interpretation of litigation statistics requires understanding why patent disputes arise, why suits are filed, and why certain suits reach trial. To illustrate, let us study the claim that the Federal Circuit is pro-patentee. Assume the Federal Circuit has changed patent law in such a way that the set of patent disputes has not changed and the probability of patentee victory at trial has increased. If these assumptions were true, what would they imply for the frequency of litigation and success of patent owners at trial? A naïve approach would treat litigation as random and independent of patent and party characteristics. Then the assumed actions of the Federal Circuit would not change the frequency of litigation, but would increase the observed success rate of patent holders.

By contrast, economists treat litigation as a bargaining failure and use bargaining models to explain why certain disputes are "selected" for litigation. Several models can be used for this purpose; most of our discussion focuses on the simplest plausible model. According to the settlement cost model, firms choose trial over settlement because the cost of settlement exceeds the cost of trial.[16] For most types of disputes, the settlement cost model is implausible because trial costs typically far exceed settlement costs. In fact, this is probably true of most patent disputes. But patent disputes can plausibly reverse the inequality. Settlement costs may exceed trial costs because a valid patent creates rights that occasionally translate into significant market power and profit that cannot be duplicated through a settlement contract; in these cases rational parties go to trial.

Consider an example of litigation concerning a patent on a chemical.[17] The chemical invention opens a new market, supplied by the patentee and a single competitor. Suppose the competitor arguably infringes the patent and the parties agree that the patentee has a probability p of winning at trial. Suppose profit in the new market is $200 million if the patentee is a monopolist;

---

[15] Clermont & Eisenberg, *supra* note 9, at 141 (discussing the refraction effect); Joel Waldfogel, *Reconciling Asymmetric Information and Divergent Expectations Theories of Litigation*, 41 J.L. ECON. 451, 458 (1998).

[16] This model appears in Michael J. Meurer, *The Settlement of Patent Litigation*, 20 RAND J. ECON. 77 (1989). The same article presents a private information model of a patent settlement. The most common approach is the optimism model of patent settlement, which is discussed for example in JEAN O. LANJOUW & JOSH LERNER, THE ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS: A SURVEY OF THE EMPIRICAL LITERATURE, (Nat'l Bureau of Econ. Research, Working Paper No. 6296, 1997), http://www.nber.org/papers/w6296. This survey article focuses more on the economic literature and covers significant results not discussed in this Article.

[17] We think this model might be particularly appropriate when applied to pharmaceuticals.

alternatively, the total profit in the industry is $150 million if the competitor competes against the patentee under a patent license, and total profit in the industry is $80 million if the competitor competes against the patentee without a license. Suppose that the cost of trial is $4 million to each party. If the parties go to trial and the patentee wins, then each party pays their legal fees and the patentee enjoys a $200 million monopoly. If the parties go to trial and the competitor wins, then each party pays their legal fees and they each get $40 million in profit, which is half of the industry profit of $80 million (we assume neither firm has an advantage and so competition leads them to split the industry profit equally). The parties can avoid legal fees by agreeing to a settlement license and dividing the industry profit of $150 million in a mutually acceptable fashion.

Settlement costs arise implicitly in this example and lead to equilibrium trial under certain conditions. Settlement is attractive to the parties in this example because it avoids trial costs.[18] But settlement is costly because it sacrifices some of the monopoly profit available in the new product market (we assume industry profit is $150 million rather than $200 million following settlement). In other words, we assume the contract terms that regulate competition in the duopoly market created by the settlement license do not fully replicate the monopoly outcome. This assumption can be justified by assuming antitrust law constrains the terms in the license or by assuming contracting costs (usually attributed to informational problems) impede perfect cartelization.

The outcome in this model depends on the probable outcome of trial. The critical value of the probability of patentee success, p, in this model is 65%—at that probability, the joint profit from settlement just equals the joint profit from trial. The joint profit from settlement is constant at $150 million, and the joint profit from trial is $200(.65) + $80(.35) – $4(2) = $150 million. If the probability of patentee success is less than 65%, then parties will settle. The division of industry profit achieved through the settlement license depends on the strength of the patentee's case.[19] If p is greater than 90%, then the competitor will be deterred from entering the market. The $4 million cost of a trial exceeds the expected profit from trial, $40(1 – p). Finally, when the probability of patentee success is between 65% and 90%, then trial occurs.[20]

This quick modeling exercise gets us to the point where we can discuss the selection effect. Assume this model explains why patent suits go to trial, and assume the effect of Federal Circuit decisions is to increase the probability that

---

[18] Settlement is also attractive because it avoids a trial outcome that invalidates or narrows the patent, which renders it ineffective as an entry barrier. Another possible settlement agreement calls for the patentee to withdraw from the market and assign the patent or exclusively license the patent to the competitor. Like the duopoly license, this strategy may suffer from high settlement costs especially because of antitrust scrutiny.

[19] If the parties split the bargaining surplus equally, then the patentee gets a share of the industry profit equal to 75 + 100p, and the competitor gets 75 – 100p. In particular, the parties share the industry profit equally if the patentee has no chance of winning at trial.

[20] The expected profit to the patentee from litigation is 200p + 40(1 – p) – 4 = 36 + 160p. Notice the profit from trial equals the profit from settling at p = .65.

a patentee wins a patent suit. What would that imply for observed win rates at trial? The answer is not clear, but one possibility is that the observed win rate is unchanged but the frequency of trial goes up. Notice this is quite different from the naïve view that trial frequency would not change and the win rate would rise. The win rate might be unchanged, because only disputes in which the plaintiff's probability of victory falls within the 65% to 90% range go to trial. The assumed actions of the Federal Circuit do nothing to change that range. The Federal Circuit's actions move some disputes out of that range and other disputes into that range, and the net effect is unclear.[21]

The essential message to draw from the foregoing discussion is that interpretation of trial outcome data requires a model of litigation. It is quite possible for the Federal Circuit to favor patentees without seeing win rates change. Alternatively, it is quite possible that win rates could change without the Federal Circuit or the PTO altering patent standards. The region of trial outcomes in the settlement cost model are determined by factors like the rigor of antitrust policy, the cost of trial, and the market value of inventions.

III. THE PATENT PREMIUM

A. The Magnitude of the Patent Premium

Economic theory and evidence present a strong case for subsidization of R&D in some industries. R&D generates positive externalities and therefore, it is underprovided by competitive markets. The patent system is one of the main policy tools used to subsidize R&D.[22] Various types of empirical research provide evidence on the magnitude of the patent premium—the reward inventors get from patenting their inventions. The research shows that patents provide a significant effective subsidy of R&D, but one that is probably much smaller than most patent lawyers would expect. Managers, on the other hand, would not be surprised. Surveys of R&D managers reveal that firms have other, often stronger, R&D incentives stemming from lead time advantage, learning, complementary products, and secrecy.[23]

---

[21] The following example would result in no change in the win rate and an increase in the frequency of trial. Suppose that there are "good" patents with $p = .7$ and "bad" patent with $p = .3$. If the Federal Circuit increases the share of good patents by 20%, then trial frequency would increase by 20% and the win rate would be 70% before and after the change.

[22] Government funding of universities and research labs, research grants, R&D contracts, and tax subsidies are the other main tools.

[23] Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development,* 1987 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 784–85; WESLEY M. COHEN ET AL., PROTECTING THEIR INTELLECTUAL ASSETS: APPROPRIABILITY CONDITIONS AND WHY U.S. MANUFACTURING FIRMS PATENT (OR NOT) (Nat'l Bureau of Econ. Research, Working Paper 7552, 2000); *see also* Jonathan M. Barnett, *Private Protection of Patentable Goods,* 25 CARDOZO L. REV. 1251, 1257–69 (2004).

Following Schankerman,[24] the ratio of the value of the patent stock to the value of the R&D stock provides an upper bound estimate of the "equivalent subsidy rate" for patent protection—that is, the subsidy that would be required to induce firms to make the same expenditures on R&D if there were no patent protection.[25] This ratio is thus a measure of the incentive effect of patents after taking other incentives into account. Several different types of studies provide estimates of this ratio. Studies based on renewal rates of patents in European countries find upper bound estimates of equivalent subsidy rates around 15%, although with quite a large range of variation over industries.[26] Survey data provide estimates ranging from 11–17%, again with significant variation across industries.[27]

Perhaps the most direct measures can be inferred from estimates of the effect of patent stocks on the market value of firms.[28] Since Griliches, economists have run regressions to decompose the market value of firms into separate contributions from physical capital, the stock of past R&D expenditures, and the stock of accumulated patents.[29] In general, these studies usually find a small, but positive, contribution of patents to the value of the firm above and beyond the contribution from R&D.

The most recent study in this line augments patent counts with citation data and gets better estimates of the market value of U.S. manufacturing firms.[30] Interpreting their data at the sample mean, we find an upper bound estimate of the equivalent subsidy rate of 12%; estimated at the sample median this figure is 7%.[31] Thus, consistent with the survey literature, patents generally create a premium sufficient to cover a relatively small fraction of the cost of R&D.

---

[24] Mark Schankerman, *How Valuable is Patent Protection? Estimates by Technology Field*, 29 RAND J. ECON. 77, 95 (1998).

[25] This is an upper bound estimate to the extent that there are diminishing returns to R&D and already existing subsidies for R&D. Also, to the extent that some of a firm's patented inventions do not derive from R&D on its products and processes, the value of patents overstates the subsidy.

[26] *See* Schankerman, *supra* note 24; Jean O. Lanjouw et al., *How to Count Patents and Value Intellectual Property: The Uses of Patent Renewal and Application Data*, 46 J. INDUS. ECON. 405 (1998).

[27] Estimates based on survey data of imitation costs suggest a figure of 11%; using a novel data set that combines survey and quantitative data for U.S. firms renders a mean estimate of 17%. ASHISH ARORA ET AL., R&D AND THE PATENT PREMIUM 29–30 (Nat'l Bureau of Econ. Research, Working Paper No. 9431, 2004), http://papers.nber.org/papers/w9431.

[28] Estimates based on market value regressions have the advantage that they reflect possible strategic interaction between firms. Estimates based on patent renewals assume that the value of each patent is independent of other patents in the portfolio; this assumption may be violated when firms pursue strategic uses of patent portfolios.

[29] See Bronwyn H. Hall, *Innovation and Market Value*, *in* PRODUCTIVITY, INNOVATION AND ECONOMIC PERFORMANCE 177 (Ray Barrell et al. eds., 2000) for a review of this literature.

[30] *See* Bronwyn H. Hall et al., *Market Value and Patent Citations*, 36 RAND J. ECON. (forthcoming 2005), http://www.iue.it/Personal/bhall/ HallJaffeTrajtenberg_RJEjan04.pdf .

[31] Details of these calculations are available on request from the authors.

The evidence on the patent premium presents a puzzle when contrasted with popular accounts suggesting high and growing profits from patents.[32] The puzzle dissolves when we probe deeper into the nature of the patent premium. First, it is important to recognize that, in absolute terms, the patent premium is large; 12% of the 2002 non-Federally funded manufacturing sector R&D expenditures amounts to about $12 billion.[33] After taking account of the costs of acquiring these patents, this is roughly equivalent to the value of federally funded R&D performed by manufacturing firms ($10.7 billion). Second, the value of patents varies sharply across inventions. In particular:

> 1. Patent values are highly skewed. Hall et al. find that a small number of highly cited patents are responsible for a large share of the total value of patents. Scherer and Harhoff review a variety of evidence on returns and find that often the top 10% of patents (or innovations) account for 80-90% of the total returns.[34]
>
> 2. The patent premium varies across industries. There is no consensus on precise magnitudes, but most commentators believe the premium is large in biotech and the pharmaceutical industry.[35]
>
> 3. Entrants earn a higher premium than incumbents. In a subsequent study by Hall, using the same dataset, she found that in electronics, machinery, instruments, and semiconductors the positive value of patent stocks was largely limited to entrant firms, especially after 1984. In aggregate, incumbent firms in those industries tended to have either no significant value to their patent stocks or even a negative value.[36]

B. How Do Firms Use Patents to Capture the Patent Premium?

In the previous section, we did not cite any empirical research on patent litigation in relation to the magnitude of the patent premium. Litigation research is not well-suited to estimating that magnitude. Certainly, the expected cost of litigation sets a lower bound on the expected value of litigated patents, but that is not very helpful, because estimates of expected litigation costs are hard to obtain, and it is not clear how close actual patent values are to the lower bound.

---

[32] *See generally* Kevin G. Rivette & David Kline, *Discovering New Value in Intellectual Property*, HARV. BUS. REV., Jan.–Feb. 2000, at 54.

[33] Total manufacturing R&D spending in 2002 was $109 billion, of which $10.7 billion was federally funded.

[34] *See* Hall et al., *supra* note 30; F.M. Scherer & Dietmar Harhoff, *Technology Policy for a World of Skew-Distributed Outcomes,* 29 RES. POL'Y 559 (2000); *see also* MOORE, *supra* note 6, at 14, http://papers.ssrn.com/so13/papers.cfm?abstract_id=566941 (53.7% of U.S. patents expire for failure to pay maintenance fees).

[35] *See* Levin et al., *supra* note 23; ARORA ET AL., *supra* note 27. Schankerman finds a rather different pattern across French industries. Part of this he attributes to price controls for pharmaceuticals; part may also be due to strategic effects. Schankerman, *supra* note 24, at 77–107.

[36] BRONWYN H. HALL, EXPLORING THE PATENT EXPLOSION sec. 3.3 (Nat'l Bureau of Econ. Research, Working Paper No. 10605, 2004), http://www.nber.org/papers/w10605.

In contrast, litigation research provides a valuable complement to other types of research on the question of how firms capture the patent premium. For example, evidence that firms in a particular industry have a high propensity to litigate their patents might indicate that patents are particularly valuable in that industry. Furthermore, litigation research reveals characteristics of patents and patent holders that are especially likely to be involved in litigation. When combined with survey, stock market, and patent renewal studies, these findings paint a picture of the type of firm and type of invention that benefits most from patent protection. Survey, stock market, and renewal studies have the advantage of using data on all patentees, but they cannot provide information about the identities of licensees or opposing parties in litigation. Naturally, studies of litigation and licensing provide such information. These studies can provide information about the characteristics of accused infringers and licensees and the magnitudes of damage payments or license fees. Additionally, litigation studies can provide information on the duration of a dispute, whether infringement was judged to be willful, whether the defendant pursued an independent research program, and whether attorney's fees were shifted in either direction.

1. Exclusion and Licensing of Competitors

Unlike many patent law commentators, we believe that the patent premium ultimately derives entirely from the rights of exclusion created by the patent grant. In other words, the patent premium flows from patent litigation or, more typically, the threat of litigation.[37] Thus, studies of patent litigation potentially can reveal information about the nature of the patent premium. For example, studies of litigation help discriminate how much of the patent premium flows from three possible sources. The first source of profit from patents arises when a patentee excludes competitors from practicing the patented invention or forces competitors to take a license under threat of an infringement suit.[38] Exclusion is a common practice in the pharmaceutical industry; and licensing competitors is a common practice in the semi-conductor industry. A second source arises when a patentee licenses or assigns the patent to a firm or firms

[37] We are skeptical of the empirical significance of patent signaling, the use of patents to monitor research employees, and certain types of defensive patenting. Patent applications are too costly compared to other signals or other monitoring techniques for the patent signaling story or the employee monitoring story to justify patenting. These stories each have merit as derivative sources of patent value. Once a firm decides for some other reason to patent, then its patent stock could signal information to financial markets, and managers might decide to use patents as a measure of employee productivity. Commentators use the term defensive patenting in different ways. According to one version, inventors patent an invention to prevent a stranger from later inventing and patenting the same invention and suing the first inventor. We think it must be cheaper to make some other form of disclosure that would defeat subsequent patent claims. Thus, this type of defensive patenting cannot be the primary motivation for patenting.

[38] Commentators sometimes describe blocked patents as defensive when the underlying technology is subject to another firm's patent. In Part III.B.3, we discuss strategic use of patents by defendants in patent lawsuits. Readers should recognize that an improvement patent or a new use patent can be used to exclude or license competitors and this source of profit is distinct from the strategic use of patents to settle litigation.

outside of the patentee's industry. This is the main source of patent profit for universities and independent inventors.[39] A third source of profit arises from a variety of strategic uses of patents in litigation. Certain strategic uses, such as the use of patents to avoid litigation and facilitate cross-licensing, may be socially valuable.[40] Other strategic uses, including opportunistic and anticompetitive patent suits based on weak or invalid patents, are clearly socially harmful.

Survey and stock market research indicates that the patent premium is greatest in the pharmaceutical industry. These findings match the intuition of most commentators, who suppose that patents are critical to pharmaceutical companies that use them to exclude potential competitors.[41] For example, Glynn Lunney Jr. uses event study methodology to examine the reactions of firm stock prices to court decisions in patent cases. He found pharmaceutical companies experienced sharp drops in market value after key patents were held noninfringed or invalid. In one case, Eli Lilly lost nearly 30% of its stock market value. The evidence of such reactions for firms in other industries was much weaker, highlighting the importance of exclusion for pharmaceutical patents.

Contrary evidence comes from renewal and litigation studies, which suggest that pharmaceutical patents only have average value. Renewal data shows that pharmaceutical patents rank near the mean in terms of frequency of renewal;[42] similarly, data on lawsuit filing shows pharmaceutical and biotechnology patents rank near the mean in terms of frequency of filing per patent.[43] We think the conventional wisdom has it right and offer two explanations for this discrepancy. First, uncertain and skewed patent value is especially apparent in the pharmaceutical industry. Firms get patents at an early stage of commercialization, get no value out of most patents, and get a bonanza from a few. Renewal rates are not especially high as failed drug candidates get weeded out. Second, litigation rates measured by Allison et al., which do not

---

[39] Commentators note that patents are assets that help start-ups get funding. We agree but note that this is not an independent source of patent value. Financiers value patents because of the exclusionary rights they provide.

[40] It is possible, however, that the dynamic effect of cross-licensing may reduce R&D incentives.

[41] For example, Allison, Lemley, Moore, and Trunkey are surprised by their finding that pharmaceutical patents are not litigated more than average patents: "This result seems quite surprising, given the large amounts of money at stake in pharmaceutical patent suits, the extensive research and development costs that go into inventions, the comprehensive lobbying efforts by pharmaceutical manufacturers for technology-specific patent laws, recent evidence that pharmaceutical companies have violated the antitrust laws in an effort to extend their patent rights, and prior survey finding pharmaceutical companies consider patents more important than companies in any other industry." John R. Allison et al., *Valuable Patents*, 92 GEO. L.J. 435, 474–75 (2004). Mark Lemley suggested to us that their result may have been skewed because they do not capture end of term suits.

[42] Jean Olson Lanjouw, *Patent Protection in the Shadow of Infringement: Simulation Estimations of Patent Value,* 65 REV. ECON. STUD. 671, 678 (1998) (finding payment of renewal fees correlates with litigation in Germany).

[43] Allison et al., *supra* note 41, at 474–75; Lanjouw & Schankerman, *supra* note 11.

show high rates in pharmaceuticals, are measuring litigation per patent. In contrast, our research shows that the chemical industry, SIC code 28, which includes pharmaceuticals, has the highest rate of litigation *per firm* of any industry.[44] Our interpretation is that the pharmaceutical industry has a relatively large number of "dry holes," but it vigorously protects commercially successful products through patent litigation.

The semiconductor industry is an interesting contrast to pharmaceuticals, because surveys of R&D managers do not highly rank patents as a means of appropriating profit from semi-conductor inventions.[45] Nevertheless, the industry does get a lot of patents, it tends to renew them, and it sees a lot of patent licensing and litigation.[46] The surveys and econometric analysis of litigation data by Rosemarie Ham Ziedonis suggests that there are two different types of semiconductor firms that pursue two different strategies for exploiting their patents. Large, vertically integrated firms tend to cross-license their patents, while smaller design firms, by necessity, license a manufacturer to make their chips, but they are litigious and exclusionary toward other industry members.[47]

An important goal for future research is to identify more clearly why patents in the semiconductor industry apparently do not contribute as much to industry profit as patents in the pharmaceutical industry. Current research hints that firms can pursue an exclusionary strategy more easily in industries like pharmaceuticals in which a single firm holds a key patent or a few patents that cover a product. Patents are harder to exploit in industries like semiconductors, in which many parties hold patents that cover their own and their competitors' products.[48] Future litigation and licensing research should also provide a better sense of the frequency with which patents are asserted against industry competitors as opposed to firms outside of the industry of the patentee.

---

[44] James Bessen & Michael J. Meurer, *The Patent Litigation Explosion* (2004) (unpublished manuscript at 12, on file with authors).

[45] Levin et al., *supra* note 23, at 784; COHEN ET AL., *supra* note 23, at 6.

[46] Scholars disagree whether litigation rates are high in the semiconductor industry. We discuss strategic use of patents in the industry and explain *infra* at text accompanying note 75 why we think the industry has a high rate of litigation.

[47] Rosemarie Ham Ziedonis, *Don't Fence Me In: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms*, 50 MGMT. SCI. 804, 817–818 (2004). Ziedonis's data show that litigation is increasing for the vertically integrated firms, and Bessen & Meurer show that the industry as whole has a high rate of litigation per firm. See *infra* text accompanying notes 72–75 for more discussion of patent litigation in the semiconductor industry.

[48] Levin et al., *supra* note 23, at 798, and several subsequent authors (especially COHEN ET AL., *supra* note 23, at 19–23) make a distinction between "discrete" and "complex" technologies. The former have patents that correspond uniquely (or almost so) with products and the patents have well-defined boundaries. Below we discuss the strategic use of patents in the semi-conductor industry to deter litigation. Perhaps semi-conductor firms have a high propensity to acquire and renew patents for defensive reasons, so "dry holes" don't really matter if the patents still pose a potential threat to competitors.

2. Assignment and Licensing of Non-Competitors

Strategies used to exploit patents depend on the nature of the patent-holding entity. Large firms engage in what William Baumol calls "routine innovation," a term borrowed from Schumpeter.[49] They have relatively systematic R&D programs that generate inventions and patents directed toward the industries that the firm participates in. If Baumol is correct, then large firms normally use their patents to exclude or license their competitors.[50] Universities exploit their patents in quite a different fashion. We suspect and hope that few or none of their patents relate to the education industry; thus universities gain most of their profit by licensing and assigning their patents to non-competitors.[51] By definition, two other classes of patent holders exploit their patents by assignment or licensing of non-competitors: independent inventors and licensing shops. The story with small firms is mixed. We suspect many small firms use their patents against competitors to facilitate entry and survival in their industry. We suspect many other small firms participate in the market for R&D and license their patents downstream to firms in related industries.[52]

Assignment and licensing of non-competitors was more significant in the early American patent system than it is today. Khan and Sokoloff document a flourishing market for patent rights and a robust class of independent inventors in the second half of the nineteenth century. The role of the independent inventor is diminished in the modern economy, in which 71% of patents issue to large firms.[53] We conjecture that the majority of patents held by large firms and a significant fraction of patents held by small firms are used within the industries that the firms occupy. If true, then exclusion and licensing of competitors is the dominant source of patent value. Patent litigation research can shed light on our conjecture by measuring the fraction of defendants that are in the same industry as the patentee-plaintiff firm.[54]

Despite its lower frequency, assignment and licensing of non-competitors holds great policy interest. Academic and independent inventions possibly have disproportionately greater social value, and thus merit special attention.[55]

---

[49] WILLIAM J. BAUMOL, THE FREE-MARKET INNOVATION MACHINE 21, 55 (2002).

[50] No doubt big firms sometimes hold patents relevant to other industries because of the unpredictable nature of R&D, the coarse linkage between technology and industry, and shifting product interests of the firms.

[51] Universities sometimes participate in faculty based start-ups, and the start-ups may use patents to exclude or license competitors. Thus, universities indirectly get some profit from the traditional strategies of excluding or licensing competitors.

[52] To recap, we have three categories: independent inventors who do not commercialize their inventions; small firms that commercialize their patented inventions and use their patents to exclude or license competitors; and small firms that sell technology (for example, bio-tech research tools) to downstream firms (pharmaceutical companies).

[53] *See* John R. Allison & Mark A. Lemley, *Who's Patenting What? An Empirical Exploration of Patent Prosecution*, 53 VAND. L. REV. 2099, 2117 (2000).

[54] A selection problem must be addressed when interpreting data describing the industry proximity of plaintiffs and defendants. Perhaps a firm is more likely to file suit against a non-competing defendant. Repeated interaction is less likely with a non-competitor, and the threat of patent retaliation might be lower.

[55] Allison et al., *supra* note 41, at 469–70.

Further, independent inventors and small firms are probably more dependent on the patent premium than other patent holders. Large firms have a wider variety of methods for extracting value from their inventions and non-profits get substantial government funding.[56] Finally, there is concern that independent inventors and licensing shops are especially likely to abuse the patent system by seeking licenses for weak or invalid patents.

Although independent inventors and non-profit inventors capture the patent premium the same way, they pursue fairly different types of inventions and patenting and litigation practices. Allison and Lemley find that small entities tend to patent mostly mechanical inventions and medical instruments.[57] Universities, on the other hand, are active across more fields of technology including biotechnology, electronics, and software, although evidence suggests that, in fields other than biotechnology, most transfer of technology to the private sector occurs without patents.[58] These numbers may reflect the high fixed cost of conducting R&D in many fields of technology, which forecloses participation by independent inventors.[59]

Following the Bayh-Dole Act of 1980, universities have become actively involved in patenting and licensing their patents. Like other patents, the value of university patents is highly skewed; only 0.56% of the licenses earned more than $1 million.[60] Overall, universities received more than $1 billion in licensing royalties and cashed-in equity shares in 2000,[61] but this accounted for only "about 4.7% of their research expenditure."[62]

Independent inventors and nonprofit patent holders choose vastly different litigation strategies. Allison et al. find that small firms and independent inventors file patent lawsuits about three times as often on a per patent basis as other patent holders,[63] while non-profit patent holders litigate at about the mean rate for all entities.[64] Possibly, small firms and independent inventors litigate more because their patents are more valuable.[65] They could be more valuable because they cover inventions with higher average quality or because patents are a more important source of profit to small firms and independent inventors. Allison et al. cast doubt on the first possibility. They use the number of

---

[56] *See* Barnett, *supra* note 23, at 1283.

[57] Allison & Lemley, *supra* note 53, at 2102.

[58] *See* Ajay Agrawal & Rebecca Henderson, *Putting Patents in Context: Exploring Knowledge Transfer from MIT*, 48 MGMT. SCI. 44 (2002). Furthermore, most university patent licenses are for early stage ideas that are little more than "proof of concept." Only 12% were "ready for practical use." Jerry G. Thursby & Marie C. Thursby, *University Licensing and the Bayh-Dole Act*, 301 SCIENCE 1052, 1052 (2003).

[59] But this does not explain independent inventors' low rate of patenting software, a field with many small entities. This may also reflect the greater costs that an independent inventor or small entity faces in prosecuting and enforcing patents.

[60] Thursby & Thursby, *supra* note 58, at 1052.

[61] *Id*.

[62] *Id*.

[63] Allison et al., *supra* note 41, at 466.

[64] *Id*. at 466 n.134.

[65] *Id*. at 471.

citations a patent receives from later patents as an indicator of invention quality. They find that litigated patents on average receive significantly more citations than non-litigated patents, except in the case of patents held by independent inventors and small firms.[66] The second possibility finds support from Hall, who obtains evidence that the patent premium is larger for small firms.[67] A third explanation is that large firms resolve disputes more easily because of reputational or scale advantages.[68] Finally, small firms and independent inventors might engage in more opportunistic litigation. We comment on this possibility in the next section.

3. Strategic Litigation

Growing evidence suggests that part of the private value created by patents arises from strategic patent litigation. We use this label to cover three different patent litigation strategies that depart from the traditional notions of how firms use patents to create value. First, firms use patents to ward off patent suits by their competitors. Second, dominant firms threaten or file predatory patent suits against smaller actual or potential competitors. Third, firms threaten or file opportunistic patent suits to earn nuisance settlement payments.

Some researchers contend that firms have the power to reduce the expected cost of patent litigation by building "defensive" patent portfolios.[69] This view is supported by survey evidence that many firms do acquire patents for purposes of trading.[70] This theory is typically presented as a variant of the arms control theory of mutually assured destruction—if you sue me, I will sue you, and we will enjoin each other. The theory is plausible in industries that rely on complex technologies that combine many patented components or features. Other theories can explain why defensive portfolios reduce expected litigation costs. First, a potential plaintiff would be leery of suing a defendant with a large patent portfolio because it would have to investigate the portfolio to estimate the risk of a successful counterclaim. Even if the defendant could not raise a successful counterclaim, it succeeds in imposing higher litigation costs on potential plaintiffs. Second, aggressive offensive use of a large portfolio supports a reputation for being a tough litigator, which can discourage potential plaintiffs. Third, large portfolios may deter entry and thereby reduce

---

[66] Allison et al. find that forward citations are the strongest predictor of litigation except for patents assigned to individuals and small entities. *Id*. at 455.

[67] HALL, *supra* note 36, sec. 2.3. During the 1980–84 period, there was no premium on patents in the valuation of new firms compared to incumbents, but in the 1985–89 period there was a significant premium to patents held by entrants in complex product industries. *Id*., sec. 3.1.

[68] Alternatively, perhaps large firms have more reason than small firms to fear retaliation in the form of a patent infringement counterclaim; independent inventors have no such fear. Allison et al., *supra* note 41, at 469.

[69] Lanjouw & Schankerman, *supra* note 11, at 47 ("[T]his portfolio effect is stronger for smaller companies, as measured by employment.").

[70] COHEN ET AL., supra note 23, at 17; *see* Rivette & Kline, *supra* note 32, at 62 (describing a small chip design company that averted a patent infringement lawsuit by Intel by purchasing a patent from a bankrupt firm that potentially covered Intel chips).

the number of potential plaintiffs.[71] Fourth, a potential plaintiff with a large portfolio might join with a defendant with a large portfolio to form a pool to offer licenses to third parties, thereby gaining from reduced negotiation and enforcement costs.

The hypothesis that defensive portfolios reduce expected litigation cost is supported by evidence that rates of litigation per patent decline as portfolio size grows. It is also supported by evidence that rates of litigation per patent are low in industries known for active cross-licensing of portfolios of patents covering entire technology fields, such as electronics and semiconductors.[72] For instance, Allison et al. argue that "[t]he paucity of litigation in the semiconductor industry is consistent with sector-specific studies of that industry by Hall and Ziedonis and others and makes perfect sense given the pattern of 'mutually assured destruction' that prevails among established companies in the industry."[73] Presumably, the pattern of mutually assured destruction leads firms to settle early in patent litigation to avoid the risk that they will both suffer adverse infringement or validity judgments.

But new evidence points in the opposite direction. First, the ratio of litigation per patent can be a misleading measure of the litigation hazard facing the firm. For example, semiconductor firms both acquire a large number of patents and engage in a high level of litigation. Ziedonis finds that the rate of litigation per R&D dollar is quite high in the semiconductor industry, both among large manufacturing firms and recently entered design firms.[74] Moreover, the rate of litigation per real R&D dollar nearly doubled following the creation of the CAFC. Bessen and Meurer find that the semiconductor industry has the second highest rate of litigation per firm (after the chemical industry—including pharmaceuticals).[75] Clearly, this high rate of litigation in semiconductors is offset by an even higher relative rate of patenting compared to other industries. But the simple fact is that the litigation hazard faced by firms is quite high. Second, although defensive patenting may lessen a firm's

---

[71] Josh Lerner, *Patenting in the Shadow of Competitors*, 38 J.L. & ECON. 463, 486–87 (1995).

[72] Lanjouw & Schankerman, *supra* note 11, at 47 ("a larger portfolio of patents reduces the probability of filing a suit on any individual patent in the portfolio" controlling for observable characteristics of the patent and patent owner); Allison et al., *supra* note 41, at 468–69; *see* Peter C. Grindley & David J. Teece, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, CAL. MGMT. REV., Winter 1997, at 8.

[73] Allison et al., *supra* note 41, at 474 (citing Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisted: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995*, 32 RAND J. ECON. 101 (2001)).

[74] Ziedonis, *supra* note 47, at 817–18. In Bronwyn Hall's latest study of patents and firm share value she concludes, "[a] preliminary interpretation of these results is the following: in established firms, accumulating patents for defensive reasons has little impact on market value because the past history of R&D spending is already a good indicator of the firm's technology position. On the other hand, an above average accumulation could be slightly negative for value if it indicates the [presence] of threatened suits for infringement." HALL, *supra* note 36, sec. 4.

[75] Bessen & Meurer, *supra* note 44, at 12.

litigation risk, all else equal, when all firms in an industry build defensive portfolios the net result appears to be greater litigation hazard. Bessen and Meurer find that two randomly selected firms within a 4-digit SIC industry are much more likely to engage in litigation with each other if they both have large portfolios than if they both have small portfolios. Thus, although it is individually rational for each firm to reduce its litigation risk by building a defensive portfolio, the collective equilibrium effect is to increase industry litigation hazards. This suggests that "defensive" patents are not used purely defensively.

Anti-competitive and opportunistic patent suits are kin to the "normal" suits that seek exclusion or licensing; they differ because they are based on "weak" patents—a difference not directly observable to the econometrician. Anti-competitive suits rely on weak patents to exclude competitors.[76] Opportunistic suits rely on weak patents to induce licensing. A patent suit is weak if the objective probability of successfully proving infringement and overcoming defenses, such as patent invalidity, is low at the time of filing.

A rational defendant will sometimes yield to the threat of a weak suit for three main reasons.[77] First, court errors are difficult to avoid in patent litigation, because claim interpretation is complex and it is difficult for fact-finders to assess evidence of infringement. Thus, a deserving defendant may face a significant risk of liability.[78] Second, a weak lawsuit may be difficult to distinguish from a strong lawsuit, at least until a defendant gathers information about the patent through discovery. Finally, even a weak lawsuit may impose significant costs on the defendant, and the defendant might settle to avoid the nuisance of mounting a defense.[79]

Evidence suggestive of anti-competitive patent litigation comes from a study by Josh Lerner and another by Lerner and Jean O. Lanjouw. Lerner studies the research programs of bio-tech firms and he finds that small firms avoid R&D in fields where the threat of litigation from larger firms is high.[80] He notes that the rate of litigation per bio-tech patent is very high and that firms

---

[76] Walker Process Equip., Inc. v. Food Mach. & Chem. Corp., 382 U.S. 172 (1965) (illustrating an anti-competitive patent suit: Food Machinery obtained a patent by fraudulently concealing a prior use from the PTO; the company was found liable for an antitrust violation because it attempted to enforce the invalid patent against a competitor); *see also* Handgards, Inc. v. Ethicon, Inc. 743 F.2d 1282, 1288–92 (9th Cir. 1984) (concluding that patentee knew patent was invalid because there was a previous inventor and because of public use before the patent application).

[77] This discussion of opportunistic and anti-competitive lawsuits is drawn from Michael J. Meurer, *Controlling Opportunistic and Anti-Competitive Intellectual Property Litigation,* 44 B.C. L. REV. 509, 512–513 (2003).

[78] Allison et al., *supra* note 41, at 475 (observing that the high frequency of lawsuits per patent among software and computer-related patents is perhaps explained by the uncertainty of software patent law).

[79] *See, e.g.,* David Rosenberg & Steven Shavell, *A Model in Which Suits Are Brought for Their Nuisance Value*, 5 INT'L REV. L. & ECON. 3, 3 (1985); Lucian Arye Bebchuk, *A New Theory Concerning the Credibility and Success of Threats to Sue*, 25 J. LEGAL STUD. 1, 2 (1996).

[80] Lerner, *supra* note 71, at 486–87.

spend as much on legal fees as they do on R&D. The study does not indicate, however, that the patents held by the larger firms are low quality. Thus, it is quite possible that smaller firms are simply looking for less crowded market niches in which they can compete more profitably.

Lanjouw and Lerner show that preliminary injunctions in patent cases tend to be used by large firms hoping to impose financial distress on smaller rivals.[81] The authors conjecture that preliminary injunctions may be especially harmful in innovative industries "driven by smaller, more vulnerable, venture-capital-based firms."[82] Despite the restrictive standard that generally applies to preliminary injunctions,[83] they are relatively common in patent cases.[84] They are useful predatory devices, because small firms face a "particular difficulty of raising external funds to finance litigation."[85]

Despite widespread popular accounts of opportunistic patent suits, hard evidence is scarce. Two pieces of data provide some hints about the nature of the problem and whether a problem exists. First, as we mentioned earlier, independent inventors and small businesses have a very high rate of patent litigation on a lawsuit per patent basis.[86] Popular accounts of opportunistic litigation suggest that "patent trolls" are usually small firms or independent inventors. Possibly, opportunistic litigation contributes to the high litigation rate of small firms and independent inventors.[87] It is also possible the high rate is explained by the importance of patents to these entities.

Second, we searched for all instances of attorney fee-shifting in U.S. patent cases in the last ten years and found that fees were shifted to the alleged

---

[81] *See* Jean O. Lanjouw & Josh Lerner, *Tilting the Table? The Predatory Use of Preliminary Injunctions,* 44 J.L. & ECON. 573, 575–76 (2001).

[82] *Id*. at 575.

[83] *See* 9 CHARLES ALAN WRIGHT, ARTHUR R. MILLER, & MARY KAY KANE, FEDERAL PRACTICE & PROCEDURE §2948, 129 (2d ed. 1995) ("It is frequently observed that a preliminary injunction is an extraordinary . . . remedy.").

[84] *See* Lanjouw & Lerner, *supra* note 81, at 595 (noting that preliminary injunctions are common in patent cases). The Federal Circuit relaxed the standards for preliminary injunctions in patent cases. Regional circuit courts used to require a showing of validity and infringement "beyond question." The Federal Circuit adopted a requirement of likelihood of validity and infringement for a preliminary injunction. *See* John G. Mills, *The Developing Standard for Irreparable Harm in Preliminary Injunctions to Prevent Patent Infringement*, 81 J. PAT. & TRADEMARK OFF. SOC'Y 51, 55–56 (1999).

[85] Lanjouw & Lerner, *supra* note 81, at 574.

[86] Barnaby J. Feder, *Medtronic Must Pay Inventor $159 Million*, N. Y. TIMES, Sept. 29, 2004, at C6 (noting that Dr. Gary Michelson holds 250 patents and 400 more applications; he frequently litigates to enforce his patents and is currently embroiled in a suit with Medtronic over their performance under licenses relating to patents on spinal surgical devices).

[87] Mark A. Lemley & Kimberly A. Moore, *Ending Abuse of Patent Continuations,* 84 B.U. L. Rev. 63, 88–89 (2004) ("Because many submarine patentees are individuals who do not file abroad, they will not be deterred by the eighteen-month publication rule. Further, our data show that individual domestic inventors, who are least likely to patent abroad, are the most common users of the continuation system. There are 854 patents that took twenty years or longer in prosecution, and 26% of these patents issued to U.S. individuals.").

infringer in 25 cases.[88] This averages 1% of patent suits that terminated via pre-trial motion or trial.[89] The reasons given for shifting fees to an alleged infringer are almost always vexatious litigation, failure to investigate whether infringement was present, abusive discovery practice, or inequitable conduct. Thus, these opinions suggest that these cases represent instances of opportunistic (or anti-competitive) conduct by the patentee. The 1% figure understates the frequency of abusive litigation for three reasons. First, it is difficult for alleged infringers to prove the patentee was acting opportunistically. Second, it may be difficult for alleged infringers to recognize that they are subject to abusive litigation. Third, presumably, opportunistic patent litigation often succeeds and alleged infringers settle.

C. How Do Patent Policy Instruments Influence the Patent Premium?

Little empirical work links patent policy instruments to the behavior of patent applicants, patent litigants, and patent courts. Future work should strengthen these links and extend them to connect patent reforms to the patent premium. At the top of our wish list, we would like to see research that links changes in the non-obviousness doctrine with the behavior of patent applicants, patent litigants, and ultimately with the magnitude and incidence of the patent premium. We would like to see similar research tracking changes in claim interpretation and application of the doctrine of equivalents.[90]

Empirical researchers have started to look at the impact of policy change on patent applications, interference proceedings, and trial outcomes. Hall finds a significant structural break in the time series of U.S. patent applications by American applicants between 1983 and 1984 (except for computer industry, which has a break between 1992 and 1993).[91] Based on interviews with industry members, she suggests that the increase in patenting resulted from successful, high-profile patent suits that convinced businesses that the Federal Circuit was making patents more valuable.[92]

There is also direct evidence that the Federal Circuit has changed patent validity and patent scope. The research must be used cautiously though, because it does not control for the selection effect. Allison and Lemley find the

---

[88] We counted awards to defendants in infringement actions plus awards to plaintiffs in declaratory judgment actions during the fiscal years 1994 through 2004.

[89] This number is calculated for the five years running from fiscal year 1994 through fiscal year 1999. During this period fees were shifted to alleged infringers 11 times. The data on patent case terminations is obtained from the Federal Judicial Center. The data shows the method of disposition was pre-trial motion in 651 cases and trial in 389 cases, thus the 1% figure is obtained by dividing 11 by (389 + 651).

[90] Glynn Lunney applied stock market event study methodology to *Festo* and other leading patent cases and could not find evidence that the market reacts to shifts in patent doctrine. Glynn S. Lunney, Jr., *Patent Law, the Federal Circuit, and the Supreme Court: A Quiet Revolution*, 11 SUP. CT. ECON. REV. 1, 37–38 (2004).

[91] HALL, *supra* note 36, sec. 2.2.

[92] *Id.* Kortum and Lerner disagree that the recent increase in patent applications can be explained by the creation of the Federal Circuit. *See* Samuel Kortum & Josh Lerner, *What is Behind the Recent Surge in Patenting?* 28 RES. POL'Y 1, 2–3 (1999).

patent validity rate has increased since the creation of the Federal Circuit.[93] Lunney finds that the Federal Circuit is less likely to find infringement than predecessor courts and thus has narrowed patent scope.[94] Wagner and Petherbridge find Federal Circuit claim interpretation decisions are growing more predictable.[95]

Another important strand of empirical work examines whether patent doctrine has a differential impact on small firms and independent inventors. In separate studies, Mossinghoff and Lemley and Chien investigated the patent priority system to see what impact it has on small inventors.[96] The first-to-invent system has survived in the U.S. despite pressure to harmonize with the rest of the world by switching to a first-to-file priority system. These researchers find small inventors get little, if any, benefit from the American system. In contrast, Lemley and Moore find that independent inventors especially benefit from continuation practice, and that continuation practice continues to be popular despite a variety of recent patent reforms that some thought would cause the number of continuation applications to decline.[97]

---

[93] Allison & Lemley, *supra* note 2, at 194 ("[Study of] 299 patents litigated in 239 different cases. These cases represent all written, final validity decisions by either district courts or the Federal Circuit reported in the *U.S.P.Q*. during an almost eight-year period from early 1989 through 1996."); *id.* at 206 (noting the validity rate has increased since the creation of the Federal Circuit); *id.* at 205 (noting that 54% of patents are found valid); *see also* Lunney, *supra* note 90.

[94] Lunney, *supra*, note 90, at 11–12 (finding patent owners succeed about 30% of the time at the Federal Circuit and suggesting the availability of injunctive relief explains the departure from a 50% success rate); *id.* at 14 (finding that the Federal Circuit is less likely than predecessor courts to invalidate a patent, but also less likely to find infringement, and thus, no more likely to find in favor of a patent owner); *id.* at 15 ("In the pre-Federal Circuit era, a ruling that the patent claim(s) at issue was invalid due to obviousness accounted for 64.8% of the failure results. In contrast, under the Federal Circuit, a failure to satisfy the nonobviousness requirement accounted for only 14.6% of the failure results."); *see also* Kevin M. Clermont and Theodore Eisenberg, *Appeal from Jury or Judge Trial: Defendants' Advantage*, 3 AM. L. & ECON. REV. 125, 130 (2001) (noting that one-fifth of federal civil, non-personal injury tort, and contract cases are appealed, and one-fifth of the appeals led to a reversal).

[95] R. Polk Wagner & Lee Petherbridge, *Is the Federal Circuit Succeeding? An Empirical Assessment of Judicial Performance*, 152 U. PA. L. REV. 1105, 1156 (2004).

[96] Gerald J. Mossinghoff, *The U.S. First-to-Invent System Has Provided No Advantage to Small Entities,* 84 J. PAT. & TRADEMARK OFF. SOC'Y 425, 426 (2002); Mark A. Lemley & Colleen V. Chien, *Are the U.S. Patent Priority Rules Really Necessary?* 54 HASTINGS L.J. 1299, 1300 (2003).

[97] Lemley & Moore, *supra* note 87, at 65 ("Congress and the courts have created a number of patent doctrines designed to combat the misuse of continuation applications. In the last ten years, they have changed the term of patents, ended the secrecy of most patent applications, revived the controversial doctrine of written description, and created an entirely new defense of prosecution laches. While these changes have indeed mitigated some of the worst abuses of the continuation process, our data demonstrate that they are not likely to be effective in tackling the core of the problem."); *id.* at 69 ("The results of our comprehensive study of patent continuations shows that 23% of all patents granted from 1976 through 2000 claim priority to one or more previously filed applications."); *id.* ("Although there has been some fluctuation over the years in the number of continuation patents filed, the trend has been a steady increase. In the mid-1970s, about one-fifth of all issued patents were based on

IV. PATENT PROSECUTION

A. The Endogenous Nature of Patent Scope and Validity

Research shows that litigated patents differ significantly from non-litigated patents. For example, litigated patents have more claims, more citations to prior art, and are more likely to be part of a family of patents claiming priority from a common predecessor.[98] Research also documents the growing complexity of patents. The number of claims, number of prior art citations, and prosecution time have all grown rapidly.[99] These results raise the question of how much control patent prosecutors have over the scope and validity of patents. Perhaps litigated patents differ from non-litigated patents because patent applicants recognize which patents are most likely to be litigated and therefore invest more effort in prosecuting those patents.[100] Perhaps patents have grown more complex because most applicants face an elevated probability of litigation or a higher expected return from their patents and this drives increased investment in prosecution of all of their patent applications.[101]

Patent applicants can refine their patents in a variety of ways. First, they can conduct better prior art searches, and then draft better claims to avoid troublesome prior art. Incidentally, the duty to disclose material prior art may lead to more citations to prior art for firms who search the prior art more

---

continuations. By the mid-1990s the number of patents issued based on continuation applications climbed to 31%. That number has declined somewhat in the last several years, in part because of changes in the way patent term is calculated, but continuation patents still constitute about one-quarter of all issued patents.").

[98] *See* Allison et al., *supra* note 41, at 456–457 ("Patent applicants whose patents were ultimately litigated filed many more continuation applications than ordinary applicants."); *id*. at 457 ("Litigated patents also tended to be part of 'families' of issued patents."); *id.* at 459 ("Litigated patents also spent significantly longer in prosecution than issued patents [using grant year–filing year]."); *id.* ("For this reason, time in prosecution was not a significant predictor of litigation in the multivariate regression in the sample study once we controlled for [the number of patent applications filed].").

[99] John R. Allison & Mark A. Lemley, *The Growing Complexity of the U.S. Patent System*, 82 B.U. L. REV. 77 (2002).

[100] Lemley & Moore, *supra* note 87, at 65 ("[C]ontinuation practice can be—and has been—used strategically to gain advantages over competitors by waiting to see what product the competitor will make, and then drafting patent claims specifically designed to cover that product. Finally, some patentees have used continuation practice to delay the issuance of their patent precisely in order to surprise a mature industry, a process known as 'submarine patenting.'").

[101] Allison & Lemley, *supra* note 99, at 139–141*; id.* at 81 ("W]e speculate on explanations for the dramatic increase in the complexity of patents. We reject a number of possible explanations, including both changes in the quality of PTO examination and changes in the nature of technology, as inconsistent with the data. The hypothesis that best fits the data is that patents are increasingly valuable to businesses, and that companies that expect to use patents in licensing or litigation are willing to spend more time and effort in the PTO to get a better patent."); Allison et al., *supra* note 41, at 455 (noting that patent applicants file more claims and cite more prior art to increase the value of their patents in litigation).

diligently.[102] Second, they can refine the claim language. Better drafted claims may have greater scope, and they may better anticipate technological developments or invent-around possibilities. Also, carefully nested claims may be more resistant to invalidation, providing better odds that the relevant claim will survive invalidation of more general claims.[103] Third, they can put more effort into enabling research and drafting the written description. Finally, patent applicants can delay prosecution and observe activities of potential infringers and complementary developments in technology. This enables them to write claim language that literally "reads on" infringers' technology, including later-developed technology.

Possibly, prosecutors are best described as passive rather than strategic, i.e., their actions are dictated by the nature of the invention, the requirements of patent law, and the whims of the examiner.[104] The high level of refinement of litigated patents could be explained by technology—valuable inventions are more likely to be litigated, and they feature complex technology that requires extensive patent refinement. The trend toward increasingly complex patents could also be explained by increasingly complex technology or rigorous patent examination. For example, continuations are filed most often in the biotechnology and chemical fields.[105] Perhaps this occurs because patents in these fields tend to be complicated, or perhaps this occurs because these industries value patents more highly than other industries.

We conducted some exploratory regressions that suggest that the number of claims and the number of citations to patent prior art are both determined in part by characteristics of the applicant.[106] We find that citations and claims are positively correlated with the applicants' cash flow and capital intensity. We find that large firms, foreign firms, and firms with large patent portfolios refine less after controlling for other factors. These preliminary findings suggest that

---

[102] Allison & Lemley, *supra* note 2, at 231 (noting that amount of prior art cited is not correlated with validity); *id.* at 234 (noting that uncited prior art is more helpful than cited prior art in invalidating a patent); *id.* at 227–28 (observing that courts rarely disaggregate claims and there might not be much value at trial to owning a patent with elaborately nested claims); *id.* at 230–31 (noting that one is unable to establish significant relationship between number of backward citations and finding of validity); *id.* at 239 (finding no significant relationship between validity and time in prosecution or time between issuance and the final determination of validity); *id.* at 232–34 (citing evidence that non-cited prior art is more likely to be used to invalidate a patent on novelty or obviousness grounds). This evidence does not make a very strong case that including more backward cites causes the patent to be stronger. Instead, it suggests that when a bad prior art search leads to sloppy claim drafting patentees get surprised at trial. Further, some patentees perhaps hope the prior art the PTO did not find will not be found by the defendant.

[103] It is not clear that a more refined patent should have more claims.

[104] Douglas Lichtman, *Rethinking Prosecution History Estoppel,* 71 U. CHI. L. REV. 151, 155 (2004) (presenting empirical evidence that examiners vary widely in terms of the changes in claim language in patents they examine).

[105] Lemley & Moore, *supra* note 87, at 85–86.

[106] The data set is described in Bessen & Meurer, *supra* note 44. The regression results are available from the authors.

market factors, as well as legal and technical factors, determine effort to refine patents.[107]

B. Reforms to Improve Patent Office Performance

Popular and academic commentators have proposed a variety of Patent Office reforms in the wake of complaints about the low quality of patent examination. Mark Lemley observed that agency resources for patent examination are limited, the average patent gets only 18 hours of review, and thus, examination offers little more than a quick look at most patents.[108] Severe limits on Patent Office resources, combined with recognition that most patents turn out to have no economic value, push commentators to recommend that the Patent Office prioritize patent applications and spend more effort reviewing patents that are most likely to be valuable.[109]

Empirical research suggests that information useful for prioritization may come from three sources: characteristics of litigated patents; characteristics of patents that are renewed; and other empirical research on sources of the patent premium. Research on litigation and renewal offers a fairly consistent view about the characteristics of important patents. Patent renewal and litigation are both positively correlated with the number of claims, the amount of prior art cited, the number of patent applications that share a common ancestor, and the number of citations subsequently received.[110] Stock market, survey, litigation and renewal research all suggest that patents are especially important in certain industries.

---

[107] Further evidence comes from studies that show litigation is more likely to occur when patents are young, and patented technology is old. Allison et al., *supra* note 41, at 445; *id.* at 462 n.114 ("Prior studies of patent litigation show that it takes over twelve years on average from the time a patent application is filed to the time litigation is completed."); Allison & Lemley, *supra* note 2, at 237 ("[I]t appears that most patents litigated to judgment involve fairly old technology."). These findings are consistent with the view that certain patents are cultivated in the Patent Office by applicants who are preparing for patent litigation.

[108] *See* Mark A. Lemley, *Rational Ignorance at the Patent Office,* 95 NW. U. L. REV. 1495, 1500 (2001).

[109] Robert P. Merges, *As Many As Six Impossible Patents Before Breakfast*, 14 BERKELEY TECH. L.J. 577, 597 (1999); Allison et al., *supra* note 41, at 463 (arguing that if the patent value theory is correct, the PTO is devoting its resources in the right manner by disproportionately spending its time examining the most valuable patents).

[110] Allison et. al., *supra* note 41, at 449; *id.* at 451 (noting that litigated patents include significantly more claims than issued patents); *id.* at 453 (noting that litigated patents also cite significantly more prior art than issued patents, and that patents that end up being litigated are much more likely to be cited as prior art by other issued U.S. patents than are non-litigated patents); Lanjouw & Schankerman, *supra* note 11, at 45 (2004); Jean O. Lanjouw & Mark Schankerman, *Characteristics of Patent Litigation: A Window on Competition,* 32 RAND J. ECON. 129, 140 (2001); MOORE, *supra* note 6, at 15, tbl. 1 (2004) (noting expired patents had fewer claims, cited fewer U.S. patents, received fewer cites (most dramatic 7.13 vs. 4.73), listed fewer inventors (2.14 vs. 1.96), and had fewer related applications).

Examination reform might follow the example set by the "second pair of eyes" policy recently implemented by the PTO to improve the quality of business method patents. The PTO devotes extra examination effort to patent applications assigned to Class 705, a class with many business method patents relating to data processing. For example, the PTO might devote extra examination effort to patent applications that contain a large number of claims, a large number of citations, or come from a large family of co-pending applications. Of course, examination priorities cannot be based on number of citations received. Instead, it might be possible to enact a "mid-life" review of highly cited patents, for example, by giving the competition authorities (FTC, Antitrust Division of DOJ) or the PTO the authority and resources to review and modify patents that are too broad or too narrow. Finally, reform might target patents in certain industries or technologies for more intense scrutiny, as exemplified by the "second pair of eyes" policy.

Although prioritizing examination seems attractive, the proposals listed above face two serious problems. The first and simplest is evasion. Allison and Hunter find patent applicants have had significant success evading the "second pair of eyes" review by writing patent applications in a way that avoids Class 705.[111] Similarly, applicants may alter their prosecution strategies to avoid the other reforms mentioned above. For example, review triggered by the number of claims might induce applicants to file for more patents containing fewer claims.

Second, the statistics mentioned above all correlate with private patent value, but maximizing social value is the appropriate goal for patent reform. Thus, we must consider whether private patent value is likely to correlate with social value. Citations received indicate social value, assuming that the pioneer status of an invention explains why its patent is highly cited.[112] It is also possible that a patent receives a lot of citations simply because it is in a crowded art. Subsequent patents might cite earlier patents simply to distinguish them, and not because they build on them.[113] The link between number of

---

[111] *See* John Allison & Starling Hunter, *A Non-Solution to a Non-Problem* (2004) (working paper on file with authors, *available at* http://www.utexas/edu.depts/bbr/rnews/2004/allison/htm).

[112] We examined a list of 33 patents awarded after 1962 and listed in the National Inventors Hall of Fame. We compared their characteristics (number of citations made and received and number of claims) to the mean values of those characteristics for the grant year. We found that the famous patents receive significantly more citations, but they do not have significantly more claims and they make significantly fewer citations. The magnitude of the difference in citations received is not that large and was driven by a few patents like the PCR patent that got the lion's share of citations. Our result is consistent with Dietmar Harhoff et al., *Citation Frequency and the Value of Patented Inventions*, 81 REV. ECON. & STAT. 511, 515 (1999) (looking at a sample of "successful" German patents and finding they receive more citations, but not that much more); *see also* Allison et al., *supra* note 41, at 440 ("[O]ne reason that citations received . . . may correlate so highly with litigation is that such patents were early entrants in a field now crowded with competitors.").

[113] IAIN M. COCKBURN ET AL., ARE ALL PATENT EXAMINERS EQUAL? THE IMPACT OF CHARACTERISTICS ON PATENT STATISTICS AND LITIGATION OUTCOMES 2–3 (Nat'l Bureau of Econ. Research, Working Paper No. 8980, 2002), http://www.nber.org/papers/w8980 ("[A]

claims, number of prior art citations, and social value is also debatable.[114] Perhaps the strongest argument in favor of this approach is that litigation involves social costs that might be reduced if the patents most likely to be litigated are improved by more thorough examination.

V. THE SOCIAL COST OF PATENT LITIGATION

Parts III and IV discussed lessons from empirical research on patent litigation for patent law and regulation. Part V shifts attention to the social burden created by patent litigation. We put core patent policy goals aside and look instead at traditional questions from the economics of civil procedure, such as, how can we encourage settlement and minimize the expected social cost from patent litigation?

We start by examining trends in patent litigation. The rate of filing has doubled in the last 10 years.[115] Furthermore, Bessen and Meurer find that the annual patent litigation hazard for a publicly traded firm has grown from about 25% in 1987 to about 46% in 1999.[116] Assuming the average cost associated with a filing is constant over time, this trend indicates an increasing burden from litigation. If the average cost is also growing then the burden is even larger.[117] Stepping back, the social harm from this increased burden might be less troubling when we take into account the increased rate of patenting. In fact, Lanjouw and Schankerman argue that when we account for the increased propensity to patent in more litigious fields, the propensity to litigate on a per

---

significant portion of the overall variance among patents in measures such as the number and pattern of citations received, the number and pattern of citations made, and the approval time can be explained by the identity of the examiner."); *id.* at 3 ("[T]here is a significant positive relationship between the citations received by a subsequently litigated patent and the 'propensity' of its examiner to issue patents that attract a large number[] of citations."); *id.* ("Although the outcome of a test of validity by the CAFC is unrelated to the number of citations received by that particular patent, validity is strongly related to the portion of the citation rate explained by the examiner's idiosyncratic propensity to issue patents which receive a high level of citations. To the extent that the examiner-specific citation rate reflects the 'generosity' of examiners in allowing claims, our empirical findings suggest that one of the roles of the CAFC is to review the discretion exercised in the patent examination process.").

[114] We discovered that the famous patents have significantly fewer prior art citations. For a similar finding, see Allison et al., *supra* note 41, at 452. ("[T]he number of claims bears no necessary relation to the breadth of a patent. Indeed, if anything the relationship should be inverse—the closer the patent is to the prior art, and therefore the narrower it is, the more claims a patentee may draft in order to help preserve the patent's validity.").

[115] Lanjouw & Schankerman, *supra* note 11, at 46 (noting that the number of patent suits in the last two decades rose almost tenfold).

[116] Bessen & Meurer, *supra* note 44, at 18.

[117] We do not have a good measure of patent litigation costs. Ideally, we would like to know the sum of payments to law firms, the opportunity costs associated with the effort devoted to litigation by managers and in-house attorneys, and costs from delay and uncertainty created by litigation.

patent basis is essentially constant.[118] But patent enforcement costs are only part of the story. It is possible that increasing litigation imposes an increasing burden on innovators who cannot avoid the growing maze of patents and ambitions of patent owners. Bessen and Meurer find that the ratio of the hazard of being an alleged infringer to real R&D expenditures rose 61% from 1987 to 1999 among public companies.[119] Regardless of whether the social burden from patent litigation is growing, commentators agree that it is large compared to other types of civil litigation.[120]

The Federal Circuit has been active in reforming patent trial procedures, but there is not much evidence that it has improved the efficiency of patent trials. The court has been criticized for creating uncertainty about claim interpretation[121] and for failing to create national uniformity in patent trials. Kimberly Moore shows that forum shopping continues to be a significant problem in patent litigation.[122] The advantages of choosing the best forum put pressure on the parties to file a lawsuit; the patent holder might fear an alleged infringer will gain a forum selection[123] advantage by filing a declaratory

---

[118] Lanjouw & Schankerman, *supra* note 11, at 46 (noting that increase is mostly explained by the increase in the number of patents issued, and a shift of patents to technology fields that are more litigious).

[119] Ziedonis finds that litigation per dollar spent on R&D has increased in the semiconductor industry. Ziedonis, *supra* note 47, at 816.

[120] Studies of patent litigation estimate that plaintiffs plus defendants lose 2–3% of their market value upon announcement of patent lawsuit filing. *See* Lerner, *supra* note 71; Sanjai Bhagat et al., *The Costs of Inefficient Bargaining and Financial Distress: Evidence from Corporate Lawsuits*, 35 J. FIN. ECON. 221, 223 (1994).

[121] Christian A. Chu, *Empirical Analysis of the Federal Circuit's Claim Construction Trends,* 16 BERKELEY TECH. L.J. 1075, 1104 (2001) ("Of the 179 cases that involved an express review of claim construction, the Federal Circuit modified claim interpretations in 78 cases, or 44% of the total, during the twenty-eight months covered by this study. Further, 53 out of these 78 cases (68%) were reversed on the basis of claim construction. In sum, the Federal Circuit reversed 29.6% of cases involving an express review of claim construction."); Moore, *Patent Cases*, *supra* note 4, at 2–3 ("In the absence of a route for expedited appeal of claim construction, district courts are forced to proceed with lengthy and expensive patent litigation based on their frequently erroneous claim construction."); *see* Peter Siegelman & Joel Waldfogel, *Toward a Taxonomy of Disputes: New Evidence Through the Prism of the Priest/Klein Model*, 18 J. LEGAL STUD. 101, 126 (1999) (finding uncertainty lowest in IP suits).

[122] Kimberly A. Moore, *Forum Shopping in Patent Cases: Does Geographic Choice Affect Innovation?*, 79 N.C. L. REV. 889, 892 (2001) ("The empirical results presented in this Article demonstrate that despite the creation of the Federal Circuit, choice of forum continues to play a critical role in the outcome of patent litigation.").

[123] *See id.* at 920 ("In cases in which the defendant was able to choose the forum (as with declaratory judgment actions) rather than the patent holder (as in infringement suits), there was a significant difference in outcome: the defendant is much more likely to win when it selects the forum."); Moore, *Black Box, supra* note 7, at 368 ("Juries are significantly pro-patentee in suits for infringement (68% patentee win rate). But when a possible infringer initiates a declaratory judgment action, the patentee only has a 38% win rate. If the same were true of judges, then one could attribute the difference in win rate to the strength of the cases—namely, that alleged infringers only bring declaratory judgment suits when they have strong cases. But patentee win rates are substantially uniform in bench trials, regardless of who initiated the suit."); Kimberly A. Moore, *Jury Demands: Who's Asking?*,

judgment suit.[124] Besides pushing the patent holder to file earlier than it would have otherwise, the threat of a declaratory judgment suit may chill settlement negotiations in advance of filing suit.[125]

The Federal Circuit's treatment of the role of the jury in patent trials has achieved mixed results. On one hand, the power of the jury has been reduced by the decision to make claim construction a question of law.[126] But on the other hand, the frequency of jury trials has soared.[127] This is problematic because jury trials are more expensive and take longer than bench trials.[128] And patent juries display a pronounced bias in favor of inventors[129] and against foreigners.[130] The Seventh Amendment jury trial right prevents the United States from mimicking the rest of the world and abolishing jury trials in patent cases. Therefore, further progress mitigating problems with jury trials will be difficult.

VI. CONCLUSION

Empirical research reveals the patent system has widely varying effects across different industries. It provides critical incentives for research and

---

17 BERKELEY TECH. L.J. 847, 859–60 (2002) [hereinafter Moore, *Jury Demands*] ("Figure 4 shows that the patent holder's jury demand rate rose to 76% after isolating those cases in which the patent holder initiated suit. By contrast, when the patent holder is the defendant (i.e., when the accused infringer initiates the lawsuit by filing a declaratory judgment action), the patent holder demanded a jury in 53% of the cases.").

[124] *See* Moore, *Black Box, supra* note 7, at 381 (noting that 14% of patent trials are declaratory judgments).

[125] The reasonable apprehension of suit is a precondition to a declaratory judgment. *See* Shell Oil Co. v. Amoco Corp., 970 F.2d 885, 887 (Fed. Cir. 1992).

[126] *See* Markman v. Westview Instruments, Inc., 517 U.S. 370 (1996).

[127] Allison & Lemley, *supra* note 2, at 211 (noting that in 1978 only 8.3% of patent trials were tried to a jury, but by 1994, jury trials accounted for 70% of all patent trials); *id*. at 213 (noting that juries more likely to hold a patent valid than judges); Moore, *Black Box*, *supra* note 7, at 366 (finding that jury trials in patent cases have risen from 2.6% in 1970 to 62% in 1999).

[128] *See* Moore, *Jury Demands, supra* note 123, at 857.

[129] *See* Moore, *Black Box, supra* note 7, at 368 ("For example, juries are significantly more likely to find patents valid, infringed, and willfully infringed than judges."); *id.* at 386 ("When the jury is the adjudicator, the patent holder prevails in 63% of all claims and 68% of all suits. When the judge is the adjudicator, the patent holder succeeds in 49% of all claims and 51% of all suits.").

[130] Kimberly A. Moore, *Xenophobia in American Courts*, 97 NW. U. L. REV. 1497, 1504 (2003) ("Domestic parties win 64% of cases tried to juries in which the adversary is foreign; foreign parties win the remaining 36% of such cases. However, there is no significant difference in win rates for foreign and domestic parties when judges adjudicate."); *see id.* at 1504–05 ("Although foreign inventors acquire 45% of patent rights annually, they seek to enforce their patent rights in only 13% of the litigated cases."); MOORE, *supra* note 6, at 14–15, tbl.1, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=566941 (showing no difference in foreign inventor vs. American inventor maintenance); *id.* at 19–20, tbl.2 (noting that U.S. corporations are slightly more likely to renew than foreign corporations, but that foreign corporations are more likely to maintain than U.S. corporations).

development in the pharmaceutical and a few other industries. In most industries, it provides a relatively small incentive. Ideally, patent policy should be tailored to reflect these industry differences.[131] Patent law should be mindful of the various sources of patent-based profit. Certain strategic uses of patents are socially harmful; more empirical research is needed to quantify the social loss from anti-competitive and opportunistic patent litigation, and guide policies that will discourage anti-social litigation. Finally, more research is needed to identify when patent disputes will degenerate into lawsuits. This research is needed to guide reforms designed to contain the apparently high and growing social cost from patent litigation.

[131] For a thoughtful discussion of industry-specific patent policy, see Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575 (2003).