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The Direct Costs from NPE Disputes

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ESSAY

THE DIRECT COSTS FROM NPE DISPUTES

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In the past, "non-practicing entities" (NPEs), popularly known as "patent trolls," have helped small inventors profit from their inventions. Is this true today or, given the unprecedented levels of NPE litigation, do NPEs reduce innovation incentives? Using a survey of defendants and a database of litigation, this paper estimates the direct costs to defendants arising from NPE patent assertions. We estimate that firms accrued $29 billion of direct costs in 2011. Although large firms accrued over half of the direct costs, most of the defendants were small or medium-sized firms. Moreover, an examination of publicly listed NPEs indicates that little of the direct costs represents a transfer to small inventors.

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†† Abraham and Lillian Benton Scholar and Professor of Law, Boston University School of Law. We thank David Anderson and the staff at RPX for invaluable assistance. We thank Brian Love, Michael Risch, and Catherine Tucker for helpful comments, and Cong Yao, supported by funds from the Coalition for Patent Fairness, for able research. Finally, we thank the Ewing Marion Kauffman Foundation for research support.

Introduction

Over the past decade, the American patent system has experienced an explosion of patent litigation initiated by parties called "Non-practicing Entities" (NPEs).[1] The term "non-practicing entity" identifies parties who own and sometimes assert patents but do not practice the technology covered by their patents.[2] Commentators agree that there has been an explosion of NPE patent litigation and that NPE lawsuits differ in important ways from other patent lawsuits,[3] but they disagree in their normative assessments of this phenomenon.[4] We believe that this explosion is troubling, and herein we present evidence that NPE litigation imposes substantial direct costs on high-tech innovators with little apparent offsetting benefit to inventors or innovators[5] from assertion of NPE patents.

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1 James Bessen, Jennifer Ford & Michael J. Meurer, *The Private and Social Costs of Patent Trolls*, Regulation, Winter 2011–12, at 26, 26, *available at* http://www.cato.org/sites/cato.org/files/serials/files/regulation/2012/5/v34n4-1.pdf; *Litigations over Time*, PatentFreedom, https://www.patentfreedom.com/about-npes/litigations/ (last updated Aug. 6, 2013).

2 *See* Bessen et al., *supra* note 1, at 26. The "troll" label is applied to NPEs that behave opportunistically or cause social harm. *Id. But see* Highland Plastics, Inc. v. Sorensen Research & Dev. Trust, CV 11-02246 SJO, slip op. at 3 (C.D. Cal. Aug. 17, 2011), *available at* http://www.iplawalert.com/uploads/file/Highland%20Plastics%20v%20Sorensen%20Rsrch.pdf (denying motion to strike "patent troll" from the complaint because it "is a term commonly used and understood in patent litigation and is not so pejorative as to make its use improper"). Colleen Chien coined the term "Patent Assertion Entities" (PAEs) to specifically identify NPEs who assert patents rather than play some other intermediary role in the market for patent rights or the market for technology. Colleen Chien, Assistant Professor, Santa Clara Univ., Presentation to the FTC/DOJ Hearing on Patent Assertion Entities: Patent Assertion Entities (Dec. 10, 2012), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2187314.

3 John R. Allison, Mark A. Lemley & Joshua Walker, *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U. Pa. L. Rev. 1, 12–20 (2009) [hereinafter Allison et al., *Extreme Value*]; John R. Allison, Mark A. Lemley & Joshua Walker, *Patent Quality and Settlement Among Repeat Patent Litigants*, 99 Geo. L.J. 677, 686–89 (2011) [hereinafter Allison et al., *Repeat Patent Litigants*]; Bessen et al., *supra* note 1, at 29.

4 *Compare* Bessen et al., *supra* note 1, at 31 (finding that NPE lawsuits caused half a trillion dollars in lost wealth from 1990 through October 2010 and that this loss of wealth has reduced incentives to innovate), *with* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 114 Colum. L. Rev. (forthcoming 2014) (manuscript at 4), *available at* http://ssrn.com/abstract=2269087 (arguing that practicing-entity patent lawsuits are often a greater policy concern than NPE patent lawsuits).

5 We use the term "inventor" to refer to the creator of a new technical idea that may be eligible for patent protection. We use the term "innovator" to refer to a party who develops technical ideas into new technology with commercial value.

In this Essay, we present results from a unique survey of firms targeted by NPE patent assertions.[6] We augment the survey results with information derived from a comprehensive database of NPE litigation and information derived from publicly traded NPEs' financial disclosures. We find that: (1) the estimated direct, accrued costs of NPE patent assertions totaled $29 billion in 2011; (2) much of this burden falls on small and medium-sized companies; (3) publicly traded NPEs likely cost small and medium-sized firms more money than these NPEs transfer to inventors; and (4) the distribution of costs imposed by NPEs is highly skewed, probably because NPEs pursue a range of different business strategies.

The survey we will describe is unique in three ways. First, it includes defendant companies that are privately held, including small firms. Second, it reveals information about costs associated with cases in which NPE patents are asserted but that are resolved before a lawsuit is filed. Finally, it provides aggregated information about NPE patent license fees. These kinds of information have not been available in part because the terms of patent licenses are often secret,[7] and in part because previous surveys have simply not asked about assertions that did not advance to the filing of lawsuits. The costs disclosed by this survey are significant and should play a prominent role in policy debates about the treatment of NPE patent lawsuits.

Our survey results are largely consistent with the only other study of NPE-litigation costs, a study we completed recently with coauthor Jennifer Ford.[8] In contrast to the $29 billion annual-cost figure estimated in this Essay, we previously estimated the annual cost of NPE litigation to publicly traded American firms to be about $80 billion.[9] The previous analysis used a slightly different data set, a very different empirical approach, and a different concept of "cost." Rather than surveying defendants and asking them to report costs, we observed the stock market reaction to the filing of an NPE lawsuit against a defendant firm.[10] We estimated litigation cost by analyzing stock-price movements associated with lawsuit filings.[11]

We are not surprised that the survey generated lower costs than the stock market event study because the survey measures only direct

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6 The survey was conducted by RPX, a firm that helps companies manage risk from exposure to patent litigation. The Coalition for Patent Fairness paid RPX to defray part of the expense of conducting this survey.

7 *See* Mark A. Lemley & Nathan Myhrvold, *How to Make a Patent Market*, 36 HOFSTRA L. REV. 257, 257 (2007) (noting that even if a patent or "ones like it have been licensed dozens of times before, the terms of those licenses, including the price itself, will almost invariably be confidential").

8 Bessen et al., *supra* note 1.

9 *Id.* at 31.

10 *See id.* at 28–31.

11 *See id.* at 28–29.

costs from NPE patent assertions while the earlier study measured total costs.[12] Direct costs include the cost of outside legal services, licensing fees, and other costs incurred in response to NPE-litigation risk. Indirect costs captured by our event-study methodology include the opportunity costs of the effort exerted by legal, managerial, engineering, and scientific personnel inside the firm, and other business disruption costs such as loss of goodwill, loss of market share, and disruption of innovative activities.

This new study also complements our earlier study by providing information on companies that are not publicly listed, including small companies. This information helps reveal the extent to which NPEs help small and medium-sized firms realize profits from their innovations and the extent to which small and medium-sized firms, to the contrary, incur costs as the targets of NPEs.

NPEs are individuals and firms who own patents but do not directly use their patented technology to produce goods or services, instead asserting their patents against companies that do produce goods and services.[13] In the past, some NPEs have played a valuable role in bringing innovations from small inventors to market.[14] Some inventors lack the resources and expertise needed to successfully license their technologies or, if necessary, to enforce their patents.[15] NPEs provide a way for these inventors to earn rents that they might not otherwise realize, thus providing them with greater incentives to innovate.[16] But in the past, also, some NPEs have used patents opportunistically. For example, during the late nineteenth century, "patent sharks" were widely seen as extracting money from innocent individual farmers and railroad companies.[17]

However, while NPEs have been around for a long time, over the last few years, NPE litigation has reached a wholly unprecedented

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12 *See id.*

13 *Id.* at 28.

14 *See* James F. McDonough III, Comment, *The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy*, 56 EMORY L.J. 189, 190 (2006); Sannu K. Shrestha, Note, *Trolls or Market-Makers? An Empirical Analysis of Nonpracticing Entities*, 110 COLUM. L. REV. 114, 115–16 (2010).

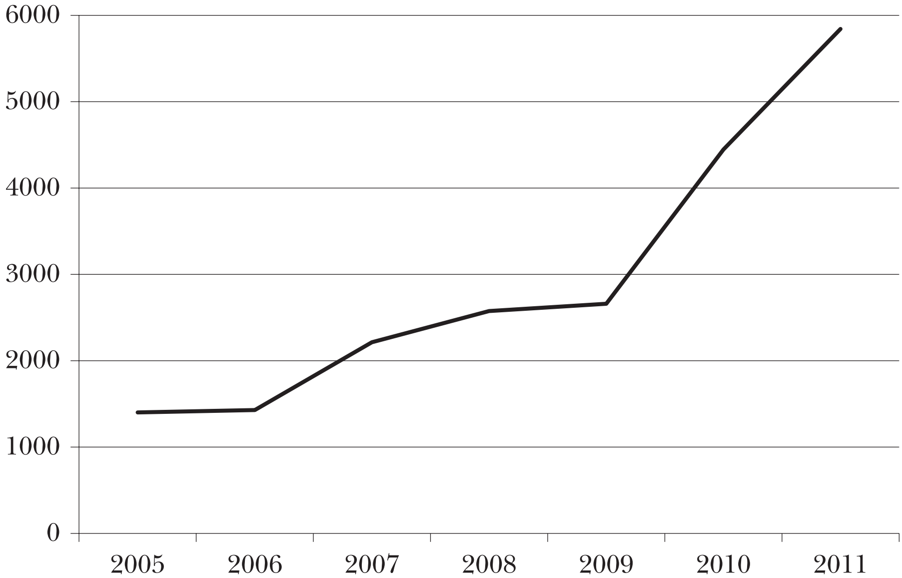
15 McDonough, *supra* note 14, at 210 ("Individual inventors and small entities rarely have the financial resources to commence and sustain a lawsuit. . . . [The] relatively high cost has the effect of inhibiting the abilities of individual inventors and small entities to enforce their patents against large corporations.").

16 *See* Ashish Arora, *Patents, Licensing, and Market Structure in the Chemical Industry*, 26 RES. POL'Y 391, 395–97 (1997). *See generally* Naomi R. Lamoreaux & Kenneth L. Sokoloff, *Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries*, *in* LEARNING BY DOING IN MARKETS, FIRMS, AND COUNTRIES 19, 31–40 (Naomi R. Lamroeaux, Daniel M.G. Raff & Peter Temin eds., 1999) (discussing the relationships between inventors and the firms to which inventors assigned their patent rights).

17 Gerard N. Magliocca, *Blackberries and Barnyards: Patent Trolls and the Perils of Innovation*, 82 NOTRE DAME L. REV. 1809, 1829, 1833 (2007).

scale and scope.[18] In 2011, 2150 unique companies were forced to mount 5842 defenses in lawsuits initiated by NPEs.[19] Moreover, the number of defenses has been growing rapidly, as seen in Figure 1. Part of this growth has been fueled by new sources of funding and new business models.[20]

FIGURE 1. NUMBER OF DEFENDANTS IN NPE LAWSUITS



Source: RPX database

I
LITERATURE REVIEW

Large-scale NPE patent litigation is a recent development, so the empirical literature is limited, but it is growing rapidly. Our NPE-lawsuit event study is the most closely related piece of earlier research; in it we found that the annual wealth lost from NPE lawsuits was about

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18 *See Litigations over Time*, PATENTFREEDOM, https://www.patentfreedom.com/about-npes/litigations/ (last updated Aug. 6, 2013); *NPE Impact*, RPX, http://www.rpxcorp.com/index.cfm?pageid=45 (last visited Oct. 15, 2013).

19 These figures come from the RPX database described below. About 4% of these defenses were mounted as declaratory actions rather than infringement suits; these were nevertheless initiated by the NPEs. The figure for 2011 reflects, to some extent, an effort by NPEs to initiate litigation before the America Invents Act took effect and restricted multiparty lawsuits. Nevertheless, the trend shown in Figure 1 illustrates rapid growth before 2011.

20 *See* EXEC. OFFICE OF THE PRESIDENT, PATENT ASSERTION AND U.S. INNOVATION 5–6 (2013), *available at* http://www.whitehouse.gov/sites/default/files/docs/patent_report.pdf; Andrei Hagiu & David B. Yoffie, *The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-Aggregators*, 27 J. ECON. PERSP. 45, 51–52 (2013).

$80 billion for publicly traded U.S. firms.[21] In theory, this cost could be composed mostly of transfers in the form of royalty payments to NPEs. Indeed, a number of papers argue that NPEs play a socially valuable role by enabling small inventors to realize greater profits from their inventions.[22] These papers, however, do not provide empirical evidence to support that assertion.

Our 2011 paper rejected that possibility based on the evidence available to us; we concluded that much of the cost borne by technology companies as they defend against NPE lawsuits is a social loss and not a mere transfer.[23] The survey results we describe below provide strong additional support for our view that much of the cost imposed on defendants is a social loss. In particular, the current study finds that NPEs impose costs not only on large technology companies but also on many small and medium-sized firms, making it even less likely that innovative start-ups are net beneficiaries of NPE activity.

One other researcher has quantified the costs to defendants from NPE litigation. Catherine Tucker examines the effect of a lawsuit by an NPE (Acacia) against several firms that make medical-imaging software.[24] She compares the impact of the lawsuit on sales of both medical-imaging and text-based medical software produced by the targeted firms.[25] She also compares the sales by the targeted firms to the sales of medical-imaging software made by other firms in the industry who were not targeted with a lawsuit.[26] She finds that sales of medical-imaging software declined by one-third for targeted firms.[27] She attributes the sales decline to a "lack of incremental innovation in

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21 Bessen et al., *supra* note 1, at 31.

22 *See generally* Spencer Hosie, *Patent Trolls and the New Tort Reform: A Practitioner's Perspective*, 4 I/S: J.L. & POL'Y FOR INFO. SOC'Y 1, 13 (2008) (arguing that the negative perception of patent trolls does not reflect their true nature and that patent reform will stunt technological innovation); McDonough, *supra* note 14, at 208–11 (arguing that having the resources to provide a credible threat of litigation will maximize the earning potential of the patent for the small inventor); Marc Morgan, Comment, *Stop Looking Under the Bridge for Imaginary Creatures: A Comment Examining Who Really Deserves the Title* Patent Troll, 17 FED. CIR. B.J. 165, 172–76 (2008) (arguing that certain patent trolls act as market intermediaries for small inventors and prevent big corporations from bullying these small inventors); Nathan Myhrvold, *The Big Idea: Funding Eureka!*, HARV. BUS. REV., March 2010, at 40, 47 (arguing that NPEs provide options for monetizing patents that create a more efficient market); Shrestha, *supra* note 14, at 126–30 (arguing that an NPE's capital and resources provide negotiating power for small inventors to enable better prices for their inventions).

23 Bessen et al., *supra* note 1, at 31–32.

24 Catherine Tucker, Patent Trolls and Technology Diffusion (Mar. 26, 2013) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1976593.

25 *See id.* at 10–16.

26 *See id.*

27 *Id.* at 19 ("The magnitudes of the estimates suggests [sic] roughly a drop of one-third of sales after litigation commenced.").

the period when litigation is ongoing,"[28] and she conjectures that incremental innovation was deterred by concerns that it would create additional risks in the ongoing litigation.[29]

Two other strands of previous research are especially relevant to this project. First, earlier work has quantified legal fees associated with patent litigation. We collected data about legal fees that were made public in court decisions concerning fee shifting in patent cases.[30] Also, the American Intellectual Property Law Association (AIPLA) conducts a biannual survey of its members and includes questions about fees in patent lawsuits.[31] The sources are helpful and we report some of their findings below, but they do not contain information about NPE litigation in particular, and they do not contain information about assertions that never reach the filing of a lawsuit.

A better-developed strand of literature reports various characteristics of NPE litigation.[32] While not measuring costs, these studies do shed light on the question of whether the private losses to firms targeted by NPE patent assertions also tend to be social losses. The answer appears to be "yes." NPE patent litigation has all the hallmarks of patent notice failure that distorts the patent system and makes it impede technological progress.[33] In *Patent Failure*, we show that the U.S. patent system works well for chemical and pharmaceutical inventions because the system provides clear notice to the world of the scope and existence of patent-based property rights.[34] For most other

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[28] *Id.* at 5.

[29] *Id.* at 26.

[30] *See* James Bessen & Michael J. Meurer, *The Private Costs of Patent Litigation*, 9 J.L. ECON. & POL'Y 59, 80–81 (2012).

[31] *See, e.g.*, AM. INTELLECTUAL PROP. LAW ASS'N, REPORT OF THE ECONOMIC SURVEY 2011 (2011).

[32] This includes Allison et al., *Repeat Patent Litigants*, *supra* note 3; Colleen V. Chien, *Of Trolls, Davids, Goliaths, and Kings: Narratives and Evidence in the Litigation of High-Tech Patents*, 87 N.C. L. REV. 1571 (2009) (noting that while NPEs are not responsible for the majority of high-tech patent suits, NPEs typically sue multiple defendants, thus increasing their overall impact); Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls Without Harming Innovators?*, 161 U. PA. L. REV. 1309 (2013) (noting, among other things, that the majority of litigation towards the end of a patent's term is dominated by NPEs); Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457 (2012) (dispelling myths surrounding the ten most litigious NPEs); David L. Schwartz, *The Rise of Contingent Fee Representation in Patent Litigation*, 64 ALA. L. REV. 335 (2012) (explaining why there has been a rise in contingent-fee representation in patent litigation); and Tucker, *supra* note 24. Other studies have looked at the characteristics of NPE patents asserted in lawsuits, including Allison et al., *Extreme Value*, *supra* note 3; Timo Fischer & Joachim Henkel, *Patent Trolls on Markets for Technology: An Empirical Analysis of NPEs' Patent Acquisitions*, 41 RES. POL'Y 1519 (2012); and Shrestha, *supra* note 14.

[33] *See* EXEC. OFFICE OF THE PRESIDENT, *supra* note 20, at 8; BRIAN T. YEH, CONG. RESEARCH SERV., R42668, AN OVERVIEW OF THE "PATENT TROLLS" DEBATE 9 (2013); Bessen et al., *supra* note 1, at 34.

[34] JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 15–19 (2008).

inventions, especially software and business methods, notice failure means that innovative firms are targeted in patent infringement suits through no fault of their own.[35]

Notice failure is likely for NPE lawsuits. Sixty-two percent of the time, they feature software patents,[36] which are notoriously difficult to interpret. John R. Allison, Allison, Mark A. Lemley, and Joshua Walker study patents litigated multiple times and usually asserted by NPEs; they find that software patents account for 72% of such lawsuits.[37] The patents asserted in NPE lawsuits are often subject to lengthy prosecutions, which delay public access to information about patent claims.[38] Rather than transferring technology and aiding R&D, it appears that NPEs usually arrive on the scene after the targeted innovator has already commercialized some new technology.[39]

II
Data

A. Survey

Between February and April 2012, RPX invited about 250 companies to participate in a survey of their NPE-related costs. The pool of invitees included RPX clients and nonclient companies with whom RPX has relationships. Most invitees were technology companies, but certain nontechnology companies with NPE exposure were also invited (for example, retailers with e-commerce exposure). Participants provided information to the extent that doing so was consistent with their obligations to third parties. The information was aggregated and rendered anonymous such that individual data was not disclosed.[40]

Participants filled out a standardized Excel template that included a range of questions about their NPE-related costs. The instructions for the template asked that participants include certain statistics estimating all of their direct (external spend) NPE-related costs from 2005 to 2011. An NPE was defined to include patent assertion entities (PAEs) and other parties using the same definition as the NPE Lawsuit Database (discussed below). A list of each participant's NPE litigations from that database was provided to ensure alignment between the survey response and database. Templates were submitted

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35 *Id.* at 191–203.

36 Bessen et al., *supra* note 1, at 29.

37 Allison et al., *Extreme Value*, *supra* note 3, at 18.

38 *See id.* at 12–16; Love, *supra* note 32, at 21; Risch, *supra* note 32, at 490–91.

39 *See* Fed. Trade Comm'n, The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition 75–80 (2011).

40 Although RPX provided data for this study, RPX did not exercise control over the substance of our text.

by e-mail or directly into a secure online data room. To the extent possible, an RPX study team reviewed the submission for quality and completeness. If needed, the company was asked certain follow-up questions. Finally, RPX aggregated the submitted data within a secure computing environment. The resulting data set forms the basis of the data tables provided in this document.

Of the 250 companies invited to participate, 82 provided data on lawsuits, and of these, 46 also provided data on nonlitigation patent assertions and related costs.

B. NPE Lawsuit Database

In addition to the survey, we also used a comprehensive database of NPE litigation developed by RPX. These NPE-litigation statistics are based on cases coded "830 Patent" in the PACER database, which is maintained by the Administrative Office of the U.S. Courts.[41] In case counts, RPX excludes misfiles, nonpatent, false marking and other non-core patent infringement cases. When a case is transferred, RPX counts it as one case and allocates it to the venue to which it was transferred. When several cases are consolidated into one, RPX counts it as one case but with multiple defendants. When a case is severed, RPX counts it as separate cases. In defendant counts, RPX rolls up operating-company subsidiaries into a parent entity (e.g., Samsung Group and Samsung Electronics count as one defendant).[42]

RPX defines NPEs to include patent assertion entities, individual inventors, universities, and noncompeting entities (operating companies asserting patents well outside the area in which they make products and compete). RPX identifies NPEs through a manual review process. In this review process, RPX reads patent complaints found in PACER and checks information in the complaint against its NPE database. RPX also checks its database of plaintiff counsel, searches public filings, and performs web research. Some of the factors that they consider when determining whether a company is an NPE (or more specifically a PAE) include: Is the entity the same as or does it share a substantial financial link with a known PAE? Is there any evidence that the company sells a product or offers a service? Does the entity webpage prominently mention technology, licensing, and patents? Does the entity webpage offer any product or sales? Does the complaint indicate whether the entity has a product in market or in development that is being harmed by infringement? Are the lawyers

41 This database does not include patent disputes before the International Trade Commission.

42 Declaratory actions are included in case counts unless otherwise noted.

involved known to specialize in representing NPEs? Is this entity known as an NPE or as an established operating company?[43]

This definition of NPE is broader than some other definitions. There is no consensus among researchers on the proper definition of NPE.[44] Schwartz and Kesan have criticized our reliance on a broad definition because it reaches plaintiffs like universities who are more meritorious in some sense.[45] They argue that because the database includes lawsuits filed by universities and other supposedly meritorious plaintiffs, it overstates the costs generated by "bad" trolls.[46] It is surely difficult to attempt to distinguish "good" NPEs from "bad" ones—some people argue that universities sometimes are bad players who occasionally abuse overly broad patents.[47] But the difficulty of divining the true nature of NPEs does little to distort our conclusions for two reasons.

First, relatively little of the patent litigation we study comes from universities—only about 1% of the NPE lawsuits.[48] Instead, the lawsuits in the RPX database were overwhelmingly filed by "patent assertion entities."[49] In fact, the RPX database closely matches other efforts to categorize litigants. The lawsuit counts are very similar to those compiled by Patent Freedom.[50] Also, Colleen Chien checked the RPX database against her own categorization of 1000 lawsuits and found little difference.[51] So our definition of NPE is hardly "unconventional," as Schwartz and Kesan claim.[52] Moreover, changes to our database, such as excluding universities, are likely to have only a small impact on our aggregate estimate of direct costs.

Second, although universities perform research that is extremely valuable to society and although most university licensing is done in a socially efficient manner, universities create social costs when they en-

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43 There are a range of views among scholars and policymakers about the appropriate definition of NPE, and different analysts are likely to assemble different NPE-litigation databases. Based on our experience researching patent litigation, we believe that the RPX database yields statistics that are consistent with information about NPE patent litigation from other sources.

44 *See* David L. Schwartz & Jay P. Kesan, *Analyzing the Role of Non-Practicing Entities in the Patent System*, 99 CORNELL L. REV. 425, 429–30 (2014) (explaining the disagreement among researchers on whether individual inventors and universities should be considered NPEs).

45 *Id.* at 440–42.

46 *Id.*

47 *See* Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 619 (2008) ("The result is a felt sense among a lot of people that universities are not good actors in the patent system.").

48 Colleen Chien, *Patent Trolls by the Numbers*, PATENTLY-O (Mar. 14, 2013, 6:31 AM), http://www.patentlyo.com/patent/2013/03/chien-patent-trolls.html.

49 *Id.*

50 *See id.* (noting that RPX reported 2921 PAE lawsuits while Patent Freedom reported 2923 NPE lawsuits).

51 *Id.*

52 Schwartz & Kesan, *supra* note 44, at 440–41.

gage in patent litigation, especially against defendants who have inadvertently infringed. The problem of cost that we identify is not based on the identities, motives, or other activities of the NPEs but instead simply on the excessive litigation the NPEs create. From this perspective, we are no less sanguine about excessive litigation among practicing companies, a point we highlight in our book, *Patent Failure*.[53] And so our estimate of $29 billion implies socially wasteful litigation-related expenditures and reduced innovation incentives even if it includes university litigation. We discuss this topic more in Part V.C.

C. Sample Characteristics

Table 1 compares characteristics of the survey sample with RPX's database of NPE-lawsuit defenses. Data for the survey are on the left, while data for the entire database of NPE-lawsuit defenses are on the right. The 82 surveyed companies collectively mounted 1184 defenses in NPE lawsuits beginning between 2005 and 2011. Of these, 784, or 66%, ended in adjudication or settlement and did not involve indemnification or other factors that cause costs to be atypical.

TABLE 1. SUMMARY STATISTICS OF SAMPLE

	Sample				All NPE lawsuits			
	Companies	Lawsuit Defenses	Lawsuits/ Company	Mean Revenue ($million)	Companies	Lawsuit Defenses	Lawsuits/ Company	Mean Revenue ($million)
Number	82	1,184	14.4	$12,474.7	9,385	20,565	2.2	$3,243.3
Resolved Lawsuits		784				15,486		
Percent Resolved		66%				75%		
Company Size	Share	Share			Share	Share		
Small/Medium	44%	13%	2.7	$297.1	90%	59%	1.4	$82.6
Large	56%	88%	14.9	$22,005.0	10%	41%	9.0	$16,666.4
Company Industry								
Software	37%	26%	6.7	$7,103.1	22%	31%	3.1	$3,654.8
Hardware	63%	74%	11.2	$15,573.7	78%	69%	1.9	$3,087.2
Public company	72%				14%			

Notes: For 2005–2011. The left panel describes the sample used for this study. The right panel reports summary statistics from RPX's database of all NPE lawsuits. In the sample, all companies reported revenue. In the RPX database, only 74% of companies have reported revenue; we assume that companies without reported revenue are small or medium-sized. The resolved lawsuits have been terminated due to settlement or adjudication. The number of resolved suits excludes those that were simple transfers, had zero litigation costs (e.g., for incorrect defendants), where the company was substantially indemnified, or where the costs borne by the company do not reflect the total direct costs of litigation for other reasons. Revenues are for the most recent year. Small and medium-sized companies are those with revenues of less than or equal to $1 billion; large companies are those whose revenues exceed this amount. Companies identified as "software" include companies whose main product is software, e-commerce, finance, or undefined. "Hardware" includes everything else.

Note that a possible truncation bias arises because so many lawsuits were unresolved at the time of the survey. Because lengthier dis-

53 *See* BESSEN & MEURER, *supra* note 34, at 120–46 (noting a patent litigation "explosion" in recent years and discussing the possible reasons for such litigation (internal quotation marks omitted)).

putes tend to be more costly, at least with respect to legal costs, and because the number of lawsuit filings has risen sharply in recent years, cost estimates based only on resolved lawsuits might be understated.[54]

We divided the companies into subcategories based on their revenue in the most recent year reported (small and medium-sized at under $1 billion or large at over $1 billion) and whether they were in the broad software industry (including e-commerce and finance) or instead in a hardware industry (everything else).[55] The latter distinction might be significant because most hardware industries involve greater sunk capital costs than do software industries or finance, and for this reason hardware industries may be more at risk of holdup.[56]

The right panel shows that small and medium-sized firms dominate the universe of NPE-lawsuit defendants. Small and medium-sized companies make up 90% of the defendant firms, mounting 59% of the defenses. Firms making less than $100 million in revenue account for 82% of the defendants and 50% of the defenses.[57]

As the Table shows, our survey sample consists of companies that are larger, are more likely to be public, and experience relatively more lawsuits than the average NPE-lawsuit defendant firm. In the rows that control for size and industry sector, survey firms appear to experience about twice as many lawsuits as do companies in the comprehensive database. This is not surprising; however, it raises the possibility that our sample might be unrepresentative of the broader population, possibly experiencing costs that are greater or smaller than those of the universe of all sued companies. Below, we do some tests to see whether the survey appears to have unrepresentative costs.[58]

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54 *See* Jay P. Kesan & Gwendolyn G. Ball, *How Are Patent Cases Resolved? An Empirical Examination of the Adjudication and Settlement of Patent Disputes*, 84 WASH. U. L. REV. 237, 243–45, 257–58 (2006).

55 To preserve data confidentiality, statistical analysis was performed by RPX personnel working under our direction.

56 Readers should be mindful of the distinction between the industry of the defendant and the technology covered by the patent asserted by the NPE. In particular, it is important to recognize that problematic software patents are often asserted against hardware manufacturers.

57 This estimate assumes that firms with unreported revenue have revenues of less than $100 million.

58 *See infra* Part III.B.

III
Findings

A. Mean and Median Costs

Table 2 provides estimates of mean legal costs,[59] licensing costs, and total costs (the sum of these) with standard errors in parentheses. The last column also shows median total costs.

Table 2. Mean Litigation Costs per Defense in Millions of Dollars

	Direct Legal Costs		Licensing Costs		Total Cost	
	Mean	Median	Mean	Median	Mean	Median
All	1.38 (0.26)	0.20	6.53 (1.76)	0.22	7.91 (1.86)	0.56
Company Size						
Small/Medium	0.42 (0.12)	0.07	1.33 (0.42)	0.18	1.75 (0.49)	0.32
Large	1.52 (0.30)	0.23	7.27 (2.01)	0.23	8.79 (2.13)	0.65
Industry						
Software	1.50 (0.41)	0.17	1.82 (0.45)	0.30	3.32 (0.81)	0.55
Hardware	1.33 (0.33)	0.21	8.14 (2.35)	0.18	9.48 (2.48)	0.59

Addendum on Legal Costs

AIPLA Survey (2011)	
Cost Through Discovery	0.49 – 3.60
Cost Through Trial	0.92 – 6.00
Fee-Shift Cases (Bessen and Meurer 2012)	
Summary Judgments	0.84
Trial	3.64

Note: Standard errors in parentheses. The total number of cases is 666; subcategory shares are listed in Table 1. Fee-shift data have been deflated to 2011 dollars.

Median total costs per litigation defense fall roughly around half a million dollars, with the figure smaller for small and medium-sized firms and larger for big ones. However, mean total costs are *much* higher, nearly $8 million for our survey sample. This difference implies that the distribution of costs is highly skewed, which we explore below.[60] Thus, one must be particularly careful in extending judgments about the costs of litigation based on small samples. While "typical" costs might only be a few hundred thousand dollars, mean

59 In the survey, estimated legal costs for a particular case were specified as: Value of any legal costs related to this matter through December 31, 2011. Include outside counsel (lead and local), experts, discovery costs, prior art searching, jury consultants, graphics, other expenses, and other related costs. Include any costs that were ultimately recouped or expected to be recouped by indemnification agreements or other mechanisms. Exclude in-house legal costs.

60 *See infra* Part III.C.

costs—reflecting the large costs in a small number of very costly lawsuits—are an order of magnitude higher.

Mean total costs are, not surprisingly, significantly greater for large companies than for small and medium-sized companies. This difference is significant at the 1% level.

The first column reports the legal component of costs. Mean legal costs per defense range from $420,000 for small and medium-sized companies to $1.52 million for large companies.

Column 2 of Table 2 reports the dollar amounts paid to the plaintiff to settle the case (characterized as a licensing cost).[61] Column 3 reports the total costs, the sum of legal and settlement costs. The mean settlement costs for small and medium-sized companies are $1.33 million and for large companies are $7.27 million. Mean total litigation costs are $1.75 million for small and medium-sized companies and $8.79 million for large companies.

Legal costs are about a third as large as settlement costs or about one-quarter of total litigation costs (and slightly larger for small and medium-sized companies).[62] This implies that a substantial part of the direct costs of NPE litigation is a deadweight loss to society.[63]

Also note that NPE litigation is relatively more costly to smaller companies. In our sample, the large companies' litigation costs were five times as high as small and medium-sized companies' litigation costs. But, as demonstrated in Table 1, the mean revenue of large companies in our sample is nearly seven times the mean revenue of the small and medium-sized companies. This means that, roughly speaking, smaller companies pay more in direct NPE-litigation costs relative to their size.

Hardware firms have higher costs than software firms. This difference is significant at the 5% level. Since hardware firms generally have greater sunk costs than software firms, this difference is consistent with the interpretation that hardware firms are more easily subject to holdup and hence have to pay more to settle litigation.

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61 In the survey, estimated settlement costs for a particular case were specified as: "Value of settlement. If a running royalty, estimate the present value of royalties. If there was an exchange of patents or other non-standard deal structure then estimate expected present value cost of that deal." Settlement costs include damages awards in a small number of cases.

62 Weighting the ratios in Table 2 to represent the relative weights of small and large companies in the total database, legal costs are 23% of the total and licensing costs are 77%.

63 The indirect costs of NPE lawsuits, such as those measured by Bessen et al., *supra* note 1, at 31–33, and Tucker, *supra* note 24, at 28–29, are likely to be a more significant source of deadweight loss.

B. Comparison to Other Studies

As noted above, the survey sample was not randomly selected and hence could be unrepresentative. In particular, it might be that survey respondents tended to be firms with higher-than-average litigation costs.

We can check the representativeness of our sample by comparing our findings to other empirical evidence. First, we compare our survey results to two different measures of patent litigation costs; then we compare our measures of NPE assertion costs to data on NPE licensing revenue. AIPLA conducts a biannual survey of its members, who estimate their typical legal costs through discovery and through trial.[64] They report these estimates for three categories of patent lawsuits depending on the amount at issue in the controversy—specifically, there is a separate category for whether the amount at issue is less than $1 million, between $1 million and $25 million, or greater than $25 million.[65] The first and third categories provide the ranges shown in the addendum to Table 2.[66] Few patent lawsuits, including NPE lawsuits, go to trial,[67] so the figure for costs through discovery is more comparable to our survey results. The AIPLA cost estimates are comparable or even higher than the mean direct legal costs estimates from our survey.[68]

This crude comparison can be refined in two ways. First, we make an adjustment to the AIPLA figures to account for the fact that most patent lawsuits terminate before discovery is complete. We made this adjustment in previous work[69] and derived an estimate of expected patent-litigation costs from the AIPLA survey responses of $483,000.[70] This figure is about one-third of the mean direct legal cost in our survey, but notice that it is very close to the median total

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64 *See* AM. INTELLECTUAL PROP. LAW ASS'N, *supra* note 31, at 1.

65 *Id.* at 35.

66 For the middle range, the estimated costs are $1.6 million through discovery and $2.8 through trial.

67 *See* Kesan & Ball, *supra* note 54, at 259 ("We . . . find that approximately 80% of patent cases settle.").

68 *See infra* Table 2 (reporting the survey's finding of $420,000 to $1.52 million in direct legal costs and AIPLA's finding of $490,000 to $3.6 million in costs through discovery).

69 We are grateful to David Schwartz and Jay Kesan for observing that we failed to make this adjustment in our initial, working-paper version. We developed the adjustment used here in Bessen & Meurer, *supra* note 30, at 82.

70 Bessen & Meurer, *supra* note 30, at 82. We explained:

> The expected legal cost associated with filing a patent lawsuit depends on the frequency of each of the different ways a lawsuit may be terminated. Kesan and Ball analyze patent lawsuit termination data available from the Administrative Office of the Federal Judiciary. After examining 5,207 lawsuits filed in 1995, 1997, and 2000, they found that most cases terminate short of trial, summary judgment, or through other substantive court rulings.

direct cost of $560,000 reported in Table 2. This median number includes *settlement payments* as well as direct legal costs. The median direct legal costs are merely $200,000, which is lower than the adjusted legal-cost figure from the AIPLA survey. This brings us to an important question of interpretation—do AIPLA survey respondents report means or medians? We cannot tell from the survey question, but we suspect that respondents interpret "typical costs" as median costs.

We also compared the survey means to mean legal fees from patent cases in the years from 1985 to 2004 in which a patent owner was required to pay the defendant's legal fees.[71] Converted into 2011 dollars, the cost for lawsuits that ended in summary judgments was $840,000; the cost for those that ended in a trial verdict was $3.64 million. Making the same adjustment as above to account for early termination of cases yields an expected mean cost of $409,000. This mean is lower than the mean from our survey sample but not surprisingly different given the escalation in patent-litigation costs because of the growth in electronic discovery in the past decade.

It is possible, of course, that our survey might report representative legal costs but unrepresentative licensing costs. This might happen, for instance, if our survey overrepresented hardware companies,

> In particular, 4.6% of lawsuits reached trial, 8.5% of lawsuits terminated with a summary judgment, dismissal with prejudice, or confirmation of an arbitration decision, and the remaining 86.9% of cases terminated earlier in the process.
>
> Kesan and Ball constructed . . . two proxies for legal fees in patent lawsuits: number of days until the suit terminates, and number of documents filed. Their data showed that suits that go to trial last about 1.5 times [as many days] as suits that end with a summary judgment, and suits that end with a summary judgment last about 1.5 times [as many days] as all other suits. Further, their data showed that suits that go to trial generate about 2.5 times as many documents as suits that end with a summary judgment, and suits that end with a summary judgment generate about 2.5 times as many documents as all other suits. Assuming that the expected legal cost in a suit that ends before summary judgment is one-half of the cost of a suit that reaches summary judgment, then the estimated amount for the alleged infringer is . . . $483,000.

Id. (footnotes omitted).

Schwartz and Kesan offer two interesting conjectures about the differences between NPE litigation and other patent litigation. First, "NPE cases are often filed in speedy venues" and thus are faster and cheaper than the patent suits studied by Kesan and Ball. Schwartz & Kesan, *supra* note 44, at 437. And second, because "[c]ompetitor litigation is more document intensive and is frequently litigated more heavily by both parties (e.g., due to the injunction risk)," they believe that NPE litigation must be less expensive than competitor litigation. *Id.* at 438 n.65. They conclude that the AIPLA survey costs are likely to be high compared to NPE litigation costs. *Id.* Their conjectures may be correct, but their conclusion does not necessarily follow. NPE-litigation costs may be higher on average than litigation costs in typical patent lawsuits because the stakes tend to be higher and because holdup problems are especially severe (since defendants are larger than in typical suits and more suits are concentrated in high-tech industries).

71 See Bessen & Meurer, *supra* note 30, at 80–81, for an explanation of how we compiled these cases and our accompanying table of results.

which tend to have relatively higher licensing costs. However, Table 1 suggests that the share of hardware firms in the survey roughly matches the share in the universe of NPE-lawsuit defendants found in the database. Based on our survey, firms with higher licensing costs tend to have higher legal costs, all else equal.[72] This is likely because firms facing a large payout can typically reduce the payout or the likelihood of having to pay damages in trial by mounting a more aggressive (and more expensive) legal defense.[73]

Our confidence in our licensing-cost results is strengthened by independent evidence we have developed on the licensing revenue earned by NPEs. We obtained licensing revenue from disclosures[74] by the 10 publicly listed firms that were predominantly in the patent-assertion business during the period from 2005 to 2010 (Acacia, Asure, Interdigital, Mosaid, Network-1, OPTi, Rambus, Tessera, Virnetx, and Wi-Lan). We matched these firms to the filed lawsuits listed in Patent Freedom's NPE-litigation database.[75] These companies filed lawsuits against 1,450 companies during this period, accounting for about one-sixth of all PAE lawsuits filed in the Patent Freedom database.

During the period from 2005 through 2010, licensing revenues totaled nearly $6 billion. The mean licensing revenue per lawsuit defense comes to $3.8 million in 2010 dollars. This figure is quite close to the estimates we obtained from the survey. Averaging the mean licensing cost for different firm sizes as given in Table 2, weighted by the proportion of small or medium-sized and large firms in the total sample (as done in Table 4), also gives a combined average of $3.8 million.[76] The estimate from the publicly listed PAE firms includes licensing revenues from nonlitigated patent assertions, while the estimate based on Table 2 does not. But the data from the publicly listed firms does not account for accruals—much of the licensing revenue from lawsuits filed in 2010 was collected not in 2010 but later. This means that the estimate from publicly listed PAE firms tends to be relatively understated. Taking both of these differences into account, the two estimates are broadly similar.

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72 *See infra* Table 2 (reporting higher licensing costs in addition to higher legal costs for large firms compared with the lower licensing costs and legal costs for small and medium-sized firms).

73 *See generally* Avery Katz, *Judicial Decisionmaking and Litigation Expenditure*, 8 INT'L REV. L. & ECON. 127, 137 (1988) (analyzing a model in which parties' probability of victory is a function of their legal expenditures).

74 We obtained licensing revenues from the firms' 10-K forms.

75 Patent Freedom is an independent company that collects data on PAEs and provides advice and risk assessment. For details on the database and the matching procedure, see Bessen et al., *supra* note 1, at 28.

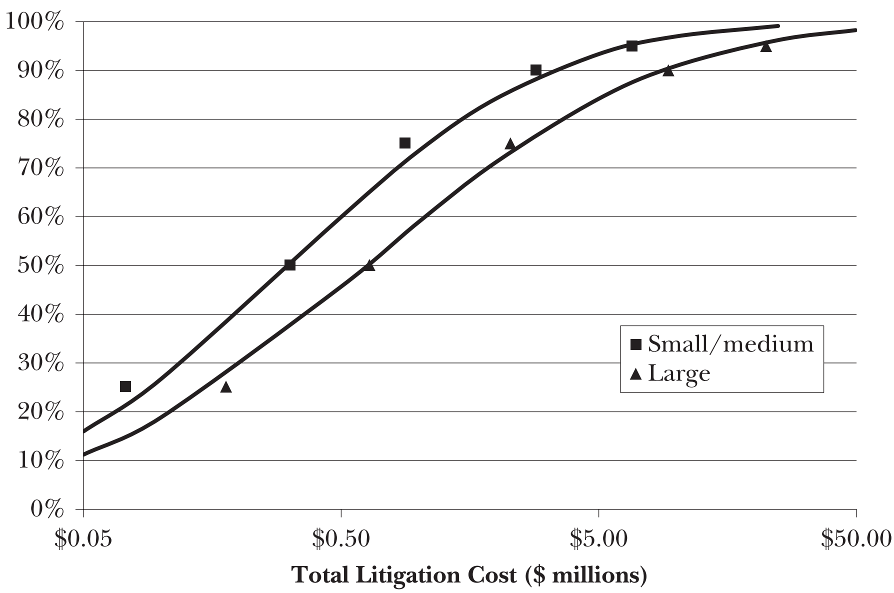
76 1.33 x 59% + 7.27 x 41% = 3.77. If instead we use the regression in the Appendix to predict litigation cost for the entire sample in the RPX database—this should better adjust for firm size differences—the weighted average cost comes to $3.2 million.

In summary, when we use data from a very different sample and use a very different methodology, we obtain results that are quite comparable. The close similarity of these means suggests that sample-selection issues do not substantially bias the survey findings. It is possible, of course, that *both* samples could be biased the same amount for different reasons, but that seems unlikely.

C. The Distribution of Litigation Costs

Sample means do not capture the distribution of costs. In fact, litigation costs are highly heterogeneous. Figure 2 shows cumulative distribution plots of total litigation costs for the small and medium-sized companies and the large companies in our sample. The smooth curves represent lognormal distribution functions fitted to the data.

FIGURE 2. CUMULATIVE DISTRIBUTION OF TOTAL DIRECT LITIGATION COST BY COMPANY SIZE



Note: Horizontal axis is logarithmically scaled. Distributions are fit with lognormal cumulative distribution functions. The distributions are for resolved lawsuits.

As can be seen, the distribution is highly skewed. The median total litigation cost for small and medium-sized companies is $318,000 and for large companies is $646,000. A large fraction of lawsuits cost less than $200,000. But a small number of lawsuits cost much, much more. For large companies, 5% of the lawsuits cost more than $22 million.

This heterogeneity likely arises in part from variation in NPE tactics. Schwartz reports that some NPEs pursue nuisance suits in which they sue many companies, big and small.[77] Plaintiffs using this tactic are willing to settle for small payments, often no more than the amount a defendant would spend on legal fees to defend the case.[78] As one such plaintiff lawyer put it, "An NPE . . . intuitively understands that we could go for triples or home runs, but we can also go for singles and get a good return and work on other things."[79] Alternatively, NPEs may act like big-game hunters, targeting only one or a few firms but expecting to win at least several million dollars.[80] The lawsuit by NTP against BlackBerry-maker RIM is a good example.[81] There, "NTP asserted patents of doubtful validity but managed to win at trial and obtain a settlement of $612.5 million from RIM."[82] The survey data does not permit us to clearly identify NPE tactics, but it does suggest that NPE activity is not uniform.

While there are far fewer suits initiated by *big-game hunters*, they represent a disproportionate share of the cost. The distribution of costs is such that the top 5% of defenses for large companies account for about two-thirds of the total cost of defense for large companies.

D. Costs from Nonlitigated Patent Assertions

Many NPE patent assertions are settled without a lawsuit being filed.[83] To gather information on nonlitigated assertions, the survey also asked a series of questions regarding these costs. Rather than count assertions, the survey asked respondents to report cumulative costs. Most reported costs for the period from 2005 to 2011, but some did not have data for the entire period. Moreover, only 46 of the companies completed this section of the survey.

The costs of nonlitigated assertions include legal fees and settlement costs paid to patent holders. They also include smaller amounts spent on NPE-specific patent-buying programs (including RPX services), on NPE-specific clearance searches, and on reexaminations of NPE patents.

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77 *See* Schwartz, *supra* note 32, at 370 ("The patents are enforced against an entire industry, or alternatively against a slew of defendants in a single lawsuit.").

78 *See id.* at 370–71 (noting that some demands are as low as $5,000).

79 *Id.* at 371.

80 *See* Patrick Anderson, *Do NPE's "Cost" Us $29 B? Intellectual Ventures Co-Founder Peter Detkin Sets the Record Straight*, GAMETIME IP (June 28, 2012), http://gametimeip.com/2012/06/28/do-npes-cost-us-29-b-intellectual-ventures-co-founder-peter-detkin-sets-the-record-straight/ (discussing the settlement amount of $612.5 million obtained by NTP from RIM).

81 *See* BESSEN & MEURER, *supra* note 34, at 49–50 (illustrating the case as an example of a several-million-dollar settlement agreement).

82 Anderson, *supra* note 80 (internal quotation marks omitted).

83 *See* Fischer & Henkel, *supra* note 32, at 1 (noting that "NPE patent disputes are often settled out of court").

The means of these components are reported in Table 3 along with the cumulative litigation costs incurred by these same companies. For the sample as a whole, nonlitigation NPE-induced costs were about half of the comparable litigation costs. For small and medium-sized companies in particular, however, nonlitigation costs exceeded litigation costs.[84] This might be because smaller firms lack internal legal resources, making it relatively more expensive for them to pursue litigation. Also, nonlitigation costs were higher relative to litigation costs for hardware firms, perhaps again because hardware firms, being more at risk of holdup, find it less costly to settle sooner. Nonetheless, this difference is not statistically significant.

TABLE 3. NONLITIGATION COSTS PER COMPANY IN MILLIONS OF DOLLARS

	Mean Cost			TOTAL Nonlitigation Cost		Comparable Litigation Cost	
	Legal	Licensing	Other	Mean		Mean	
All	0.50	24.59	4.66	29.75	(13.89)	58.38	(19.18)
Company Size							
Small/Medium	0.05	7.85	0.23	8.14	(7.68)	7.06	(3.15)
Large	0.77	34.40	7.25	42.43	(21.22)	88.47	(28.95)
Industry							
Software	0.38	11.83	4.14	16.35	(9.14)	38.34	(20.74)
Hardware	0.56	30.76	4.91	36.24	(20.03)	68.08	(26.46)

Note: Standard errors in parentheses. Results are for a subsample of 46 companies that reported full litigation and nonlitigation costs. Figures are totals over 2005–2011 per company, although not all companies reported all years.

In any case, it is clear that nonlitigated patent assertions are responsible for much of the direct costs imposed by NPEs on operating companies. In this regard, it is likely that our sample underrepresents these costs because we have only surveyed companies that have been involved in litigation. That is, we have not included the potentially large number of small companies that have only settled NPE patent assertions and have not gone to court. Anecdotal evidence from small companies suggests that there might be very many such firms, and their costs are missing from our analysis.[85]

84 *See infra* Table 3. Colleen Chien surveyed 223 high-tech start-ups and found that "the likelihood that a company reported an actual litigation, rather than the threat of one, increased with revenue. Lawsuits represented only 31% of demands received by companies with under $10M in revenue, but 67% of demands received by companies with over $10M in revenue." Colleen Chien, *Startups and Patent Trolls*, 17 STAN. TECH. L. REV. (forthcoming 2014) (manuscript at 10 n.57), *available at* http://digitalcommons.law.scu.edu/facpubs/553.

85 *See* Chien, *supra* note 84 (manuscript at 2) (finding that 18% of small companies settled due to higher litigation costs); Robin Feldman, Patent Demands & Startup Companies: The View from the Venture Capital Community 35, 38 (Oct. 18, 2013) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2346338

IV
AGGREGATE COSTS OF NPE ASSERTIONS

A. Aggregation

What is the aggregate cost of NPE patent assertions, including both litigated and nonlitigated assertions? To estimate this, we began by estimating the mean cost of resolved litigation for small and medium-sized firms and for large firms. We could have directly used the data in Table 2, but this might overstate costs because the average small or medium-sized firm in our survey sample is larger than the average small or medium-sized firm in the entire database.[86] To correct for this within-category variation, we regressed log cost against log revenue for the survey sample and, using this, computed the predicted mean cost over the actual distribution in the database for each size category.[87] In using these means, we assume that the lawsuits in each category in the database will, on average, accrue costs equal to these respective mean values. That is, for lawsuits where a third party indemnified the defendant, we assume that some party will pay an amount equal to the mean cost for defendants in that category even if the defendant firm itself does not necessarily pay this amount. Also, we assume that lawsuits that are still underway will eventually accrue costs equal to these means even if the current out-of-pocket costs are not yet equal to this accrued cost.

To adjust these figures to account for nonlitigation assertions, for each category we divided the total nonlitigation cost by the total number of lawsuits filed, including lawsuits that were still active. This gave us a prorated nonlitigation cost per lawsuit filed. We added this to the mean litigation cost for each category to give a total cost of NPE assertions per lawsuit filed.[88]

The second part of this exercise consisted of breaking the cases in the RPX NPE database into the two size categories. Where revenue was reported (about 74% of the database), we allotted the defenses to small and large cells depending on whether the revenue was smaller

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(finding that over 30% of venture funded start-ups received patent demands, and that "monetizers" initiated most of these demands).

86 *See infra* Table 1. In fact, we calculated aggregate costs using the data in Table 2, including the software and hardware categories. These estimates came out about 5%–10% higher than those reported in Table 4.

87 Regressions are reported in the Appendix. We used a regression that also included a dummy variable for firms with less than $100 million in revenue in order to capture a nonlinearity in the relationship between log cost and log revenue. The predicted mean cost per litigation was $1.527 million for small and medium-sized firms and $5.641 million for large firms. We also ran regressions using hardware and software dummy variables, but the coefficients on these dummies were not statistically significant.

88 These are $3.17 million for small and medium-sized firms and $7.59 million for large firms.

than or larger than $1 billion.[89] We conservatively assigned those companies without reported revenue to the "small" cells.

B. Year-by-Year Accrued Costs

The left portion of Table 4 presents the number of defenses reported in the NPE database by year for each size category. The right portion shows the aggregate cost of NPE assertions per year, which we calculated by multiplying the number of defenses reported on the left by the prorated total cost of defense per cell (where the cost of defense includes licensing costs). The final column reports the aggregate cost, summing over both categories for each year. Aggregate direct costs of NPE patent assertions grew rapidly from about $7 billion in 2005 to $29 billion in 2011.[90]

TABLE 4. AGGREGATE ACCRUED DIRECT COSTS OF NPES BY YEAR

	Number of Defenses		Aggregate Direct Accrued Costs (millions)		
Year	Small/Medium	Large	Small/Medium	Large	TOTAL
2005	919	482	$2,916	$3,657	$6,574
2006	899	530	$2,853	$4,021	$6,874
2007	1,238	976	$3,929	$7,406	$11,334
2008	1,571	1,004	$4,985	$7,618	$12,603
2009	1,461	1,198	$4,636	$9,090	$13,726
2010	2,588	1,857	$8,213	$14,090	$22,303
2011	3,424	2,418	$10,866	$18,347	$29,213
Size shares	59%	41%	37%	63%	

Note: Aggregate costs are calculated by the method described in the text. Aggregate costs include legal costs, settlement costs, and other costs for resolved lawsuits, unresolved lawsuits, and nonlitigated assertions. These report accrued costs—that is, we include the full projected cost of currently unresolved lawsuits.

It is important to note that these totals represent *accrued* costs, not necessarily the immediate out-of-pocket cost. That is, we accrue the projected cost of a lawsuit in the year in which the suit was filed even though the lawsuit might not be resolved. This is important because about half of the lawsuits filed in 2011 were not resolved at the time of our survey. The implication is that substantial sums will be flowing to NPEs over the next several years from lawsuits already filed. Because the number of NPE lawsuits has been growing so rapidly, the

89 RPX gathered revenue data from the financial statements of publicly listed firms as well as estimates based on information such as number of employees available for private firms. Revenues were not reported when a private firm could not be definitely identified in their data sources.

90 As a point of comparison, Polinksy and Shavell calculate that "the litigation costs associated with the U.S. tort system are approximately $46 billion per year." A. Mitchell Polinsky & Steven Shavell, Costly Litigation and Optimal Damages 2 (Jan. 24, 2012) (unpublished manuscript), *available at* http://ssrn.com/abstract=1990786.

current revenues of NPEs likely understate the total costs of lawsuits already filed.[91]

Moreover, the effect of these assertions does not just fall on a small number of large companies. Some NPE advocates have argued that NPE litigation is largely a matter of lawsuits against a small number of large "serial infringers."[92] To the contrary, these data show that about 59% of the litigation events are directed to small and medium-sized companies and about 37% of the aggregate cost falls on small and medium-sized companies. Moreover, this share is likely understated because, as discussed above, this analysis does not include those companies that have only faced NPE assertions that did not go to court.

Finally, these tabulations do not include the indirect effects of NPE assertions on defendants' businesses. Case-study evidence suggests there are significant indirect costs of NPE patent assertions.[93] These include diversion of management or engineering resources, delays in new product introductions and improvements, loss or delay of revenue, and credit constraints. Bessen, Ford, and Meurer estimate the total business costs of NPE litigation for public firms using stock market event studies.[94] Although the samples and methods are not directly comparable, they find an aggregate loss of stock market capitalization of around $80 billion per year during recent years, corresponding to an aggregate cost in operational funds to the firms of about half that amount.[95] This suggests loosely that total business costs of NPE assertions might be at least twice as large as the figures reported in Table 4.

C. Benefits to Innovators

It is sometimes argued that NPEs facilitate innovation by providing incentives to small inventors who would not otherwise be able to license their patents.[96] In this view, "NPEs create patent markets, and those markets enhance investment in start-up companies by providing

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91 We also caution readers not to rely on intuition based on the median cost of defending against NPE patent assertions. Median cases are "typical," but of course it would not be correct to multiply the median cost by the number of assertions to calculate aggregate costs numbers.

92 Patrick Anderson, *Did Serial Infringers Commission "Academic" Patent Study to Support Widespread Infringement?*, GAMETIME IP (Sept. 20, 2011), http://gametimeip.com/2011/09/20/did-serial-infringers-commission-academic-patent-study-to-support-widespread-infringement/.

93 *See* Tucker, *supra* note 24, at 26–28.

94 *See* Bessen et al., *supra* note 1, at 26, 28.

95 *See id.* at 26 (finding that the "defendants are mostly technology companies that invest heavily in R&D").

96 *See* McDonough, *supra* note 14, at 190; Risch, *supra* note 32, at 459; Shrestha, *supra* note 14, at 115–16.

additional liquidity options. NPEs help businesses crushed by larger competitors . . . who infringe valid patents with impunity."[97]

How much of the costs accrued by defendants actually flow to inventors? We can gain some indication of this by looking at the expenditures of publicly listed NPE firms. Examining the 10-K filings of these firms, we identified the licensing revenues that these firms received as well as the payments these firms made to inventors in the form of royalties (when the inventor kept title to the patent) and patent-acquisition payments (when the NPE bought the patent).[98] We also obtained the amount the NPE firm spent on its own R&D, which some of these firms perform in order to acquire more patents. Table 5 reports the mean annual payments for those years where we could identify both licensing revenues and payments to inventors.[99]

TABLE 5. ANNUAL PAYMENTS FROM DEFENDANTS TO NPEs AND INVENTORS

	Annual Expenditures ($2010 millions)		Share of Defendant Payments	
Payments from Defendants				
Licensing Revenues of NPEs	$1,161		77%	
Implied Defendant Legal Cost	$348		23%	
TOTAL Defendant Payments	$1,510		100%	
Payments for Invention				
Royalties + Patent Acquisition	$59		5%	
Small Inventors		$32		3%
Large Inventors		$27		2%
NPE Own R&D	$169		15%	
NPE Operating Costs	$818		47%	
NPE Net Income	$115		10%	
	$1,161			

The top panel of the table displays the out-of-pocket payments made by defendants. The licensing revenues are the mean settlement payments that these NPEs received per year, totaling just over $1 billion in 2010 dollars. Using the mean ratio of defendant legal costs to settlement costs from Table 2 (.3 to 1), the second row of Table 5

97 Risch, *supra* note 32, at 459 (footnote omitted).

98 *See infra* Table 5. In some cases we used patent-acquisition payments from the Cashflow Statement; in others, we used the amortization of patent assets from the Income Statement. The latter includes more than just payments to inventors, such as legal costs related to patent acquisitions.

99 The data include the following years for each company: Acacia, 2007–11; Asure, 2002–06; Interdigital, 2004–11; Network-1, 2003–11; OPTi, 2002–10; Rambus, 2003–11; Tessera, 2005–11; Virnetx, 2007–11; and Wi-Lan, 2006–11. Figures for Tessera only include the Intellectual Property business unit.

shows the imputed defendant legal cost, summing to a total annual cost to defendants of $1.5 billion from this group of NPEs.

The second panel shows the flows to inventors and to NPEs' R&D departments. Payments to independent inventors come to only 5% of the direct costs to defendants (and are only 7% of NPE licensing revenues). Note furthermore that this figure likely overstates the long-term flow of funds to inventors because it compares current licensing revenues to current patent-acquisition payments, but the patents acquired will likely accrue additional licensing revenues in the future.[100] If we include payments to the NPEs' own R&D departments, then, loosely, payments to inventors come up to 20% of defendants' costs. Finally, 47% of the direct costs to defendants are eaten up by NPE operating costs, and another 10% are NPE profits.

Based on these figures, it seems difficult to make a convincing argument that the effect of NPEs is to increase innovation incentives. First, previous research has shown that the defendants in these lawsuits are largely tech companies that invest heavily in R&D.[101] This estimate suggests that their losses are much larger than the possible flows to small inventors, especially if one adds indirect costs of NPE litigation to the direct costs reported in Table 5. Effectively, what defendants pay in costs as a result of NPE litigation reduces their own R&D budgets. Small inventors would have to be an order of magnitude more innovative per dollar of R&D than the defendant companies in order for the net effect on innovative activity to be positive.

Second, to the extent that small inventors are important for innovation, NPE patent assertions hinder innovation by hurting small inventors in at least two ways. As we have seen, the majority of defendants in NPE lawsuits are small and medium-sized companies, and these companies accrue larger costs relative to their size.[102] Risch finds that the median revenue of a company filing an NPE patent in his sample is $6.3 million.[103] Given that the median revenue of a company in the RPX database of firms sued by NPEs is $10.8 million, it appears that the typical firm sued by an NPE is roughly the same size as the typical firm benefiting from NPE activity. Also, these costs

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100 We also include licensing revenues from patents acquired in the past, but patent acquisitions have been increasing rapidly, so this is a much smaller effect.

101 *See* Bessen et al., *supra* note 1, at 26.

102 *See* Chien, *supra* note 84 (manuscript at 5–6) (illustrating the costs on small companies). "66% to 82% of unique defendants in NPE cases made less than $100M" per year. *Id.* (manuscript at 10). Their small size makes them more vulnerable and less able to absorb the impacts of demands: 40% of survey respondents reported that their company delayed hiring or achievement of another milestone, changed the product, pivoted their strategy, shut down a business line or the entire business, and/or lost valuation due to a patent demand. *See id.* (manuscript at 12). "The smaller the company, the less able it was to absorb the impact of a lawsuit without a significant impact . . . ." *Id.* (manuscript at 13).

103 Risch, *supra* note 32, at 488.

make things more difficult for small inventors who wish to license their technology—not just their patents—to other firms. If the prospective licensees expect NPE-related costs, they will be less willing to license from small inventors or will not be willing to pay as much.

Third, the incentives provided to patent holders by the current crop of NPEs may be the wrong kind of incentives. NPE activity may skew the research agenda of small firms away from disruptive technologies and toward mainstream technology and associated patents that can be asserted against big incumbents. Even worse, small firms are encouraged to divert investment from genuine invention toward simply obtaining broad and vague patents that might one day lead to a credible, if weak, lawsuit.[104]

The publicly listed NPEs are only a part of the population of NPEs, but they are an important part, accounting for about one-sixth of all NPE lawsuits.[105] It is possible that the private NPE firms might pay higher royalties to inventors or pay more to acquire patents. But there is no evidence of this, nor any evidence to support the common assertions from patent lawyers that NPEs help small inventors. The available evidence suggests instead that NPEs burden small firms.

V
Response to Critics

An earlier version of this Essay has attracted significant criticism. The most thoughtful commentary comes from David Schwartz and Jay Kesan whose work appears in the same issue of the *Cornell Law Review*.[106] In this Part, we address our critics, with special attention given to Schwartz and Kesan. For convenience, we have organized the critical comments into three main questions.

A. Have We Overstated the Direct Costs from NPE Disputes?

Given the explosion of NPE patent litigation, it is difficult to pin down precisely the direct costs to defendants, but we believe that the $29 billion annual figure derived above is a plausible estimate; the true number could be higher or lower. Before we take issue with the claims that our estimate is biased upward, we take a moment to review some findings that do not seem to be disputed.

We have not read anyone who seriously disputes that NPE patent litigation has exploded. Something important is happening. Over a

104 *See* Chien, *supra* note 84 (manuscript at 18) ("Among the 90 patentees [listed] on the 'Investor Testimonials,' 'Inventor Spotlight,' and 'Senior Spotlight,' sections of [two NPEs'] websites, based on our analysis, less than 15% appeared to be connected to still practicing companies not focused on patents." (footnotes omitted)).

105 Calculation by authors.

106 Schwartz & Kesan, *supra* note 44.

decade, the amount of NPE litigation has grown from less than 5% of all U.S. patent litigation to over 60%.[107] We have not read anyone who seriously disputes that NPEs have a bargaining advantage over practicing-entity patent plaintiffs because NPEs are invulnerable to patent counterclaims and have lower litigation costs, especially discovery costs.[108] We have not read anyone who seriously disputes that NPE litigation is concentrated in business method, software, and computer technologies, technologies for which many believe the U.S. patent system performed poorly even before the rise of NPE litigation.[109] These observations suggest that NPEs have rushed in to exploit failings in the patent system by displacing operating-company plaintiffs because the NPEs can more effectively extract payments from innovators who are targeted as defendants through no fault of their own. Thus, the case for new patent-policy reform was already made before this study.

Returning to the costs from NPE disputes, we first observe that the total costs to defendants may far exceed $29 billion once the indirect costs of NPE disputes are accounted for. Our event-study research indicated that the annual aggregate cost to defendants from NPE lawsuits is about $80 billion.[110] The survey that we describe in this Essay did not attempt to quantify the indirect business costs from NPE patent assertions because the lawyers who received the survey probably did not have good information on indirect costs.

The event-study methodology captures the reaction of stock market investors to the filing of an NPE lawsuit. Investors care about and have reason to learn about both direct and indirect costs borne by defendant firms because these costs are reflected in changes in share value.[111] Schwartz and Kesan criticize the event studies for two reasons. First, one professor has "harshly criticized" this methodology.[112] Second, they tell us that the estimates do not correspond with

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107 *See* Gwendolyn G. Ball & Jay P. Kesan, *Transaction Costs and Trolls: Strategic Behavior by Individual Inventors, Small Firms and Entrepreneurs in Patent Litigation* 15 (Univ. of Ill. Coll. of Law, Ill. Public Law & Legal Theory Papers Series No. 08-21, 2009), *available at* http://ssrn.com/abstract=1337166.

108 *See* Bessen et al., *supra* note 1, at 34.

109 *See id.* at 29, 34–35; Shawn P. Miller, *Where's the Innovation? An Analysis of the Quantity and Qualities of Anticipated and Obvious Patents*, 18 VA. J.L. & TECH. 5–6 (2013) ("[O]pportunistic litigation by licensing firms may disproportionally add to increased costs because the more uncertain scope of software and business methods makes these patents ideal tools to extract rents from independently inventing producers in 'hold up' litigation.").

110 Bessen et al., *supra* note 1, at 26.

111 *See id.* at 29–31.

112 Schwartz & Kesan, *supra* note 44, at 447 & n.12 (discussing Glynn S. Lunney, Jr., *On the Continuing Misuse of Event Studies: The Example of Bessen and Meurer*, 16 J. INTELL. PROP. L. 35 (2008)). Lunney is skeptical of the efficient market hypothesis that is central to financial economics. *See* Lunney, *supra*, at 53–54.

their personal experiences as patent attorneys.[113] Nevertheless, this methodology is widely accepted and has been used in over a thousand research studies.[114] And we suspect that our sample of 2,887 events for publicly listed firms is likely far more representative than the experience of a few attorneys who are unlikely to have direct knowledge of investor losses in any case.[115] Although the event study needs to be interpreted carefully, this sort of criticism does little to dispel the indication that the private costs of NPE disputes might well be higher than $29 billion.

Critics have identified two different types of biases that might cause our survey-based measures of direct costs to be overstated: misleading responses by respondents (or manipulation by RPX), and statistical bias attributable to the survey sample or the survey response pattern.[116] We do not take the first type of criticism seriously. This study provides the best-available survey data related to activities that are usually shrouded in secrecy. Ideally, the federal government will take steps to make patent settlement and licensing more transparent and make more empirical analysis of NPE patent litigation possible.[117] We cannot guarantee the honesty of survey respondents, but we assume for the most part they simply copied data from available business records for their survey responses. Why would a respondent be dishonest when there is so little to be gained from the distortion of a single survey response? And RPX has reputational concerns that lead us to believe that it was in its best interest to help us produce an honest report.[118] We have not received any compensation from RPX or

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113 Schwartz & Kesan, *supra* note 44, at 448.

114 Our search of scholarly papers in the SSRN archive, http://www.ssrn.com, found 2191 papers using the key words "event study."

115 Schwartz and Kesan also point out that the event studies are only for publicly listed firms. Schwartz & Kesan, *supra* note 44, at 447. That is correct; including private firms would make the aggregate cost even higher. They also criticize the study for not considering what happens after the lawsuit is filed. In fact, the paper does look for evidence of a bounce back by extending the event-study window, but finds, to the contrary, that losses deepen. And the paper discusses the literature that finds that stock market values are not restored when the lawsuits are settled.

116 *See id.* at 434–35, 446.

117 *See* Mark Bohannon, *The FTC Roadmap on Patent Litigation Aggressors*, OPENSOURCE.COM (July 1, 2013), http://opensource.com/law/13/7/ftc-patent-litigation-roadmap (describing possible FTC investigation of the activities of PAEs).

118 The GAO apparently trusted RPX data enough to use it to verify the accuracy of litigation data from Lex Machina, though the GAO indicated it was "not able to fully assess the reliability of the judgments RPX used in making [litigant] classifications." *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-13-465, INTELLECTUAL PROPERTY: ASSESSING FACTORS THAT AFFECT PATENT INFRINGEMENT LITIGATION COULD HELP IMPROVE PATENT QUALITY 5 n.14 (2013), *available at* http://www.gao.gov/assets/660/657103.pdf.

any other source to carry out this research.[119] This project fits nicely with our long-standing research interests.

Schwartz and Kesan have more plausible concerns about sample and response bias. They argue that our sample of firms (RPX clients or firms that have some relationship with RPX) has higher-than-average litigation costs and that, among this sample, the firms that are most likely to respond are the firms with the highest litigation cost.[120] Then they observe that if these biases are present, it is not appropriate to impute the mean costs derived from our survey to the entire population of NPE defendants.[121]

Out of concern about possible biases, Part III.B demonstrates the plausibility of our results by benchmarking the outside legal costs and licensing payments measured in this study against patent-litigation cost measures derived from other data sets using a variety of methods.[122] In particular, we use two different sources of data on patent litigation costs to confirm that the payments for patent defenses reported in the survey are plausible. Furthermore, we show that the license revenue per lawsuit derived by publicly traded NPEs corresponds closely to licensing payments reported in the survey.[123] Of course, critics may question whether publicly traded NPEs differ systematically from nonpublic NPEs in terms of their license revenue per lawsuit. Once again, the lack of transparency concerning patent licenses blocks us from further investigating this question.

Why doesn't the bias suggested by Schwartz and Kesan appear in our survey data? They have merely identified *possible* biases; they have not established that these are significant. Indeed, we provide estimates of the costs of litigation from three different sources (survey, publicly listed NPEs, and stock market event studies) and these are all more or less consistent once differences in the costs being measured are taken into account. It is possible, of course, that *all three* of these data sources represent biased samples, but that seems unlikely, and Schwartz and Kesan would need to come up with some explanation for why all three would have similar biases.

Moreover, there are a priori reasons to believe that the biases are not present or even push the data in the opposite direction. To understand the possible sample bias, one must understand why firms

119 We did receive funding for a summer research assistant from the Computer and Communications Industry Association, and we have a grant from the Kauffman Foundation that provides us general research support.

120 Schwartz & Kesan, *supra* note 44, at 434–35.

121 *Id.* at 436.

122 *See supra* text accompanying notes 64–71.

123 *See supra* text accompanying notes 74–76.

subscribe to the RPX service.[124] If the main effect of RPX membership is a fixed reduction in expected litigation cost per defense, then high-frequency defendants are more likely to select membership; however, there would be no relationship between membership and expected cost per suit and thus no sample bias. It is even possible that certain firms who face NPE suits at a high frequency have a relatively high aggregate, expected NPE-lawsuit defense cost and *lower*-than-average defense costs per suit.[125] This could happen if experience with NPE suits makes defendants more efficient—perhaps because they have previously gathered relevant documents to meet discovery requests, trained personnel to handle depositions, developed litigation strategies, or the like.[126] Schwartz and Kesan's discussion of response bias also confounds litigation frequency with cost per defense. They speculate that respondent firms likely had "easier access to the information."[127] Perhaps this is true (we have no way to know), but this seems to be an attribute associated with frequency of litigation and not with magnitude of defense costs. Finally, they suggest various reasons why large firms are overrepresented in our sample and contend that this may distort our results.[128] We are careful to note that large firms do indeed face higher costs (and small firms face higher costs relative to their revenue), but we account for this difference in the extrapolation that yields our aggregate-cost figure.

In the two years since we first published our event study, no one has come forward with actual empirical evidence to suggest our estimates are substantially biased. Certainly, more data and better research could generate lower estimates, but Schwartz and Kesan simply have no empirical basis for their conclusion that the $29 billion estimate is "substantially overstated."[129]

B. Is $29 Billion in Direct Costs Really a Problem?

Yes, a $29 billion tax on innovation is a problem that keeps us up at night. Not much of this payment goes to inventors or innovators; rather, most of the payment is dissipated by transfers to the NPEs'

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124 Firms select RPX service if the subscription fee is less than the expected litigation savings. RPX seeks to reduce expected litigation costs by acquiring patents, by facilitating syndicate patent purchases by members, by providing litigation intelligence, and recently by offering insurance. *Reducing Patent Risk*, RPX, http://www.rpxcorp.com/rpx-services (last visited Oct. 17, 2013).

125 As Schwartz and Kesan suggest, other assumptions are consistent with RPX membership being positively correlated with high costs per defense. Schwartz & Kesan, *supra* note 44, at 435.

126 One additional point: because the RPX subscription fee rises with firm size, it is not clear that only large firms with high litigation exposure select membership.

127 Schwartz & Kesan, *supra* note 44, at 435.

128 *Id.* at 435–36.

129 *Id.* at 455.

owners, investors, and personnel, and to the lawyers representing both the NPEs and the defendants.[130] Most importantly, the direct costs from NPE disputes are borne by firms because they chose to innovate and thereby exposed themselves to the largely unavoidable risk of an NPE lawsuit.[131] Unfortunately, this tax on innovation for defendant firms is not counterbalanced by significant transfers from NPEs to other inventors or innovators.[132] Hence, patent assertion by NPEs constitutes a tax on innovation.

Schwartz and Kesan assert, to the contrary, that most of what defendants pay is merely a transfer to "meritorious" patent owners.[133] They note that defendants' payments to outside counsel are less than one-quarter of the total direct cost.[134] But that is not quite right: they forget that NPEs also spend on legal fees and other operating costs. As we see from Table 5, for publicly traded NPEs, about 70% of the payments that defendants make go to the legal costs of both parties or to the operating costs of the NPEs.[135] We see no evidence that private NPEs are any more efficient at transferring wealth to worthy inventors.

Schwartz and Kesan counter that the data in Table 5 are unrepresentative because they come from a small number of NPE firms and because that sample includes three firms that conduct substantial R&D in-house (Interdigital, Tessera and Rambus).[136] The NPEs in that sample account for about one-sixth of all of the lawsuit defenses in the total database, so while the sample is hardly a small one, it might be unrepresentative. However, there is no reason to conclude that it necessarily is unrepresentative, and, in fact, several of the large, private NPEs are also known to conduct their own R&D.[137] Nevertheless, this table sharply contradicts the common rhetoric about the benefits of NPEs: most of the money that defendants pay does not represent a transfer to inventors; instead, it is largely consumed by legal and operating costs. If we exclude the three R&D-performing firms, then 78% of the cost is consumed by these costs while 21% flows to inventors. The evidence, although limited, suggests that NPEs are hardly a socially efficient way of funding inventors.

Schwartz and Kesan also fail to consider the dynamic effect on innovation incentives caused by the costs arising from inadvertent in-

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130 *See* Bessen et al., *supra* note 1, at 33.

131 *See id.*

132 *See id.*

133 *See* Schwartz & Kesan, *supra* note 44, at 438–39.

134 *Id.*

135 Depending on how one counts profits, only a couple percent flows to NPEs' profits.

136 Schwartz & Kesan, *supra* note 44, at 443–45.

137 *See, e.g.*, *Intellectual Ventures Laboratory*, INTELL. VENTURES, http://www.intellectualventures.com/index.php/inventions-patents/iv-lab (last visited Oct. 17, 2013) ("Intellectual Ventures Laboratory's mission is to conduct advanced research on some of IV's most promising inventions.")

fringement. They fundamentally misapprehend the patent-policy framework we developed in *Patent Failure* and apply in this Essay. In *Patent Failure*, we measured the aggregate benefits that large American firms derived from their patents and the costs they incurred because of the assertions of other parties' patents.[138] We studied the period from 1984 to 1999, a time before NPE litigation was significant, and we found that for most technologies and most industries, the U.S. patent system imposed a net tax on innovation.[139] We attribute this failure to the deterioration of the notice function of the patent system.[140] Especially for business methods and software, the patent system provides innovators who might be targeted with a patent suit with little information about the existence, ownership, or scope of relevant patent rights.[141] The patent tax that we identified in our book arises because of legal costs, various indirect business costs, and transfers in the form of license and damages payments. Innovation is equally discouraged by the payment of legal costs and the payment of transfers.

What Schwartz and Kesan are really expressing is simply their hope that the license payments gained by NPEs provide a positive incentive for invention and innovation, and that this incentive more than offsets the harm done to defendants. But we already know that the aggregate value of patent-based incentives is smaller than the aggregate value of negative incentives in the sectors affected by NPE litigation.[142] Furthermore, we cast serious doubt on their premise that NPEs actually provide a significant incentive for invention or innovation. In Part V.C, we show that publicly traded NPEs transfer a small fraction of the costs that they impose to inventors.

Schwartz and Kesan's line of argument appeals to many commentators who believe that NPEs provide a special benefit to small firms and independent inventors by vindicating their patent rights.[143] At the outset, we are suspicious of this argument because the small inventors who really get a significant return from their patents in the bi-

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138 Bessen & Meurer, *supra* note 34, at 95–146.

139 *See id.* at 138–46.

140 *See id.* at 147–64.

141 *See id.* at 187–214. We build the case that most patent infringement is inadvertent. For example, we show that patent defendants are hardly ever shown to be copyists. *Id.* at 126; *see also* Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. Rev. 1421, 1451 (2009) (finding that out of a data set of 1871 patent infringement opinions, 129 of them included allegations of copying, and that of these 129 opinions, copying was found only in 33 cases).

142 Bessen & Meurer, *supra* note 34, at 145.

143 *See* McDonough, *supra* note 14, at 223; Shrestha, *supra* note 14, at 118; *cf.* Myhrvold, *supra* note 22 (arguing that inadequate funding severely hinders innovation and that NPEs can help create a capital market to fund inventions). *But see* Feldman, *supra* note 85, at 53 (finding that 65% of surveyed "venture capitalists disagreed with the statement, '[a]s a venture capitalist, in making funding decisions, I consider the potential for selling patents to patent assertion entities if the companies fail.' Only 18% agreed.").

otech and medical-device industries have flourished without relying on NPE enforcement.[144] We have trouble seeing how a trickle of NPE payments to small firms in the tech sector makes much difference to the overall rate of innovation. We note that the majority of small high-tech firms do not rely on patent protection to profit from their R&D.[145] We also note that only about one-half of the patents asserted by NPEs come from small firms and independent inventors.[146] And this study shows that most of the firms sued by NPEs are, in fact, small firms. These findings suggest that NPEs do more to discourage innovation among small firms than they do to encourage it.

C. Are There Good NPEs?

A third significant line of criticism is that our critical treatment of NPE patent litigation lacks nuance. Critics contend that certain NPEs play socially valuable roles and that they get unfairly tarnished because of the actions of other problematic NPEs.[147] Peter Detkin from Intellectual Ventures commented on our work. The following is an excerpt from Gametime IP's report of its interview with Detkin:

> "They are taking a small piece of the puzzle and extrapolating out to the entire puzzle," explains Detkin. He believes that the basic premise behind the research is a real phenomenon—that there are bad actors who impose costs onto everyone because of the improper way in which they use the legal system. "When I coined the term 'troll' more than 10 years ago, I was talking about people who take specious patents that were likely invalid and asserted them broadly across an industry to extract nuisance value settlements." Ten years later, Detkin thinks some of the research validates his suspicions that a lot of people are "gaming the system and that there is a consummate cost to society."
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> . . . "To me, when you win at trial and on appeal, that means that your patents are not of 'doubtful validity' anymore." In fact, the amount of the settlement alone speaks volumes about the strength

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144 *See* Bessen et al., *supra* note 1, at 29 (finding that only 1% of NPE lawsuits arise in drug or medical-technology patent classes).

145 *See* Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1287, 1291–92 (2009); *Do Patents Really Matter to Startups? New Data Reveals Shifting Habits*, TECHCRUNCH (June 21, 2012), http://techcrunch.com/2012/06/21/do-patents-really-matter-to-startups-new-data-reveals-shifting-habits/; *cf.* James Bessen, *A Generation of Software Patents*, 18 B.U. J. SCI. & TECH. L. 241, 255–57 (2012) (showing that most software firms do not patent and that the increase of patenting in the software industry is due to a few large firms).

146 Colleen Chien, *A Race to the Bottom*, INTELL. ASSET MGMT., Jan./Feb. 2012, at 10, 13 fig.2 (using RPX data to show that 50% of litigated patents are owned by small companies).

147 *See* McDonough, *supra* note 14, at 223; Shrestha, *supra* note 14, at 118; *cf.* Myhrvold, *supra* note 22 (defending the author's own company as one that promotes investment in applied research).

> of NTP's claims. As former head of IP litigation for Intel, Detkin agreed, saying "I would have to be hard pressed to go to my management and say 'You should pay more than half a billion dollars for patents we don't think we infringe.'"[148]

We certainly acknowledge that some types of NPE behavior are likely to be socially desirable. Certain NPEs administer patent pools; others facilitate technology transfer and the outsourcing of R&D. However, we disagree with the view that only "nuisance value"[149] trolls are problematic. NPEs that press their assertions on to trial have a strikingly low win rate,[150] and even those that find a measure of success in court generally cause harm to innovation.

We disagree with Detkin and with Schwartz and Kesan that an NPE like NTP is meritorious, and we lament the ability of NPEs to extract large settlements or court awards from small, innovative firms like RIM. We believe that the NTP suit is a poster child for the problem of patent notice failure and harmful patent assertion by NPEs. NTP was founded by a failed wireless e-mail innovator named Campana and his patent attorney.[151] Campana obtained patents on wireless e-mail containing vague claims that were hidden from RIM during the early years of research and development of the BlackBerry.[152] RIM was unaware of Campana's invention and did not become aware of his patent until after they had succeeded with their innovation.[153] Nevertheless, RIM was forced to share the fruits of its success with NTP, a company that contributed nothing to the BlackBerry.[154] Supporters of NTP might consider them "meritorious" because they achieved litigation victories in court (although the asserted claims were later invalidated during reexamination)[155] and a large settlement payment. Our view is that NTP acted opportunistically to expropriate a portion of the rewards earned by a genuine innovator.

Schwartz and Kesan accuse us of focusing on the wrong question, asserting that the real question is "whether the lawsuits are being

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148 Anderson, *supra* note 80.

149 *Id.*

150 *See* Allison et al., *Repeat Patent Litigants*, *supra* note 3, at 687 (finding that the win rate for the most litigated patents is 10.7% compared to 47.3% for once-litigated patents). Win rates must be interpreted cautiously because cases that go to trial may differ from cases that are settled. One study that controls for selection bias estimates that 28% of NPE patents would be found at least partially invalid for lack of novelty or for obviousness if they were litigated through trial. *See* Miller, *supra* note 109, at 6–7.

151 Bessen & Meurer, *supra* note 34, at 49–50.

152 *See id.* at 49–50, 124–25.

153 *See id.* at 49.

154 *See id.*

155 Although NTP succeeded in court, the relevant patents were invalidated during reexamination at the PTO—too late to benefit RIM. The Federal Circuit affirmed the invalidation of one of the NTP patents and partially reversed and remanded the findings of invalidity for the other patents. *See In re NTP*, 654 F.3d 1279, 1289–90 (Fed. Cir. 2011).

brought because the defendants are infringers of a valid patent."[156] However, standard economic-welfare analysis implies that patent litigation even over valid patents can be socially harmful. If litigation incurs tens of billions of dollars of socially wasteful expenditure each year, then this represents a static loss in social welfare. If litigation also decreases innovation incentives, then the social losses could be much larger. Large numbers of expensive lawsuits by NPEs impose substantial costs on society regardless of whether the patents involved are valid or not.[157]

VI
Policy Implications

The rapid growth and high cost of NPE litigation documented here should set off an alarm, warning policymakers that the patent system still needs significant reform to make it a truly effective system for promoting innovation. The heterogeneous nature of NPEs—ranging from universities to semiconductor-design firms to trolls—suggests that policy reform should address troll-like behavior rather than merely status as an NPE.[158]

The top priority is reform of the patent system to improve notice; this kind of reform will make the patent system perform more like an idealized property system.[159] More rigorous enforcement of the claim-definiteness standard would be an excellent step forward. Likewise, we favor rigorous implementation of recent Supreme Court deci-

156 Schwartz & Kesan, *supra* note 44, at 455.

157 Schwartz and Kesan appear to misunderstand that we applied the label of "deadweight loss to society" to socially unnecessary expenditures related to litigation and assertion. *See also* Bessen & Meurer, *supra* note 30, at 61 & n.11 (describing "deadweight losses"). They assert, incorrectly, "Bessen and Meurer's calculation assumes every time a small inventor licenses a patent to a practicing company, it results in a 'deadweight loss,' regardless of the merits of the infringement claim." Schwartz & Kesan, *supra* note 44, at 440–41. That is not so. First, ex ante licensing typically does not involve much transaction costs by comparison to the kind of ex post licensing that NPEs do. We only measure the activity of NPEs and only count social losses to the legal and operating costs, not to actual transfers to inventors or NPE investors.

158 *See* Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 Berkeley Tech. L.J. 1583, 1587 (2011) (distinguishing between "patentees who make real contributions to innovation and those who do not"); Damien Geradin, Anne Layne-Farrar & A. Jorge Padilla, *Elves or Trolls? The Role of Non-Practicing Patent Owners in the Innovation Economy* 3 (Tilburg Univ., TILEC Discussion Paper No. 2008-018, 2008) (arguing that "the definition of all [NPEs] as patent trolls is far too broad and is unjustified by economic theory and evidence").

159 *See* Bessen & Meurer, *supra* note 34, at 215–26; Fed. Trade Comm'n, *supra* note 39, at 74; Peter S. Menell & Michael J. Meurer, *Notice Failure and Notice Externalities*, 5 J. Legal Analysis 1, 5–6 (2013). Lemley and Melamed also emphasize that patent reformers should focus on fundamental patent reforms that reduce the harm from patents asserted by both practicing and non-practicing entities. *See* Lemley & Melamed, *supra* note 4 (manuscript at 4–5).

sions restricting the patentability of business methods and other abstract processes that are difficult to propertize. It is also crucial to provide greater transparency in the patent system. Robin Feldman and Tom Ewing document the remarkable opaqueness of Intellectual Ventures in connection with its patent ownership and patent assertion.[160] Finally, courts should rigorously supervise patent-lawsuit damages awards to make sure that damages are proportionate to the value of the patented technology.[161] These reforms should not harm genuine inventors who crave publicity rather than secrecy and who should still be able to obtain broad but clear patent protection.

It is also instructive to look for policy reforms in the law and economics analysis of the generic problem of frivolous lawsuits. One promising policy reform is greater use of fee shifting to favor defendants in cases brought by trolls. Allison et al. find that troll patents fare poorly in court.[162] The bargaining power of a troll seeking a nuisance settlement would be greatly diminished in an aggressive fee-shifting regime. Similarly, more stringent pleading requirements have been justified in other areas of the law as a method of reducing frivolous lawsuits; this strategy might also work for patent litigation.[163]

Conclusion

Using survey data and the associated database of NPE litigation, our major findings are these:

The direct costs of NPE patent assertions are substantial, totaling about $29 billion accrued in 2011. This figure does not include indirect costs to the defendants' businesses such as diversion of resources, delays in new products, and loss of market share. Even so, the direct costs are large relative to total business spending on R&D, which totaled $247 billion in 2009,[164] implying that NPE patent assertions effectively impose a significant tax on investment in innovation.

Much of this burden falls on small and medium-sized companies, which make up about 59% of the companies sued and pay about 37% of the direct costs. NPE litigation costs smaller companies more relative to their revenues. In addition, smaller companies pay relatively more to NPEs in connection with assertions that do not go to court.

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160 Tom Ewing & Robin Feldman, *The Giants Among Us*, 2012 Stan. Tech. L. Rev. 1, 3–5 (2012), http://stlr.stanford.edu/pdf/feldman-giants-among-us.pdf.

161 *See* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 Tex. L. Rev. 1991, 2044 (2007).

162 Allison et al., *Repeat Patent Litigants*, *supra* note 3, at 680.

163 *See, e.g.*, Douglas A. Blaze, *Presumed Frivolous: Application of Stringent Pleading Requirements in Civil Rights Litigation*, 31 Wm. & Mary L. Rev. 935 (1990) (discussing the stringent pleading requirements in the civil rights context).

164 *See* Nat'l Sci. Bd., Nat'l Sci. Found., Science and Engineering Indicators 2012, at 4-4 (2012), *available at* http://www.nsf.gov/statistics/seind12/pdf/c04.pdf.

The burden of all of these costs appears to rebut the assertions that NPEs play an important role in improving the profits of innovative start-ups.

About a third of the cost to defendants involves patent assertions that do not go to court. Moreover, we have likely underestimated these costs because we have not surveyed small companies that do not also have NPE patent litigation.

NPEs appear to be highly heterogeneous. Much of the litigation appears to consist of nuisance suits that settle for a few hundred thousand dollars. But some NPEs are "big-game hunters" who seek and get settlements in the tens or hundreds of millions of dollars.

Little of the out-of-pocket payments made by defendants ends up in the pockets of small inventors. Only about 5% goes to independent inventors and roughly half of that goes to large firms. If one adds the R&D spending of some of the NPE companies, that share rises to 20%. Nevertheless, most of the out-of-pocket costs—roughly 70%—go to socially wasteful legal fees or to the NPEs' operating expenses.

These findings imply that the recent surge in NPE litigation is a significant social problem associated with billions of dollars of socially wasteful expenditure each year, as well as reduced innovation incentives for both small and large firms. Moreover, while NPEs appear to assert a high percentage of patents that would be found invalid if challenged in court, even valid patents impose social costs when litigated. More generally, our analysis suggests that a major cause of the high rates of litigation may be poor patent notice, which may create high levels of inadvertent infringement. In this sense, NPE litigation may be more a symptom of a deeper problem than the result of a particular business model.

We join our critics in the call for more research on the costs and potential benefits of NPEs. But we also note that legal scholars have now accumulated quite a bit of empirical evidence. In particular, over the last several years we have made three different estimates of the costs that NPEs impose on defendants, each using a different data source and a different methodology and estimating a slightly different measure.[165] Together, all three provide a reasonably consistent picture: these costs are substantial, and the available evidence further suggests that defendants' private costs correspond to substantial social costs as well. This picture might not correspond to preconceived notions about NPEs or to the personal perceptions of individual patent attorneys, but until better evidence comes along, this evidence provides an important guide for policy.

165 *See* BESSEN & MEURER, *supra* note 34; Bessen et al., *supra* note 1; Bessen & Meurer, *supra* note 30.

Appendix

Table A1. Log Cost Regressed Against Log Company Revenue

	(1)		(2)	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	10.30	(0.85)	10.90	(0.91)
Ln(Rev)	0.13	(0.04)	0.10	(0.04)
Revenue < $100m			-1.11	(0.63)

Note: 784 observations.

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Heterogeneity Among Patent Plaintiffs: An Empirical Analysis of Patent Case Progression, Settlement, and Adjudication

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This article empirically studies current claims that patent trolls, also known as patent assertion entities (PAEs) or non-practicing entities (NPEs), behave badly in litigation by bringing frivolous patent infringement suits and seeking nuisance fee settlements. The study explores these claims by examining the relationship between the type of patentee-plaintiffs and litigation outcomes (e.g., settlement, grant of summary judgment, trial, and procedural dispositions), while taking into account, among other factors, the technology of the patents being asserted and the identity of the lawyers and judges. The study finds significant heterogeneity among different patent holder entity types. Individual inventors, failed operating companies, patent holding companies, and large patent aggregators each have distinct litigation strategies largely consistent with their economic posture and incentives. These PAEs appear to litigate differently from each other and from operating companies. Accordingly, to the extent any patent policy reform targets specific patent plaintiff types, such reforms should go beyond the practicing entity versus non-practicing entity distinction and understand how the proposed legislation would impact more granular and meaningful categories of patent owners.

I. Introduction

There is a popular belief that an "explosion of patent litigation," driven by a particular type of patent holder, is the key contributor to a national epidemic that supposedly has

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cost the economy $320 billion within five years.[1] Even President Obama announced a number of actions and asked Congress to enact legislation to combat this patent assertion problem.[2] And this increase in patent litigation is driven, the current thinking goes, by a particular class of patent holder— "patent assertion entities" (PAEs)[3] or "non-practicing entities" (NPEs)[4] (also referred to by some as "patent trolls"). Those proposing this legislation point to these PAEs in general as causing the sharp increase in patent litigation and settling more cases before trial than in the past.[5] Because these entities make no products, they are immune from counterclaims for patent infringement in a way that operating companies are not.[6] The current narrative is that they sue thousands of defendants,[7] from operating companies to individual consumers of allegedly infringing products,[8] carefully picking the judicial districts where they bring their patent lawsuits[9] and asserting questionable Internet patents.[10] PAEs[11] rely heavily on the

[1]Laurie White & Dale Venturini, Protect Main Street from Patent Trolls, Providence J., Feb. 27, 2014 (http://www.providencejournal.com/opinion/commentary/20140227-laurie-white-and-dale-venturini-protect-main-street-from-patent-trolls.ece).

[2]The White House Office of the Press Secretary, FACT SHEET—Executive Actions, Answering the President's Call to Strengthen Our Patent System and Foster Innovation (http://www.whitehouse.gov/the-press-office/2014/02/20/fact-sheet-executive-actions-answering-president-s-call-strengthen-our-p).

[3]Colleen V. Chien, From Arms Race to Marketplace: The New Complex Patent Ecosystem and its Implications for the Patent System, 62 Hastings L.J. 297 (2010) (coining the term "patent assertion entity").

[4]Robin Feldman, Thomas Ewing & Sara Jeruss, The AIA 500 Expanded: The Effects of Patent Monetization Entities, 11 Duke L. & Tech. Rev. 357 (2014).

[5]Megan M. La Belle, Against Settlement of (Some) Patent Cases, 67 Vand. L. Rev. 375 (2014).

[6]Brian J. Love, An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls Without Harming Innovators? 161 U. Pa. L. Rev. 1316 (2013) ("Because NPEs do not sell products that could be the subject of a counterclaim, they do not face this risk when filing suit.").

[7]RPX 2015 Report, NPE Litigation, Patent Marketplace, and NPE Cost at 8, Chart 3 (2015) (finding over 4,000 defendants in NPE cases in 2014).

[8]Joe Mullin, Patent Trolls Want $1,000—For Using Scanners, Ars Technica (Jan. 2, 2013) ("But in the history of patent trolls, 2012 may go down as the 'year of the user.' The [letters described in the article] are a particularly alarming example of a practice that has become commonplace in the past year or two—going after the users of basic technologies.").

[9]The patent lawsuit venue criticism may change after the recent U.S. Supreme Court decision in T.C. Heartland LLC v. Kraft Foods Group Brands LLC, No. 16–341 (decided May 22, 2017) (https://www.supremecourt.gov/opinions/16pdf/16-341_8n59.pdf).

[10]Colleen Chien & Michael Risch, Recalibrating Patent Venue, 77 Md. L. Rev. (forthcoming 2018); Brian Love & James Yoon, Predictably Expensive: A Critical Look at Patent Litigation in the Eastern District of Texas, 20 Stanford Tech. L. Rev. 1 (2017).

[11]While we recognize that some people use NPE, PAE, and patent troll interchangeably while others differentiate among the terms, in this article we will use "PAE" to mean all entities that assert patents in litigation without concurrently manufacturing or selling products. We divide PAE into various types, which is explained in Section III.A.

asymmetric costs of litigation, which swing heavily in their favor since they have few documents to produce in discovery.[12] PAEs also collect "nuisance fees" from those afraid of expensive litigation.[13] In contrast to this general class of PAEs, companies that assert patents that are embodied in their own products and/or services, referred to as "operating companies," are seen as behaving in an acceptable and more predictable manner when engaged in patent litigation. To combat this "explosion" of PAE litigation, in 2016 Congress proposed new litigation and civil procedure rules applicable only to patent cases, including some directed specifically at those who do not practice the patent.[14]

However, there is also a counternarrative in the literature that is supported with data and analysis. There is an increasing realization among academics that this "explosion" in patent litigation may be overblown. A major factor is the anti-joinder provision of the 2011 Leahy-Smith America Invents Act (AIA).[15] That provision required that a patent holder file a separate lawsuit against each unrelated defendant,[16] reversing the practice of some courts that permitted unrelated defendants to be sued in a single lawsuit.[17] After the AIA was passed, there were an increased number of suits filed,[18] as

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[12]General Accounting Office, Intellectual Property: Assessing Factors that Affect Patent Infringement Litigation Could Help Improve Patent Quality at 10 (August 2013) (http://www.gao.gov/assets/660/657103.pdf) ("parties that do not offer products or services using the patents at issue often have far fewer documents to disclose—because they do not have any documents related to their products or services—than patent owners or accused infringers who do offer products or services").

[13]Jim Spencer, Patent Trolls Collect "Nuisance Fees" and Political Enemies, Star Tribune, June 15, 2013 (http://www.startribune.com/business/211615651.html) ("You end up with companies that aren't making anything, trying to extract a nuisance fee.")

[14]Paul R. Gugliuzza, Patent Litigation Reform: The Courts, Congress, and the Federal Rules of Civil Procedure, 95 B.U. L. Rev. 279 (2015); see Innovation Act, Proposed Revision to 35 U.S.C. 299 (requiring that, upon a showing that the patentee "has no substantial interest in the subject matter at issue other than asserting such patent claim in litigation," the other interested parties can be joined to the lawsuit to pay potential awards of attorney fees.)

[15]35 U.S.C. § 299 (2012). See generally David O. Taylor, Patent Misjoinder, 88 N.Y.U. L. Rev. 652 (2013).

[16]Section 299, in relevant part, requires that accused infringers may be "joined in one action as defendants or counterclaim defendants, or have their actions consolidated for trial, only if—(1) any right to relief is asserted against the parties jointly, severally, or in the alternative with respect to or arising out of the same transaction, occurrence, or series of transactions or occurrences relating to the making, using, importing into the United States, offering for sale, or selling of the same accused product or process; and (2) questions of fact common to all defendants or counterclaim defendants will arise in the action."

[17]Fabio E. Marino & Teri H.P. Nguyen, Has Delaware Become the "New" Eastern District of Texas? The Unforeseen Consequences of the AIA, 30 Santa Clara High Tech. L.J. 527 (2014) (http://digitalcommons.law.scu.edu/chtlj/vol30/iss4/3).

[18]Robin Feldman, Thomas Ewing & Sara Jeruss, The AIA 500 Expanded: The Effects of Patent Monetization Entities, 17 UCLA J.L. & Tech. 1, 48 (2013) (reporting a spike of approximately 500 percent around September 2011, when the AIA was signed into law).

each defendant needed to be sued in a separate lawsuit since many defendants could no longer be joined in the same action.[19] This largely ministerial change caused the number of lawsuits to rapidly increase, while the underlying amount of litigation (i.e., the number of plaintiffs and the number of defendants) remained constant.[20] After accounting for the changes in the joinder provision, the apparent explosion of PAE activity from 2010 until 2012 appears to be a mirage.[21] There is also some recognition in academic research—less so in the popular press—that not all "non-practicing entities" are the same.[22]

But there has been little empirical investigation of the other allegations driving the calls for legislation—that all patent trolls or PAEs behave the same in litigation and seek early settlement and, in turn, act distinctively different from operating companies.[23] For instance, do all PAEs settle their cases quickly?[24] Do all PAEs avoid adjudication of their claims on the merits?[25] More broadly, do all PAE lawsuits look the same and, in turn, are they noticeably different from lawsuits asserted by other types of patentees such as operating companies?[26] It could be that within the full universe of PAEs, one group, such as individual inventors, behave differently from other groups within the broader category.[27] For example, failed companies may litigate differently from

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[19]There was an uptick in litigation after the joinder provisions were publicly announced and just before they went into effect in Sept. 2011. Brian Howard, Year in Review, Continued Analysis, Lex Machina (July 23, 2014) (https://lexmachina.com/2014/07/year-review-continued-analysis/).

[20]Christopher A. Cotropia, Jay P. Kesan & David L. Schwartz, Unpacking Patent Assertion Entities, 99 Minn. L. Rev. 649, 655 (2014) ("most of the differences between the years [2010 and 2012] are likely explained by, and attributable to, a change in the joinder rules adopted in 2011 as part of the America Invents Act").

[21]Id. at 660–73 (analyzing the patent litigation data based on number of lawsuit, number of patent owners, and number of defendants).

[22]Id.; Mark A. Lemley & A. Douglas Melamed, Missing the Forest for the Trolls, 113 Colum. L. Rev. 217 (2017) (distinguishing among various business models of "patent trolls"); see also Edward Lee, Patent Trolls: Moral Panics, Motions in Limine, and Patent Reform, 19 Stanford Tech. L. Rev. (2016) (noting differences among types of "patent trolls").

[23]Ira Blumberg, Why Patent Trolls Won't Give Up, Tech Crunch (June 5, 2016) (https://techcrunch.com/2016/06/05/why-patent-trolls-wont-give-up/ (patent "trolls" are "aggressive" and "operate with near impunity").

[24]James F. McDonough III, The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy, 56 Emory L.J. 189 (2006).

[25]For an analysis of adjudicated cases, see John R. Allison, Mark A. Lemley & David L. Schwartz, How Often Do Non-Practicing Entities Win Patent Suits? Berkeley Tech. L.J. (forthcoming 2017) (http://ssrn.com/abstract=2750128).

[26]David Segal, Have Patent, Will Sue: An Alert to Corporate America, N.Y. Times, July 13, 2013 (quoting the owner of a PAE as saying that if there is enough resistance to an allegation of patent infringement, he can "go thug. . . . Once you go thug, though, you can't unthug").

[27]Christopher A. Cotropia, Individual Inventor Motif in the Age of the Patent Troll, 12 Yale J.L. & Tech. 52 (2009) (arguing that since its inception, patent law has viewed individual inventors as special in the innovation system).

companies whose sole business purpose is to purchase patents.[28] There is very little, if any, empirical evidence to date that supports the current thinking on PAEs and provides a detailed account as to how various patent entities behave during litigation.[29] Answering these questions with extensive data and robust empirical analysis is the focus of this article.

In this work, we present an empirical study of the relationship between the type of patentee-plaintiffs and litigation behavior (e.g., settlement, duration, grant of summary judgment, trial, and procedural dispositions) in patent lawsuits to test the current assumptions about PAEs as a group and as compared to operating companies. We take into account, among other factors, the technology of the patents being asserted, the judicial districts where these lawsuits were filed, the judge to whom the case was assigned, and the lawyers representing the patent holder.[30] Using a unique, hand-coded dataset, we break down the different types of patentee-plaintiffs on a refined basis, distinguishing among operating companies, patent holding companies, large patent aggregators, individual inventors, universities, and failed startups.[31] To study the relationship between patentee entity type and case progression and disposition, we employ a variety of empirical approaches. We present summary statistics, regression results, and duration/survival analyses. As a result, we are able to provide a detailed picture of the relationship between the type of patentee-plaintiffs, choice of patented technology, and venue and litigation outcomes, including settlement.

We recognize that the role of PAEs in the patent system is not confined to litigation.[32] It may be interesting to study patent grants,[33] patent assignments and related transactions among various entities,[34] and patent demands that do not result

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[28]Kristen J. Osenga, Formerly Manufacturing Entities: Piercing the Patent Troll Rhetoric, 47 U. Conn. L. Rev. 435 (2015) (arguing that "formerly manufacturing entities do not impose the harms associated with patent trolls more broadly and, in fact, provide unique benefits for commercialization of new technologies").

[29]Laurie Self, Misleading Patent Troll Narrative Driven by Anecdote, Not Data, IPWatchdog (Nov. 12, 2015) (http://www.ipwatchdog.com/2015/11/12/misleading-patent-troll-narrative-driven-by-anecdote-not-facts/id=63122/).

[30]As we explain in Section III, there are preexisting theories on why each of these variables may relate to the decision to settle or press a patent infringement lawsuit.

[31]We use the same coding schema as Cotropia et al., supra note 20.

[32]For a broad overview of PAE-related transactions outside of litigation, see Andrei Hagiu & David B. Yoffie, The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-Aggregators, 27 J. Econ. Perspectives 45 (2013).

[33]Before the present debate about PAEs, researchers studied patent prosecution. John R. Allison & Mark A. Lemley, Who's Patenting What: An Empirical Exploration of Patent Prosecution, 53 Vand. L. Rev. 2099 (2000)

[34]The U.S. Patent & Trademark Office (USPTO) recently released a dataset with assignment, security interest, and other information that was recorded with the USPTO. No one, to our knowledge, has analyzed the PAE issue using this new dataset. For information about the dataset, see Alan C. Marco, Amanda F. Myers, Stuart J.H. Graham, Paul A. D'Agostino & Kristen Apple, The USPTO Patent Assignment Dataset: Descriptions and Analysis (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2636461).

in litigation.[35] However, most of the charges about PAEs are focused on litigation abuses by patent holders. As such, we focused our initial inquiry on PAE litigation behavior, focusing on cases that resulted in a settlement or other voluntary disposition. Most patent cases settle and we think that studying settlement behavior is the best way to understand the PAE litigation ecosystem, especially since much of the anecdotal evidence relates to nuisance fee settlements. We also report information on the small subset (less than 10 percent) of defendants whose cases reach a substantive outcome. We are cautious about extrapolating too much from this small subset, which most scholars theorize is skewed relative to the population of all lawsuits.[36] We are not aware of other prior academic research on settled PAE patent cases, and we believe that our study is substantially different from and, in important ways, represents an advance over, studies that focus only on the small subset of adjudicated disputes.

In sum, and counter to the some of the current assumptions about PAEs in the literature, we find significant heterogeneity among different patent holder entity types, both between various types of PAEs and as compared to operating companies. Individual inventors, failed operating companies, patent holding companies, and large patent aggregators each have distinct strategies largely consistent with their economic posture and incentives.[37] These PAEs appear to litigate differently from each other and from operating companies. At minimum, the notion that patent holders fall into two categories—operating companies and PAEs/non-practicing entities—is deeply flawed. Hence, we urge that to the extent any patent policy reform targets specific patent plaintiff types, it should go beyond the practicing entity versus non-practicing entity distinction and understand how the proposed legislation would impact more granular and meaningful categories of patent owners.

The remainder of this article is organized as follows. In Section II, we propose an economic explanation of the litigation incentives for the disparate types of patent holders. We continue, in Section III, by setting forth our study design and methodology. Next, in Section IV, we provide the results of the study. The results include information about case duration and case dispositions. We discuss implications in Section V. We briefly conclude in Section VI.

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[35]Professor Robin Feldman surveyed venture capitalists about patent demands. See Robin Feldman, Patent Demands & Startup Companies: The View from the Venture Capital Community, 16 Yale J.L. & Tech. 236 (2014).

[36]George L. Priest & Benjamin Klein, The Selection of Disputes for Litigation, 13 J. Legal Stud. 1, 16–17 (1984). Others have criticized parts of the Priest-Klein theory. See, e.g., Yoon-Ho Alex Lee & Daniel M. Klerman, The Priest-Klein Hypotheses: Proofs and Generality, 47 Int'l Rev. of L. & Econ. 59 (2016).

[37]We discuss these economic motivations in Section II.

II. Economic Motivations of Patent Holders in Litigation

In this section, we expound a basic economic theory of how various patent holders might be expected to litigate.[38] We provide separate theories for operating companies, patent holding companies, large aggregators, individual inventors, and other types of patent plaintiffs.[39]

Until very recently, patent litigation was primarily between operating companies offering goods and services in the same technology sector.[40] For instance, until about 2008–2009, there were four times as many operating companies as there were non-operating companies filing patent lawsuits.[41] While each case is different, often when an operating company sued another operating company, the stakes and overall litigation exposure of both parties were quite symmetric.[42] The defendant entity in this scenario may assert a patent infringement counterclaim based on its patent portfolio and thereby even the liability exposure for both sides.[43] The discovery costs (such as e-discovery, documentary evidence, depositions, and experts) and challenges of proving infringement *vel non* were also symmetric.[44] Remedies including reasonable royalty estimates, lost profit claims, possible price erosion, injunctive relief, and willful infringement were equally available to both patent-plaintiffs and counterclaim defendants, since they were both operating companies.[45]

This scenario becomes considerably more asymmetric when the patent plaintiff is not an operating company.[46] An individual inventor, a research university, a failed

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[38]See Kenneth Dam, The Economic Underpinnings of Patent Law, 23 J. Legal Studies 247, 247–49 (1994) (detailing various economic theories of patent law).

[39]These theories were discussed briefly in our earlier work. See Cotropia et al., supra note 20.

[40]See, e.g., Colleen V. Chien, Of Trolls, Davids, Golaiths, and Kings: Narratives and Evidence in the Litigation of High-Tech Patents, 87 N.C. L. Rev. 1571, 1574 (detailing this historic "sport of kings").

[41]See Kirti Gupta & Jay P. Kesan, Studying the Impact of *eBay v. MercExchange* on Injunctive Relief in Patent Cases (2016) (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2816701) (showing the number of lawsuits filed by operating companies and non-practicing entities from 2000–2012 in Figure 5).

[42]See, e.g., John R. Allison et al., Valuable Patents, 92 Geo. L.J. 435, 474 (2004) (finding that semiconductor patents are litigated only one-third as often as other patents, and offering the symmetry of relationships as an explanation).

[43]See Mark Lemley, Are Universities Patent Trolls? 18 Fordham Intell. Prop. Media & Ent. L.J. 611, 615 (one of the assumptions corporations in patent intensive industries (such as IT or, increasingly, biotechnology) make about patenting is symmetry: that if a competitor sues you for infringement you can sue them back).

[44]James Bessen & Michael J. Meurer, The Direct Costs from NPE Disputes, 99 Cornell L. Rev. 387, 413 (2014) ("NPEs have a bargaining advantage over practicing-entity patent plaintiffs because NPEs are invulnerable to patent counterclaims and have lower litigation costs, especially discovery costs").

[45]Id.

[46]Id. at 412–13 (detailing the bargaining advantage due to this asymmetry for NPEs).

startup, or a patent holding company that does not make goods or offer services is not exposed to a patent infringement counterclaim.[47] As a result, the defendant is limited in terms of increasing the litigation risk and exposure of the plaintiff.[48] The discovery costs become more asymmetric as the patent plaintiff may not possess significant documentary evidence to turn over to the defendant, although it still bears the costs of proving infringement based on the defendant's evidence.[49] In addition, the available remedy that must be proven by the plaintiff is limited in this scenario since it most often comprises an estimate of the reasonable royalty for past and future sales.[50] In short, when a non-operating company sues an operating company for patent infringement, the costs involved and the litigation stakes may be more asymmetric compared to a patent lawsuit between two operating companies.[51]

That said, all non-operating companies are far from being similarly situated. The motivations of different types of non-operating, non-practicing companies vary greatly.[52] For instance, when a patent holding company or large aggregator of patents (also referred to as a patent assertion entity) is the plaintiff, there are several relevant factors at play that influence the outcome of the patent lawsuit.[53] First, the patent holding company may create a new entity for holding the patents that are asserted in the lawsuit, thereby minimizing the discovery burden and the downside litigation exposure. The new entity has few assets other than the patents and may be dissolved in the event the lawsuit fails. The lack of potential downside risk from their limited liability status may encourage riskier patent owner behavior, resulting in cases that last longer and more adjudications on the merits. Second, the patent holding company may be able to spread any potential loss arising from this lawsuit over many other patent lawsuits involving the same patent portfolio. Thus, the patentee's costs may be lower, permitting it to litigate longer and at a cheaper cost. In addition, large patent aggregators, companies who purchase and aggregate numerous patent portfolios from various sources, may be monetizing several other patent portfolios and can spread their risks even more widely.[54] Third,

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[47]Lemley, supra note 43, at 615–16 (detailing the lack of symmetry for patentees such as universities).

[48]See, e.g., Jason Rantanen, Slaying the Troll: Litigation as an Effective Strategy Against Patent Threats, 23 Santa Clara Computer & High Tech. L.J. 159, 160 (2007) (noting this difference in risk).

[49]Bessen & Meurer, supra note 44, at 412–13.

[50]See Christopher B. Seaman, Permanent Injunctions in Patent Litigation After *eBay*: An Empirical Study, 101 Iowa L. Rev. 1949 (2016) (establishing the de facto use requirement for an injunction empirically).

[51]Bessen & Meurer, supra note 44, at 412–13.

[52]David L. Schwartz & Jay P. Kesan, Analyzing the Role of Non-Practicing Entities in the Patent System, 99 Cornell L. Rev. 425, 429–30 (2014) (discussing some of these differences between assertion entity types).

[53]David L. Schwartz, On Mass Patent Aggregators, 114 Colum. L. Rev. Sidebar 51, 56–61 (2014) (noting the complexity of the mass aggregators role in the patent system).

[54]Id. at 56–57.

since the patent holding company is a third-party purchaser and not the inventor, it does not have to contend with any issues related to the genesis of the invention(s) that resulted in the asserted patent(s) and is insulated from any litigation issues related to the inventors. As the cases reach adjudication on the merits, especially trial, the lack of an "inventor story" may disadvantage patent purchasers, resulting in a lower win rate. Fourth, a large aggregator may be seen by a defendant to be a repeat player in the world of patent litigation and thus the defendant's strategies (such as aggressively continuing the lawsuit or offering a settlement) will take that into account. Moreover, the large aggregator will also consider the possibility that it may have to sue the same defendant again in connection with another patent portfolio. In short, a large aggregator can pursue a patent monetization strategy that is highly diversified, with reduced risk, involving cumulative assimilation of specialized knowledge over time.[55] The repeat-player nature of large aggregators may result in more settlements, and quicker settlements, since the parties know each other and expect to continue to interact with each other in the future.

Individual inventors, research universities, and failed startups, while falling within the broad rubric of non-operating companies, find themselves in a very different position compared to a patent holding company and large aggregators.[56] First, the patents that are asserted by them in litigation are the result of their own research efforts and their involvement in the development of the underlying technology. The resulting patents being asserted are of personal importance and their association with the patents are often intimate.[57] Consequently, these entities may be inclined to overvalue their patents and their exclusivity in the market, a phenomenon that is referred to as the inventors'/creators' endowment effect.[58] As a result, individual inventors and other similar entities may be inclined to continue litigating a patent case (including spurning a settlement offer), even if continued litigation is not in their objective best interest. Such overoptimistic behavior may lead to higher loss rates for individual inventors. Second, unlike patent holding companies, the patents that individual inventors, universities, and failed startups choose to monetize are necessarily limited in number since they can typically only assert patents that arise from technologies created by them. Third, individual inventors, universities, and failed startups may be seen to be rare patent plaintiffs, and thus defendants may be incentivized to continue to litigate these patent cases or not offer a

[55]Id. at 60–65 (describing this monetization strategy).

[56]See, e.g., Gwendolyn G. Ball & Jay P. Kesan, Transaction Costs and Trolls: Strategic Behavior by Individual Inventors, Small Firms and Entrepreneurs in Patent Litigation, U Illinois Law & Economics Research Paper No. LE09-005; Illinois Public Law Research Paper No. 08–21 (Feb. 1, 2009) (http://ssrn.com/abstract=1337166).

[57]Chien, supra note 40, at 1586–87 ("some independent inventors are perceived as seeking not only money, the main objective of licensing shops, but also justice or vindication by a court").

[58]See Christopher Buccafusco & Christopher Sprigman, Valuing Intellectual Property: An Experiment, 96 Cornell L. Rev. 1, 17–31 (2010) (conducting experiments "that demonstrated a substantial valuation asymmetry between authors of poems and potential purchasers of them").

meaningful settlement, knowing that these entities are less sophisticated litigants against whom they may never have to litigate again.[59] These aspects of their interaction may result in longer case durations, with greater numbers of cases reaching a substantive disposition.

There is even a diversity among individual inventors, research universities, and failed startups. Universities' primary business is in education and research, not patent enforcement, and their reputation is very important.[60] Failed startups, in contrast, have little ongoing business. They may feel that the alleged infringer unfairly beat them in the marketplace. The alleged infringer may have the opposite view of the marketplace battle, and these underlying divergent views may affect the patent case. This divergence in views between failed startup plaintiffs and defendants may make disputes more difficult to settle, resulting in longer disputes. Failed startups also have investors who may desire some return, via the patent lawsuit, on their otherwise lost capital.[61] Even within individual patent holders, there is diversity. Individual inventors sue in their personal capacity (i.e., John Doe) or they can form a corporate vehicle (i.e., John Doe LLC). Those with access to sophisticated counsel are likely to be advised to form a corporate vehicle.[62] Those without may even litigate pro se, representing themselves in the litigation. Defendants may litigate against individuals, especially pro se individuals, quite differently. They may be less willing to offer meaningful settlements and take more aggressive litigation positions.

We pause here to acknowledge that not all patents are created equal, and that patents are not randomly assigned to companies. Even before litigation, some patents are more likely to be valid than others. Some parties may be more willing to enforce a patent that has suspect validity, or assert a weak claim of infringement, than other parties. Non-practicing entities that purchase patents from others have the ability to select which patents to purchase, while many operating companies have limited themselves to the patented technologies they have invented.[63] Thus, even before the litigation process, the various patent owners may carry patents of varying quality. We cannot observe this underlying quality, and suggest caution in comparing litigation outcomes (including settlements) among entity types.

Based on the foregoing, it is clear that a straightforward examination of the economic incentives faced by different types of patent plaintiffs to settle or to

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[59]See Mark Lemley, The Myth of the Sole Inventor, 110 Mich. L. Rev. 709, 710–11 (2012) (detailing the rarity of truly individual inventions).

[60]Cleopatra Veloutsou et al., University Selection: Information Requirements and Importance, 18 Int'l J. Educ. Mgmt. 160, 161 (noting that applicants consider reputation when selecting universities).

[61]See John E. Dubiansky, An Analysis for the Valuation of Venture Capital-Funded Startup Firm Patents, 12 B.U. J. Sci. & Tech. L. 170, 172 (2006) (noting that patent assertion is a viable exit strategy for failed startups).

[62]See Robert W. Hamilton, The Corporate Entity, 49 Tex. L. Rev. 979 (1971).

[63]David L. Schwartz, On Mass Patent Aggregators, 114 Colum. L. Rev. Sidebar 51, 63 (2014) (arguing that non-practicing entities may be purchasing undervalued patents).

continue to litigate a patent case even to trial can be distinctly different.[64] Therefore, dividing the world of patent plaintiffs into binary categories—operating entities and non-operating entities—as a way to understand behaviors in patent litigation may well be unjustifiable and misguided or, at the very least, less than illuminating and incomplete. More granular categories of patent plaintiffs will necessarily be more revealing.

III. Study Design and Methodology

In the following section, we set forth how data were located, collected, and coded. Our work here expands on a unique dataset we previously collected by hand. As described in detail elsewhere,[65] the authors previously spent several weeks personally attending to gathering information about all patent lawsuits brought in 2010 and 2012. For the sake of comprehensiveness, we briefly review the contents of the unique dataset with particular emphasis on additional information about the lawsuits that we added for the present study.

In what follows, we explain the contours of our initial dataset and the additional coding we conducted for this article.

A. The Previously Collected Data

The previously collected dataset includes information from all patent infringement lawsuits filed in two complete calendar years: 2010 and 2012. We used Bloomberg Law's Federal Docket Database to identify the patent lawsuits filed in these years.[66] We verified that Bloomberg Law's database was substantially identical to that of PACER,[67] the database maintained by the federal courts.[68]

For the present study, we focus on only lawsuits filed in 2010 because almost all the lawsuits filed then have been resolved, permitting us to investigate outcomes, settlements, and other information related to litigation. Of course, if we had chosen a more recent year, a much larger number of cases would still be pending, reducing our ability to observe settlement and judgment patterns. Lawsuits filed in 2010 are, nevertheless,

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[64]See Michael Risch, Patent Troll Myths, 42 Seton Hall L. Rev. 457, 458–59 (2012) (noting the variety of non-practicing entities that may assert patents).

[65]Cotropia et al., supra note 20 at 660–73.

[66]We limited the docket search on Bloomberg Law to lawsuits between Jan. 1 and Dec. 31 of the given year. We used the Nature of Suit field to isolate "830 – Patent" cases.

[67]PACER stands for Public Access to Court Electronic Records. It is an electronic database that permits access to federal courts. Access is available at https://www.pacer.gov/.

[68]See Cotropia et al., supra note 20 at 663–64.

relatively recent.[69] Although there are reasons to think that recent changes, including adjustments to the law of patentable subject matter,[70] joinder,[71] and administrative reviews of patents,[72] are significant, our results indicate an accurate portrayal of patent litigation in 2010. We contend that information about patent litigation in 2010 has continued relevance toward understanding what patent litigation looks like in 2016.[73] More importantly, patent litigation in 2010 provides a telling snapshot of economic incentives of a plaintiff related to settlement and case duration and progression.

For every lawsuit, we reviewed the docket report and a copy of the complaint, amended complaints, answers, and amended answers. The complaint is the legal document that initiates a lawsuit,[74] and the answer is the legal response filed by the defendant to the lawsuit's allegations.[75] While the complaint frequently does not contain detailed factual contentions, it always identifies the parties to the lawsuits, and sometimes includes background information about the parties.[76] We eliminated several types of cases from the dataset, including all complaints alleging patent false marking,[77]

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[69]In many areas of law, one may expect lawsuits filed today to be resolved similarly to lawsuits filed six years ago. However, patent law may be different. Several major changes have occurred in the last six years, including the rise of inter partes review (IPR) that is concurrent with much patent litigation, and the Supreme Court decision in Alice Corp. v. CLS Bank, 134 S. Ct. 2347 (2014). Furthermore, the pleading standards for patent cases changed in Dec. 2015, when revisions to the Federal Rules of Civil Procedure went into effect.

[70]There are several Supreme Court consequential cases since 2010. See, e.g., Alice Corp. v. CLS Bank, 134 S. Ct. 2347 (2014); Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289 (2012).

[71]The America Invents Act (AIA) requires that lawsuits filed against multiple unrelated parties are filed separately. 35 U.S.C. § 299 (2012). For example, in 2010, while a patentee could sue three defendants in one patent lawsuit in some venues, after the implementation of the AIA, the same patentee may have to sue each defendant separately, resulting in three patent lawsuits. The number of defendants in a lawsuit may relate to the measured variables, including duration.

[72]The America Invents Act created new forms of administrative review and modified existing ones. More specifically, the AIA created post-grant review and covered business method review. 35 U.S.C. § 282(b); 35 U.S.C. § 314(a). It also established inter partes review, 35 U.S.C. § 311(a), and supplemental examination, 35 U.S.C. § 257.

[73]In 2010, the advent of non-practicing entities in patent litigation in significant numbers was well underway, see supra note 41.

[74]Complaint, Legal info. Inst. (http://www.law.cornell.edu/wex/complaint/). The requirements for notice pleading in complaints is set forth in Fed. R. Civ. P. 8.

[75]Answer, Legal info. Inst. (http://www.law.cornell.edu/wex/answer/). The rules for answers are set forth in Fed. R. Civ. P. 9.

[76]Id.; see generally Fed. R. Civ. P. 8–10.

[77]False marking disputes are cases in which someone, often a member of the general public, complains that a company labeled its product as "patented" when, in fact, no unexpired patent covered the product. The issues in patent false marking cases are quite different from disputes about whether a party infringes a patent. For instance, the validity of the patent is not at issue in patent false marking cases. Many of the cases involved companies that, without bad intent, continued to mark their products with a patent number even though the patent had expired. In these cases, infringement was not at issue either. Furthermore, none of the current debate about PAEs involves claims about false marking. Consequently, we thought it best to remove these cases from the dataset.

complaints alleging only design (and not utility) patents,[78] non-patent infringement allegations (i.e., legal malpractice,[79] inventorship disputes,[80] demands for patent term adjustments,[81] interferences,[82] motions to quash or enforce subpoenas,[83] other actions against the Patent Office, and mislabeled trademark and copyright infringement actions[84]), and duplicate cases (i.e., mirror-image complaints for patent infringement and declaratory judgment actions for no patent infringement[85] involving the same patents and parties). After elimination, our dataset contained 2,520 patent infringement lawsuits in 2010.

We obtained certain specific information for each lawsuit from Bloomberg Law. We recorded the judicial district[86] in which the lawsuit was brought, the judge assigned to the case, the civil action number, the filing date of the lawsuit, the utility patent numbers asserted in the lawsuit,[87] and a list of all parties to the lawsuit. Patent numbers asserted in the 2010 cases were used to categorize the lawsuits by technology.[88]

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[78]Design patents cover ornamental aspects of articles of manufacture, in contrast to the functional aspect. For a thorough discussion of the history of design patent law, see Jason J. Du Mont & Mark D. Janus, Origins of American Design Patent Protection, 88 Ind. L.J. 837 (2013).

[79]In 2013, the Supreme Court clarified that actions alleging malpractice in the handling of a patent case do not arise under federal law. Gunn v. Minton, 568 U.S. 310 (2013).

[80]Inventorship can be challenged in the federal courts. See 35 U.S.C. § 256; Thomas M. Morrow, Challenging Inventorship in Patent Litigation, HIPLA Fall Institute (Oct. 5, 2012) (http://www.hipla.org/Morrow_Thomas.pdf). These cases do not involve contested issues of infringement or validity, and the debate about PAEs does not touch directly on false inventorship issues.

[81]Patent owners can contest the term of the patent and challenge whether an extension is owed. See, e.g., 35 U.S.C. § 154(b).

[82]A patent interference is a proceeding within the U.S. Patent & Trademark Office to determine which of multiple applicants is entitled to a patent. 35 U.S.C. § 135(a).

[83]Parties may move to quash a subpoena pursuant to Fed. R. Civ. P. 45.

[84]Jay P. Kesan & Gwendolyn G. Ball, How Are Patent Cases Resolved? An Empirical Examination of the Adjudication and Settlement of Patent Cases, 84 Wash. U. L. Rev. 237, 261 tbl. 1 (2006) (noting that a small number of trademark and copyright cases are miscoded as patent cases in PACER).

[85]An accused infringer can initiate a lawsuit seeking a declaration of non-infringement, invalidity, or unenforceability, provided that there is a sufficient case or controversy between the parties. See MedImmune, Inc. v. Genentech, Inc., 549 U.S. 118 (2007).

[86]There are 94 separate judicial districts in the federal courts.

[87]The complaints included an explicit identification of the patents-in-suit.

[88]Information about the NBER patent classification can be found in B.H. Hall, A. B. Jaffe & M. Trajtenberg, The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools, NBER Working Paper 8498 (2001).

We hand coded the defendants in the 2010 patent lawsuits. To hand code them, we relied on the complaint, and any amended complaints, for each coded lawsuit and counted the number of defendants listed. We included in the defendant count any party identified by the plaintiff(s) as a defendant in the complaint.[89] For declaratory judgment cases,[90] we counted plaintiffs as "defendants." A defendant was counted as a "defendant" even if that party was dismissed from a lawsuit.[91]

Then, we determined the type of patent holder involved in the lawsuit. We classified all patent holders into one and only one of the following groups: (1) University; (2) Individual Inventor; (3) Large Patent Aggregator; (4) Failed Operating or Startup Company; (5) Patent Holding Company; (6) Operating Company; and (7) Technology Development Company.[92]

Below is a brief description of each category:

1. *University*: A public or private institution of higher learning. It includes foreign and domestic institutions.[93] An example is Cornell University.
2. *Individual Inventor*: One or more inventors who own(s) a patent (i.e., it is unassigned to a company). Often, the party to the litigation would be an individual litigating in his individual capacity. We also included family trusts in this category. Additionally, if it appeared that an individual had formed a corporate vehicle that she completely controlled for the primary purposes of litigation, we coded this as an individual, and we also created a separate subcategory of individuals litigating in a corporate capacity. This arose when the name of the corporate vehicle included the name of the Individual Inventor and no products were being sold. For instance, Ronald A. Katz Technology Licensing, L.P. (RAKTL) asserts patents invented by Ronald A. Katz.[94] While Ronald Katz does

[89]Unfortunately, it was not feasible to exclude "related" defendants. Thus, if two distinct yet apparently related corporate entities (i.e., LG Electronics Inc. and LG Electronics USA Inc.) appeared as separate defendants, we counted those as two defendants. In follow-on research, we are manually identifying such related parties to permit them to be removed, when appropriate.

[90]Typically, declaratory judgment cases are brought under jurisdiction under 28 U.S.C. § 2202.

[91]We included dismissals with and without prejudice.

[92]To determine the proper classification for a plaintiff we looked at several sources. First, we reviewed the complaint filed in the lawsuit. Sometimes, the complaint mentioned whether products were being manufactured by the patent holder and whether those products were covered by the patents at issue. If the complaint made that sort of statement, then we coded the patent holder as an Operating Company. When the complaint was silent (as it was in the majority of cases), we used web searches to obtain information about the patent holder. If the patent holder had a website indicating that it manufactured products, then we classified it as an Operating Company.

[93]We do not believe that any of the entities we categorized as universities were instead patent holding companies that were named to sound like universities. We reviewed the complaints for all cases and the complaints contained recitations of each party in the case. The recitation of universities typically indicated something along the lines that they were not-for-profit educational institutions.

[94]See Company Overview of Ronald A. Katz Technology Licensing, L.P., Bloomberg Businessweek (http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=7672486, last visited Sept. 19, 2014).

not technically hold these patents in his individual capacity, we believe that RAKTL is best understood as an Individual Inventor. Sometimes, our review of corporate records revealed that the Individual Inventor owned all shares of the corporation. Unfortunately, such corporate records were not available for all companies, especially for companies we identified as Patent Holding Companies. Consequently, we suspect we may undercount the number of individuals litigating in a corporate capacity and, similarly, overcount Patent Holding Companies.

3. *Large Patent Aggregator*: A company with a large patent portfolio whose primary business is enforcing patents of numerous other individuals and entities.[95] This includes Acacia companies, Wi-Lan, and Intellectual Ventures. We believe that there are few to no false positives in our coding of Large Patent Aggregators. All the entities that we identify as Large Patent Aggregators are indeed so. However, we acknowledge that there may be some false negatives. There may be companies that are affiliated with a larger patent enforcer, but that relationship is not evident from the publicly available sources we consulted.
4. *Failed Operating or Startup Company*: A company that originally invented the patent-in-suit and attempted to commercialize the technology. At present, the company sells no products, and its primary business appears to be patent litigation. An example of a Failed Operating or Startup Company is Broadband Graphics LLC.
5. *Patent Holding Company*: Typically, limited liability companies that appear to have been formed solely to hold and enforce a patent or small portfolio of patents. As far as we can tell, the original inventor does not own these companies. Frequently, these companies were formed shortly before litigation was commenced. Because pubic information about private companies is difficult to obtain, we cannot rule out that some entities that we classified as Patent Holding Companies are instead either Individual Inventors who formed a corporate non-practicing vehicle to enforce their patents or Large Patent Aggregators who formed separate entities for different patent portfolios. We believe, however, that most of the entities we have classified as Patent Holding Companies are one-off companies asserting patent rights that they obtained from another.
6. *Operating Company*: Companies that manufacture products or deliver services (other than licensing patents). An example of an Operating Company is Hewlett Packard. We have not analyzed whether the Operating Company is actually making use of the patent-in-suit.[96] We also included IP holding companies

[95]The line between Patent Holding Company and Aggregator is not completely clear. We generally used the Aggregator category sparingly, limiting it to companies that had assembled via acquisition of portfolios hundreds of patents or more.

[96]We know that some operating companies assert patents that they do not utilize in their business operations. See Ted M. Sichelman, The Vonage Trilogy: A Case Study in "Patent Bullying," 90 Notre Dame L. Rev. 543 (2014).

owned by manufacturing companies in this category. For instance, AT&T Intellectual Property I, L.P. was considered an Operating Company.[97]

7. *Technology Development Company*: A company that invested in the development of technology, perhaps with the intention of licensing rather than commercializing. A Technology Development Company is the original owner of the patents but does not manufacture products covered by the patents. Examples of Technology Development Companies are Walker Digital LLC and Tessera Technologies.

As previously reported, our intercoder reliability for the coding of patentee entity types is high.[98]

Our data are publicly available at http://www.npedata.com, and the data have been downloaded by hundreds of users, including legal and business scholars, employees of governmental agencies, consultants, lawyers, and interested members of the public.[99] Since the data's public release, the coding schema (and the raw data) has been used in academic studies by many researchers.[100] Some of these researchers have used the specific codings we performed for the 2010 and 2012 patent litigation data in their own research.[101] Others have taken our coding schema and used it to code other, raw

[97]There were only 150 defendants that were sued by IP holding companies of manufacturing companies. As a robustness check, we performed all statistical analysis both separating IP holding companies owned by manufacturing companies and combining them with operating companies. The results were entirely consistent. Because we believe these entities are very close to the manufacturing companies—they typically report to the same management—we report in this article only the combined results.

[98]The three co-authors personally coded the entity types of the patent holders, with each co-author completing slightly more than one-third of the lawsuits.

[99]The three co-authors maintain the website npedata.com. As of July 17, 2017, 346 individuals had registered to download the data.

[100]See, e.g., Lauren Cohen, Umit G. Gurun & Scott D. Kominers, Patent Trolls: Evidence from Targeted Firms (http://www.nber.org/papers/w20322) (working with "hand-coded, finely classified public data assembled by Cotropia et al. (2014)"); Christopher B. Seaman, Permanent Injunctions in Patent Litigation After *eBay*: An Empirical Study, 101 Iowa L. Rev. 1949, 1987 (2016) ("This study classified each patent holder into one of eight categories based on a classification system developed in a recent empirical study by Christopher Cotropia, Jay Kesan, and David Schwartz regarding the role of PAEs in the patent system."); Christopher B. Seaman, Ongoing Royalties in Patent Cases After *eBay*: An Empirical Assessment and Proposed Framework, 23 Texas. Intell. Prop. L.J. 203, 236 (2015) (explaining that the empirical study article relied "on the coding methodology developed by Professors Chris Cotropia, Jay Kesan, and David Schwartz"); Hannah Jiam, Fee-Shifting and Octane Fitness: An Empirical Approach Toward Understanding "Exceptional," 30 Berkeley Tech. L.J. 611, 628 n91 (2015) (using "a dataset compiled by Christopher A. Cotropia et al." to determine if an entity was an NPE); Jay P. Kesan & Kirti Gupta, Studying the Impact of *eBay* on Injunctive Relief in Patent Cases (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2629399) ("We utilize a systematic methodology for identifying potential non-manufacturing entities, as explained by Cotropia, Kesan and Schwartz."). See also Stephen Kiebzak, Greg Rafert & Catherine Tucker, The Effect of Patent Litigation and Patent Assertion Entities on Entrepreneurial Activity, 45 Research Policy 218 (2016) (noting that the Cotropia, Kesan, and Schwartz classification system is more nuanced than the coding schema used by the authors, but arguing that the schema used in the article was sufficient for the claims the article is testing).

[101]See, e.g., Lauren Cohen, Umit G. Gurun & Scott D. Kominers, Patent Trolls: Evidence from Targeted Firms (http://www.nber.org/papers/w20322).

patent litigation data.[102] We have also "crowd-sourced" testing of the robustness of the coding schema and the actual coding itself through significant feedback on the publicly available dataset.[103]

We recognize that there are other classifications of patent holders upon which some scholars rely. For instance, one of us, in other work with John Allison and Mark Lemley, has coded patent owners using a slightly different schema.[104] There is much overlap between all the coding schemes of patent plaintiffs, including separating universities from other types of non-practicing entities. However, the coding schema used in the present study is more granular in a key aspect that is relevant to our area of inquiry. More specifically, our coding schema attempts to separate patent aggregators from more run-of-the-mill patent holding companies. Other classification systems do not separate these entity types. We believe that the behaviors of these two types of patent holders may systematically differ, and we exploit the separation of these entity types in the results that follow.

B. Enhanced Data

For the present article, we gathered new information about the 2010 patent lawsuits. More precisely, we gathered information about when and how each defendant in each lawsuit exited the lawsuit. It is important to emphasize that we gathered this information on a per-*defendant* basis, not on a per-lawsuit basis. Thus, if a lawsuit had five unrelated defendants, we would record separate disposition information for each of the five defendants. Our dataset includes 9,101 defendants in total, not all of whom are unique. If, instead, we had gathered the information on a per-lawsuit basis, we would capture only information about the last defendant to settle or exit the lawsuit. Although it was substantially more time intensive for us to gather information on a per-defendant basis, we believe that this information is significantly more useful when analyzing patent litigation. A majority of the 2010 lawsuits involved multiple defendants.[105] If most defendants settled earlier than the final defendant, then using a per-lawsuit method may substantially overestimate case durations. On the other hand, if most defendants settled early, but one defendant litigated the case until judgment, then reviewing only the judgment would not completely or accurately represent the litigation. A large number of early settlements may show evidence of patentees' strategic behavior that would otherwise be missed by viewing the data on a per-lawsuit basis. Again, only by evaluating data on a per-defendant basis can patent litigation be comprehensively unpacked and untangled.

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[102]See, e.g., Christopher B. Seaman, Ongoing Royalties in Patent Cases after *eBay*: An Empirical Assessment and Proposed Framework, 23 Texas. Intell. Prop. L.J. 203, 236 (2015).

[103]See Cotropia et al., supra note 20, at 690–91 (detailing this feedback we have obtained on the data and our responses to such feedback).

[104]See supra note 25.

[105]One-thousand-three-hundred-sixty-four of the 2,520 (54.13 percent) cases in 2010 included two or more defendants.

For each defendant, we identified the date that the party entered the case and exited the case. The entrance date is the date of the first complaint naming the party, which is typically the original date of the lawsuit.[106] Sometimes, a party is added after the original filing date via an amended complaint.[107] In such instances, we used the date of filing of the amended complaint.[108] The date of exit from a lawsuit is the date that the party was dismissed from the lawsuit. In most instances, there is a voluntary dismissal entered by the court,[109] presumably and often clearly following a settlement agreement.[110] We used the date of an actual dismissal as the exit date.[111] In lawsuits without dismissal, we used the date of judgment by the district court.[112] From the entry and exit dates, we determined the case duration for each *party* in each lawsuit filed in 2010.[113]

We also recorded the reason for the dismissal of each defendant from the lawsuit. There are many reasons that a defendant may exit a case, and we call this reason the "disposition." We recorded this information on a very granular level. For simplicity, we group these types of dispositions into three categories: (1) voluntary dispositions; (2) procedural dispositions; and (3) substantive dispositions. Voluntary dispositions include stipulated dismissals and voluntary dismissals by the patent holder. Procedural dispositions include dismissals for lack of standing,[114] improper joinder,[115] lack of personal jurisdiction,[116] and lack of subject matter jurisdiction.[117] We classified default

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[106]The complaint is typically the first document filed in PACER. It always identifies the defendant to the lawsuit, both in the caption and in the text.

[107]Amended complaints are covered by Fed. R. Civ. P. 15. Leave is freely given to parties to amend their complaints. Foman v. Davis, 371 U.S. 178, 182 (1962).

[108]A small number of cases had "John Doe" defendants. If a defendant was later substituted in place of a John Doe defendant, we used the date that the defendant was specifically named in a complaint as the entrance date.

[109]Voluntary dismissals are pursuant to Fed. R. Civ. P. 41.

[110]Private settlement agreements typically include a provision that the parties will dismiss pending lawsuits. For an example of such a settlement agreement, see Section 8 at https://images.template.net/wp-content/uploads/2016/03/24054857/Confidential-Settlement-of-Known-Unknown-Claims.pdf.

[111]Rarely, there was a motion for violation of a settlement agreement. We did not consider the case still open if such a motion was filed. Once the party was dismissed from the lawsuit, even if there was a later dispute, we counted the party as having resolved the lawsuit.

[112]Judgment is a term of art. See Fed. R. Civ. P. 54.

[113]More precisely, to determine the duration of a party, we subtracted the party's exit date from its entry date. It is the raw number of days between these two milestones. We did not adjust for weekends or holidays.

[114]A motion to dismiss for lack of standing is typically brought under Fed. R. Civ. P. 12(b)(1).

[115]A motion to dismiss for improper joinder is typically brought under Fed. R. Civ. P. 20(a).

[116]A motion to dismiss for personal jurisdiction is typically brought under Fed. R. Civ. P. 12(b)(2).

[117]A motion to dismiss for lack of subject matter jurisdiction is typically brought under Fed. R. Civ. P. 12(b)(3).

judgments,[118] which occur when the defendant does not appear in court to answer the complaint, as procedural dispositions. Substantive dispositions include trial outcomes[119] and grants of summary judgment[120] on merits issues. We also included the small number of cases decided under Rule 12(b)(6) for failure to state a claim as substantive dispositions. There were a small number of defendants—245—that were still pending when we completed our coding in November 2015.[121] We report some information on these pending defendants in Figure 5. For our analysis, we right censored the data by assuming that the close date of these defendants is November 2015.[122]

We recorded if the case had been stayed[123] or transferred.[124] Stayed and transferred cases lasted longer than run-of-the-mill cases. Much of the delay was caused by the stay or transfer itself. For that reason, we omit stayed and transferred cases from the analysis below, unless we specify otherwise.

We made another important classification of defendants. Many times, a patent owner asserts infringement against multiple, related parties. For instance, a patentee may sue Fujitsu America, Inc., and Fujitsu Components America, Inc.[125] These companies are frequently represented by the same counsel, and they enter and exit the case on the same date.[126] These entities, when they file papers in the litigation, always file a joint brief, motion, or other filing.[127] For the purposes of our analysis, we had concerns

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[118]A default judgment, entered under Fed. R. Civ. P. 55, is typically entered when a party fails to plead or otherwise defend in a litigation.

[119]We include both bench and jury trials under the category of trials.

[120]A motion for summary judgment is brought under Fed. R. Civ. P. 56. A party is entitled to summary judgment on an issue if there is no genuine dispute as to material fact on that issue, and the law favors the moving party.

[121]See Section IV.A.1.

[122]As a robustness check, we also analyzed the data assuming that all open defendants reached a substantive disposition. Because the number of open cases was large relative to the number of substantive dispositions, our results with respect to individual inventors on substantive dispositions lost significance when assuming that all open cases would reach a substantive disposition. We believe that such an assumption is too conservative as even cases that pend for a long period of time frequently settle. However, one should know that this result is more vulnerable than others to what transpires in the open cases.

[123]Courts have inherent power to stay or pause litigation. Courts may stay litigation if, for instance, the U.S. Patent & Trademark Office is reexamining the patent in suit. See Wayne O. Stacy, Reexamination Reality: How the Courts Should Approach a Motion to Stay Pending the Outcome of Reexamination, 66 Geo. Wash. L. Rev. 172 (1997).

[124]Cases can be transferred from one judicial district to another, through, for instance, 28 U.S.C. § 1404.

[125]These defendants are parties to PACID Group, LLC v. Asustek Computer Inc. et al (6–10-cv-00108) (E.D. Texas).

[126]These defendants are both represented by Christopher M. Joe of Buether Joe & Carpenter. They were both dismissed on Feb. 1, 2011 through a single court order, in response to a joint motion by these defendants.

[127]These defendants, for instance, filed a joint motion to extend time to answer, at docket entry 55.

about considering the two Fujitsu parties as two defendants. We are primarily measuring case duration, settlement behavior, and adjudications. The costs for these two defendants are likely the same as if either one were sued. The burden on the court and the plaintiff is similarly the same for one or two parties. In fact, it appears that multiple, related parties are often sued because plaintiffs may be overly cautious, desiring to make sure that there is no possibility of naming the wrong defendant. For that reason, we chose to collapse related defendants into a single defendant for the purposes of our analysis.

To collapse related defendants into a single defendant, we identified "related" defendants using two different definitions, one broad and one narrow. Our narrow definition of related defendants required that the parties share a root name, like the Fujitsu example above,[128] and enter and exit the case on the same dates. If two parties fit our narrow definition of related defendants, we would exclude one of the two for our analysis. Our broad definition of related defendants included everything in the narrow definition, and a small number of additional parties. The broad definition included multiple defendants where one defendant owned another, even if they did not share the same name. For instance, in one lawsuit, the patentee sued the American Broadcasting Company (ABC), as well as various Disney entities.[129] Disney owns ABC,[130] so we identified ABC within our broad category of related defendants. We recognize that the ABC and Disney defendants may be duplicative for the same reasons that we identify above with respect to narrow defendants. However, these defendants *may* make different allegedly infringing products, requiring additional time for the court and the parties. It is not feasible for us to investigate each of these defendants more fully; consequently, we identify them as broadly related.

In the results section, we identified where we exclude related defendants using the narrow definition. In unreported results, we analyzed the data using the broad definition of related parties. There are no material differences in the results, given that few defendants fell within our broad definition and not our narrow definition.[131]

Finally, we supplemented our dataset with information about the lawyers and law firms who represented the parties in the cases. Docket Navigator provided us with a list of every attorney who ever represented a party in a 2010 lawsuit.[132] We matched these attorneys to our cases. Some of the individual inventors in our dataset represented

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[128]See supra note 125.

[129]See Civil Action No. 3:10-cv-00146 in the Southern District of California.

[130]See Geraldine Fabrikant, Walt Disney to Acquire ABC in $19 Billion Deal to Build a Giant for Entertainment, N.Y. Times, Aug. 1, 1995 (http://www.nytimes.com/1995/08/01/business/media-business-merger-walt-disney-acquire-abc-19-billion-deal-build-giant-for.html?pagewanted=all).

[131]In fact, only 45 defendants fell within the broad definition as compared to the narrow definition.

[132]Docket Navigator obtained the attorney information from PACER. It includes all attorneys who filed appearances in the case, including trial and local counsel, as well as counsel whose representation was terminated before the conclusion of the case. Docket Navigator provided us a list of attorneys and their respective law firms.

themselves as pro se litigants.[133] A case was deemed pro se if the patent holder was an individual inventor,[134] the lawyer's name was the individual inventor, and there was no law firm identification present.

IV. Results and Analysis

A. *Influence of Patentee Entity Type on Overall Case Progression*

Based on our data, we looked at whether the category of patentee entity type was correlated with the duration of the case and how the case was disposed. We also explored if the technology of a given case or the venue or judge was correlated to the patentee entity type. Our main focus was whether the entity was linked to litigation behavior, the popular narrative being that PAEs either brought weak cases or engaged in "hit and run" tactics, and thus their cases were voluntarily disposed of (most likely via settlement), and this disposition happened early. We also sought to determine if the cases had particular settlement patterns based on entity type.

1. Duration of the Cases

As previously mentioned, we coded for duration by defendant, and not by case. For the 9,101 defendants we coded for from 2010, 8,399 of those defendant's cases were closed at the time of coding. Among those remaining, 245 were still open, 347 had been transferred or consolidated,[135] and for 110 of the defendants, termination was impossible to reliably code. The transferred or consolidated cases were often merged into other cases. Thus, excluding the transferred or consolidated cases, 96.2 percent of the cases were closed at the time of coding.

In Figure 1, we report the median and mean of the duration of these closed cases. These durations are separated by patentee entity type—with Figure 1 separately reporting case durations on a defendant basis for lawsuits brought by Individual Inventors (including family trusts), Operating Companies, Failed Operating Company, Patent Holding Companies, and Large Aggregators.[136] These last two could be considered collectively as PAEs—or non-operating companies. We also collected data for other non-operating companies such as Universities and Technology Development Companies, but

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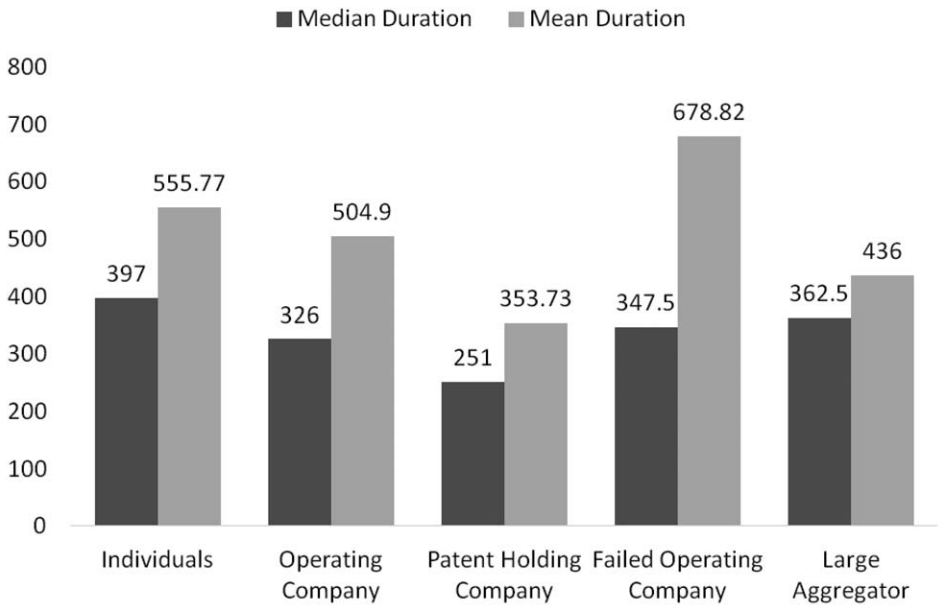
[133]Pro se is Latin meaning "on one's own behalf." It refers to parties who represent themselves in court without retaining a lawyer.

[134]Under the rules of legal ethics, only individuals can appear pro se. Corporations must appear through an attorney.

[135]Under Fed. R. Civ. P. 42(a), the court may consolidate multiple separately filed lawsuits into a single action. The multiple lawsuits must involve common issues of fact. Cases can be consolidated for discovery, claim construction, and/or summary judgment, without necessarily consolidating the lawsuits for trial purposes.

[136]We are aware of only one study investigating duration of lawsuits by entity type. That study uses the broad classifications of NPE or non-NPE, not the granular categories that we use. See Alex Haus & Steffan Juranek, Patent Trolls: A Specialization or Hold-Up Story (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2424407).

Figure 1: Case duration by patentee entity type.



do not report those results here because of the small number of defendants falling under these three categories.[137]

Notably, Failed Operating Companies showed the longest mean duration at almost 700 days, with Individuals having the second longest duration. The difference in mean duration for such patentees was statistically significant.[138] Patent Holding Companies had a lower mean and median duration than Operating Companies and this difference was statistically significant.[139] The range of median durations was fairly large, ranging from a low of 251 days for Patent Holding Companies to a high of 397 days for Individual/Family Trust patentees. We focus here on median durations since they are not influenced as much by outliers.

While mean and median durations are a useful start, we further analyzed the data by examining the complete distribution of durations. In Figure 2, we plot the duration of each defendant by patentee entity type.

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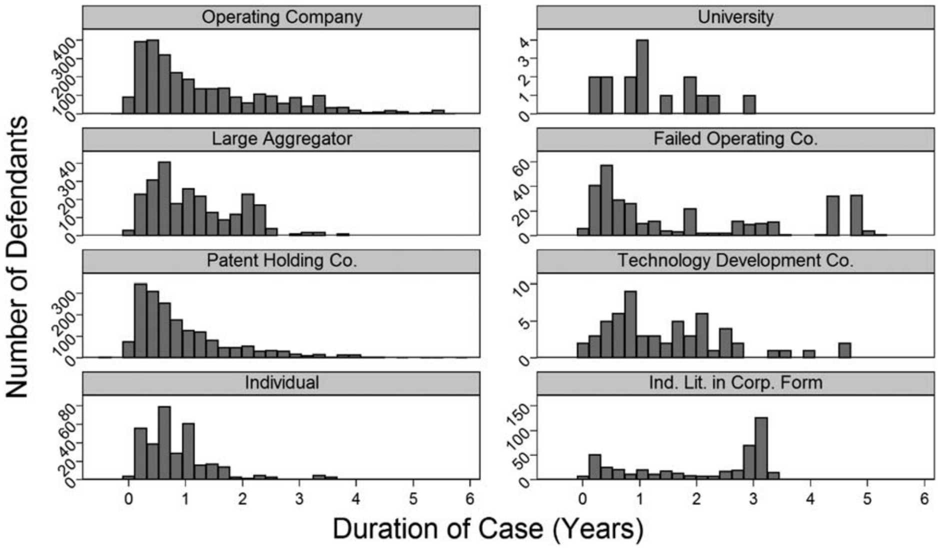
[137]We follow this convention throughout—reporting the descriptive statistics for patent holding companies, failed operating companies, and large aggregators to give the reader an insight into the behavior of non-operating companies/PAEs. However, when we perform other statistical analysis, we look at all categories of patentees.

[138]A t test assuming unequal variance reported a two-tailed p value of 0.0005, with a t statistic of -3.3284 with 451.275 degrees of freedom.

[139]A t test assuming unequal variance reported a two-tailed p value of 0.0000, with a t statistic of -6.7264 with 3596.84 degrees of freedom. Accord Risch, A Generation of Patent Litigation.

Figure 2: Histogram of case duration by patentee entity type.



From the histogram, we observe that durations for defendants sued by Operating Companies and Patent Holding Companies are both right skewed. The Patent Holding Company distribution is slightly thicker at shorter durations, hinting at a great propensity of Patent Holding Companies to settle earlier in litigation. The Large Aggregator and Failed Operating Company durations are most evenly spread apart. The Individual Inventor, especially the individuals who have formed a corporate vehicle to litigate (the right-bottom box in Figure 2), show a bimodal distribution, with some defendants exiting the case very early and others exiting very late in the litigation.

Next, we used a hazard model to fit the case durations. A hazard model estimates how various factors affect a known hazard.[140] These models, such as the Cox proportional hazard model that we employ, are widely employed in the medical field where the hazard is patient death.[141] Our hazard is termination of the case for a particular defendant. To better understand the effect of entity types on case duration, we used the hazard model to estimate how entity type affects the time to termination (i.e., survival time)—both any type of termination in general and just those terminations that were settlements.

The first hazard model looked at all defendants that terminated, regardless of the type of termination (substantive ruling by the court, procedural ruling by the court, or

[140]Stephen J. Walters, What is a Cox Model? Statistics (2009), http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/cox_model.pdf.

[141]See, e.g., Spotswood L. Spruance, Julia E. Reid, Michael Grace & Matthew Samore, Hazard Ratio in Clinical Trials, 48 Antimicrobial Agents & Chemotherapy 2787 (2004).

Table 1: Survival in Days for 2010 Patent Lawsuits (Any Disposition)

	# of Defs	*25%*	*50%*	*75%*	*90%*
University	16	241	395	698	820
Individuals	817	206	397	1,043	1,148
Large Aggregator	278	202	362.5	674	827
Failed Operating Company	330	160	347.5	1,192	1,722
Patent Holding Company	1943	120	251	468	804
Operating Company	2899	147	326	693	1,118
Tech. Development Co.	56	231	515	766	1,020

voluntary dismissal of the complaint). The survival is quantified in terms of number of days the case is pending before termination. In Table 1, we report the survival quartiles for each entity type. The 50 percent column in Table 1 corresponds to the median duration of defendants, as shown in Figure 1.

Most entity types exhibited a similar distribution among the various quartiles. The range of durations in the first quartile was the most compact. In the first quartile (25 percent), all the entity types had resolution times between 120 and 241 days. The survival times spread out across the categories by the third quartile (75 percent), with resolution dates ranging from 468 days (Patent Holding Companies) to 1,192 days (Failed Operating Companies). Individuals and Failed Operating Companies both appear to pend longer in the later quartiles. Operating Companies exhibit a similar behavior, but not to the same extent.

To further investigate whether there are any statistically significant differences, we controlled for a variety of independent variables that may also influence the survival time of a case. These include the total number of defendants in a given case, the technology at issue, and the district court in which the case is pending. The results of the series of hazard model regressions are reported in Appendix A1, with the graphical output shown in Figure 3.[142]

The lines in Figure 3 illustrate the survival rate (the y-axis, between 0 and 1) over time (the x-axis, measured in years from lawsuit filing). Half the defendants will have settled at a survival of 0.5. Figure 3 plots the survival curves for Operating Companies and an aggregate NPE category including all Non-Operating Companies.[143] The general configuration for both entity types is strikingly similar. The NPE curve is lower than the Operating Company survival curve, showing that defendants sued by NPEs, in general, obtain quicker resolutions than defendants sued by Operating Companies.

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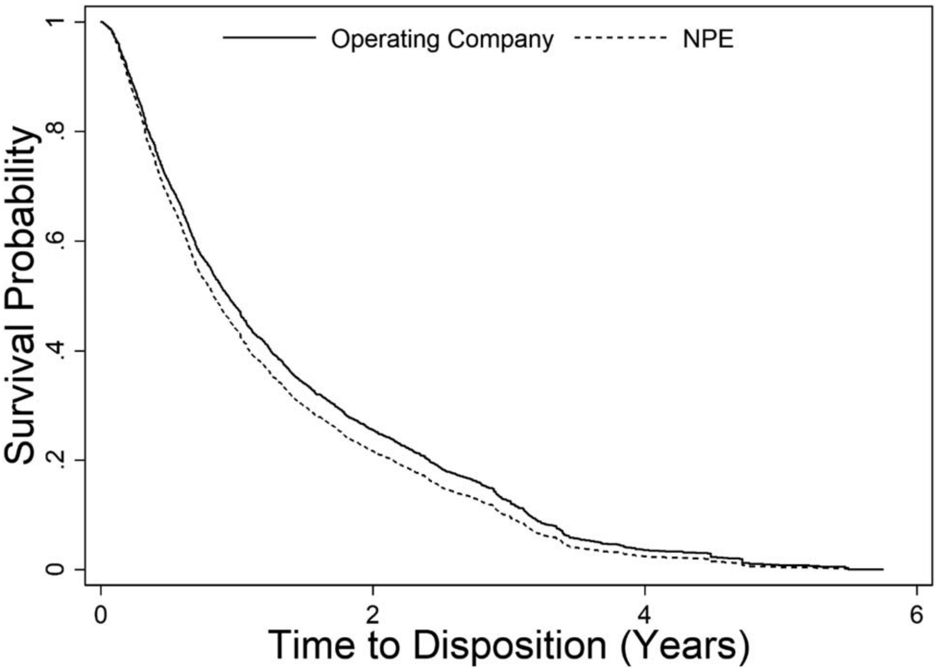
[142]In unreported hazard models and regressions, we performed the same analyses using uncollapsed defendants. The trends were identical to those reported in this article. The same variables were statistically significant and the coefficients were in the same direction.

[143]In the regressions, we chose a "base" category for entity type. The base category forms the baseline against which to compare the other categories, both in terms of testing for significance and the magnitude of difference. We chose to use Operating Companies as the base entity type because we are interested in differences in durations for various forms of NPEs in comparison to operating companies. In unreported hazard models and regressions, we performed the same analysis using Failed Operating Companies as the base category. The difference between this base and every other entity type was statistically significant. Because our core hypotheses deal with the difference between operating companies and various types of NPEs, we felt that operating companies were a more appropriate base category.

Figure 3: Hazard model (any disposition).



We also separate NPEs into various categories. In Figure 4, we plot the survival curves for entity types, separating these categories, and also separating true individual inventors from individuals litigating in a corporate form.

Patent Holding Companies and Large Aggregators survive at lower rates, both compared to Operating Companies. That means that Patent Holding Company cases are disposed of quicker. Defendants sued by Large Aggregators also obtain quicker resolutions. Individual Inventors who litigated in their personal capacity differed from Individual Inventors who formed a corporate vehicle before litigating. Individual Inventors who litigated in their personal capacity survived shorter—their cases were resolved faster. In contrast, Individual Inventors who litigated in corporate form survived longer than Operating Companies, meaning that their cases were resolved slower. Failed Operating Companies had their cases resolved slower.[144]

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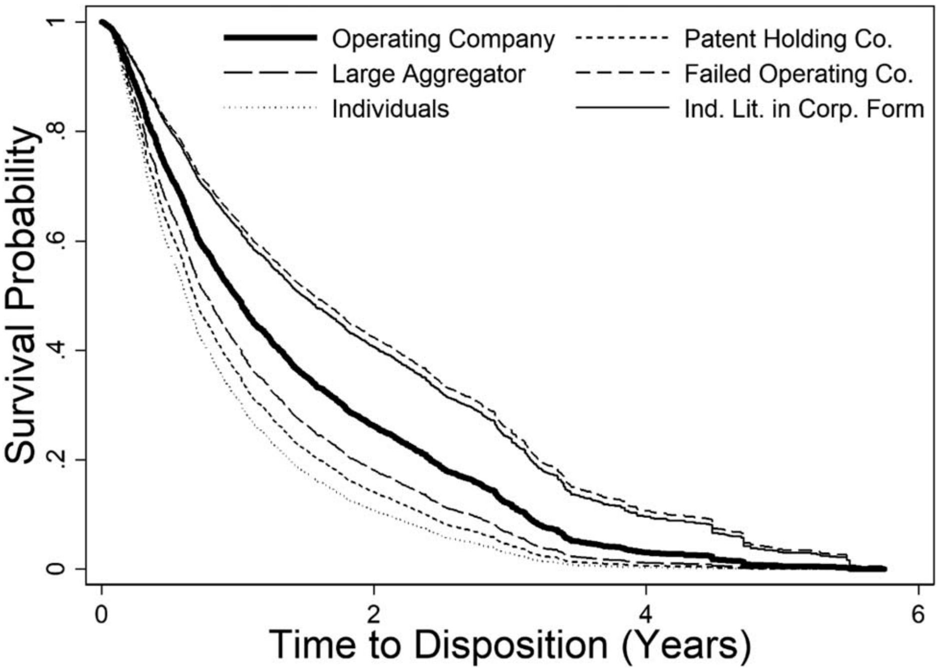
[144]These hazard curves could be compared to hazard curves for the duration of other types of civil litigation. However, the data that were readily available—information from the U.S. Administrative Office of the Courts (AO)—suffered from two limitations that prevented such a comparison. First, the AO data, while breaking the cases down by subject matter litigated, do not categorize the data by plaintiff type like our data. This lack of granularity inhibits a proper comparison between various other civil litigations and patent litigation. Second, the specific collection methodology and actual validity of the AO data are difficult to ascertain. This makes the ultimate integrity of a comparison between the AO data and our data questionable. These limitations prevent such a comparison in this study. However, one-to-one comparison, once the data are collected and coded for other types of civil litigation, is a fruitful future avenue of research.

Figure 4: Hazard model (any disposition, separating types of NPEs).



As reported in Appendix A1, we performed a series of regression models with a range of control variables.[145] The results were completely consistent with the trends shown in Figure 4 and also consistent across models. The regression results provide more evidence that our findings are robust. The control variables we include in the models are consistent with several ex ante views on various factors that may relate to case duration. One control variable was the total number of defendants in the lawsuit. Although our unit of analysis is the individual defendant, we recognize that cases may proceed more slowly the greater the number of defendants in the case. There is more discovery to take and a greater chance of a disagreement that requires court intervention.

We controlled for technology because case complexity may be related to technology. Technology, especially the chemical/pharmaceutical category, may be an imperfect proxy for generic drug litigation. Those cases have a complex statutory framework that includes an automatic 30-month stay upon filing of an application for approval of the

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[145]In the regression models, we only included unrelated defendants. As we previously discussed, we are concerned that some patentees sued multiple related defendants, which may result in some double counts. Removing related defendants avoids this possibility.

Table 2: Survival in Days (Voluntary Dispositions Only)

	# of Defs	*25%*	*50%*	*75%*	*90%*
University	16	241	395	698	820
Individuals	659	192	481	1,067	1,160
Large Aggregator	277	202	363	674	827
Failed Operating Company	286	160	324	1,259	1,722
Patent Holding Company	1844	117	237.5	449	747
Operating Company	2545	142	298	622	1,044
Tech. Development Company	44	220	388	739.5	931

generic formulation. In these cases, there is little incentive for the patent holder to quickly press for a ruling on the merits. We controlled for judicial district[146] as the districts across the country vary in backlog, speed, and the number of patent lawsuits filed in that district. We also controlled for the number of patents asserted. The thinking here was that more asserted patents means more work for the parties, which could mean longer duration. Finally, we controlled for whether the plaintiff was a declaratory judgment plaintiff as previous empirical work has found this related to duration.[147]

The regression results confirm that there are some statistically significant differences in the duration of cases by entity type and district. Notably, Failed Operating Company cases survived longer than Operating Company cases. Failed Operating Companies had the smallest coefficient in the most complete model. Individual Inventors who formed a corporate vehicle before litigation also survived longer than Operating Companies.

Two entity types survived shorter than Operating Company cases: Patent Holding Companies and Large Aggregators. Patent Holding Companies had the largest coefficient in the most complete model. The other entity types did not have statistically significant differences from the base. Cases involving Individual Inventors litigating in their individual capacity also survived for less time.

The second hazard model focused on a subset of the dispositions, only those cases that terminated voluntarily. These voluntary terminations are likely settlements, which may be useful to evaluate litigation strategies of entity types without formal court adjudication. To truncate the dataset, we excluded defendants that did not settle, but instead exited the case through a procedural or substantive determination. In Table 2, we report the survival quartiles for each entity type.

The distribution among entity types is very similar to that observed for all dispositions. Again, Individuals and Failed Operating Companies both appear to pend longer in the later quartiles. The difference between Operating Companies and other entities is not as pronounced as seen in Table 1.

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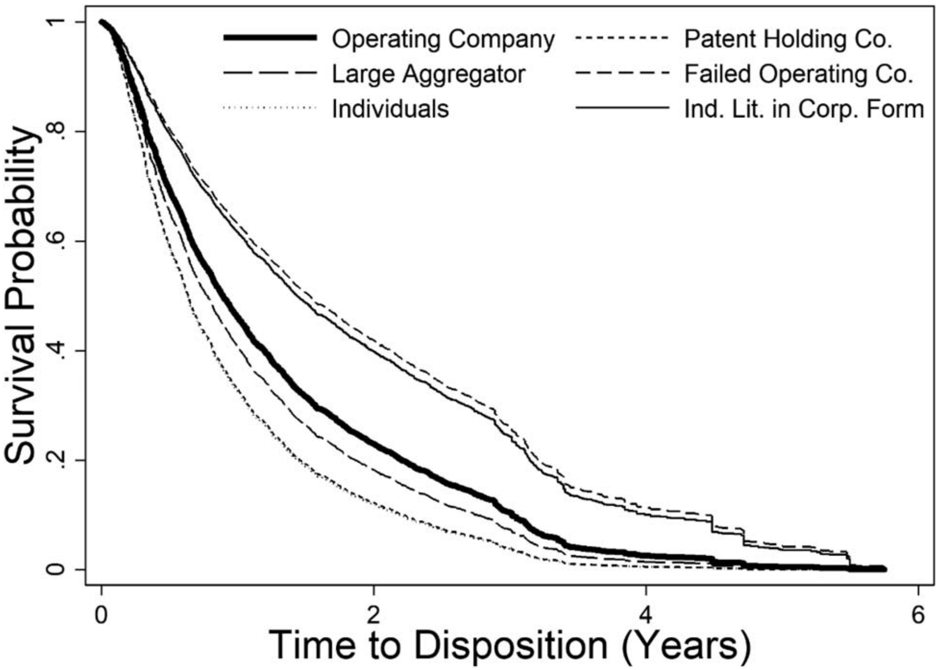
[146]For our district fixed effects, we included a separate dummy variable for each judicial district in which a patent case was filed in 2010.

[147]See Michael Risch, A Generation of Patent Litigation, 52 San Diego L. Rev. 67, 95–96 (2015).

Figure 5: Hazard model (voluntary dispositions only).



To further investigate whether there are any statistically significant differences, we controlled for the same independent variables listed above. The results of the hazard model regressions are reported in Appendix A2, with the graphical output shown in Figure 5.

As reported in Appendix A2, our basic results with respect to statistical significance of Patent Holding Companies and Individual Inventors litigating in corporate form—all relative to Operating Companies—were consistent across all models, and were the same for voluntary dispositions as they were for all dispositions. Failed Operating Companies had longer durations, but Individual Inventors litigating as individuals had shorter durations.

In addition to the hazard models, we also investigated the relationship between entity type and case duration using a series of linear regression models. As reported in Appendix A3, we find similar results in the linear regression models as we do in the hazard models. More specifically, we find that Patent Holding Companies litigate, on average, between 127 and 197 days less than Operating Companies, while Large Patent Aggregators litigate on average between 91 and 132 days less than Operating Companies.[148] True Individuals litigate on average between 91 and 195 days fewer than Operating Companies. Individual Inventors litigating in corporate form litigate on average between 149 days and 207 days longer than Operating Companies. We note that while

[148]To estimate the number of days, we converted the coefficients from the regressions from years to days.

these results are statistically significant, that does not mean that these relatively small differences are practically important.

In sum, in terms of raw durations, there are differences in durations based on the patentee entity type. This survivability is statistically significant among many entity types.

2. Disposition of the Cases

Moving beyond case duration, we now discuss case dispositions. Our data also allow us to observe the disposition of the 8,399 terminated defendants by patentee entity type. As previously mentioned, we grouped dispositions into three categories: voluntary, procedural, and substantive dispositions. Figure 6 reports these results for all the coded defendants for six categories of patentee types: Individuals litigating in their individual capacity, Individuals forming a corporate vehicle to litigate, Operating Companies, Patent Holding Companies, Failed Operating Companies, and Large Aggregators, after correcting for related defendants.[149]

As can be seen in Figure 6, the dominant disposition for all patentee entity types is voluntary, which are highly likely to be settlements. Over 80 percent of all defendants exit lawsuits because of voluntary settlements. A larger percentage of defendants sued by Large Aggregators are terminated by settlements compared to other categories of patentees.[150]

There are, as seen in Figure 6, differences in distribution among the different disposition categories depending on the patentee entity type. We have, however, concerns that certain aspects of the raw distribution are endogenous, including where the lawsuits are filed and the technology. To try to untangle these potential effects, we performed a series of linear regressions for each disposition—voluntary, procedural, and substantive—with the entity type.[151] In the full specification, we also controlled for the total number of defendants in each case, the number of patents asserted, whether the action was a declaratory judgment action, technology group fixed effects, district court fixed effects, judge fixed effects,[152] plaintiff attorney fixed effects,[153] most litigious patent holder fixed effects,[154]

[149]In unreported results, we find essentially the same pattern without collapsing multiple, related defendants into a single defendant.

[150]The differences are not statistically significant.

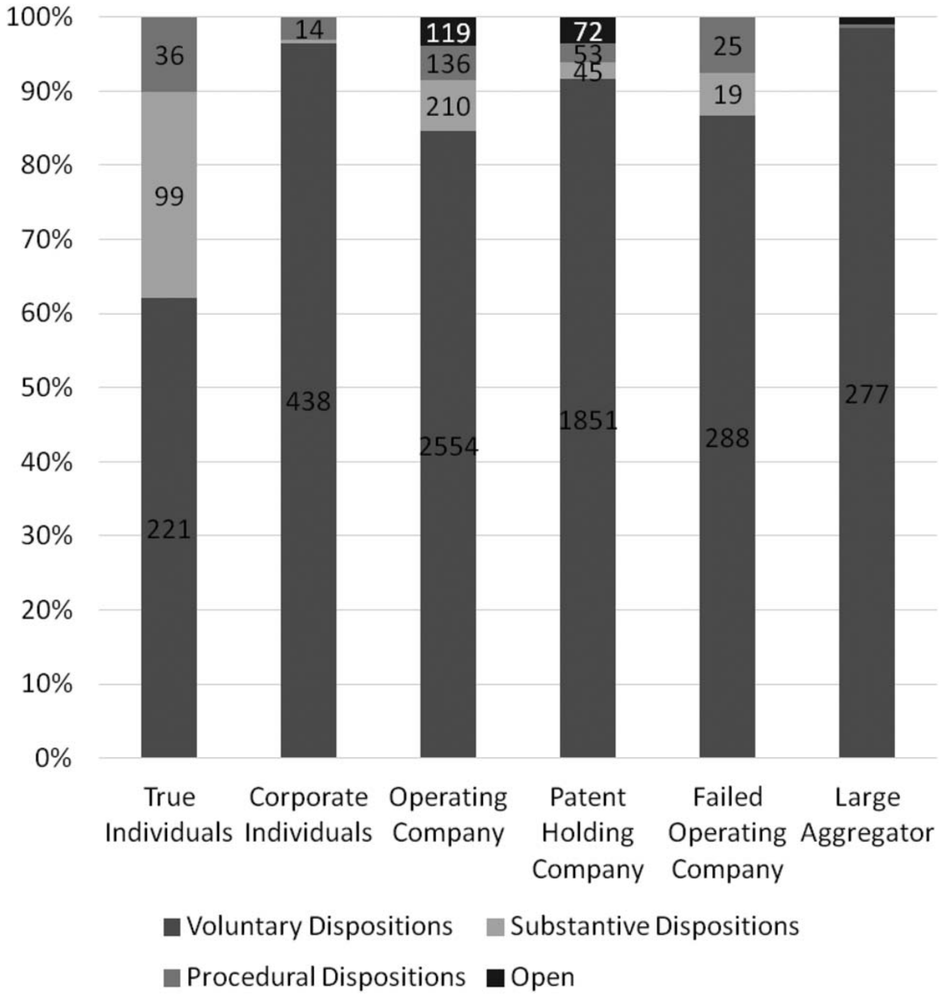
[151]We separately ran logit, probit, and linear regression models. The results were consistent. For ease of interpretation of the coefficients, we report in this article the results from the linear regression models.

[152]For judge fixed effects, we included a separate dummy variable for each judge who presided over five or more defendants in 2010. The remaining judges were included in a residual dummy variable.

[153]We included a separate fixed effect for each attorney appearing in more than 25 cases, which included 36 lawyers.

[154]We included a separate fixed effect for each of the most litigious patent holders in 2010. For the most litigious patent holders, we used any patent holder who sued 50 or more companies in 2010. These were Geotag, Parallel Networks, Condatis, PACid Group, Uniloc, Adjustacam, ArrivalStar, Gharb, Lexmark, Lottotron, Patent Harbor, Tripharma, Wolf Run Hollow, and Wordcheck Tech.

Figure 6: Number of dispositions by patentee entity type (collapsing related defendants).



and a pro se representation dummy.[155] We ran separate regressions for each disposition, in part as a robustness test, since the cases that reach each phase may be different. We clustered standard errors at the district level.[156] As reported in full in Appendices B1, B2,

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[155]For these models, we performed the analysis only on the collapsed defendants. The unreported results for all defendants showed the same variables as statistically significant and in the same direction.

[156]As a robustness check, we also reran the regressions with standard errors clustered at the case level. The results reported in the appendices cluster at the district level, but results from clustering at the case level are materially the same in terms of statistical significance.

and B3, there is statistical significance between some entity types.[157] For comparison purposes, we used Operating Company as the base category. An *F* test for joint entity type effects was statistically significant in all models, further supporting our finding that there are statistically significant differences among the entity types. The judge fixed effects model controlled for the identity of the judge. Including judge fixed effects increased the explanatory power of some of our models from about 13.5 percent to over 38 percent, a large increase. The increase in the power of predicting durations when the judge is controlled for makes sense since the judge has substantial power over the case schedule.

Individual Inventors are statistically significant in many models. Individual Inventors litigating as true individuals are positively correlated with substantive dispositions.[158] They are across our models about 88 percent and 213 percent (7–24 percentage points, with lower percentage points in models with more controls) more likely to result in substantive dispositions than are Operating Companies. They are negatively correlated with voluntary dispositions (settlements) by about 13 percent and 29 percent (between 5–25 percentage points, with 25 percentage points in the model with least controls). That means that Individual Inventors were more likely than Operating Companies, on average, to have their cases proceed to a resolution by the courts, and less likely to settle. Fewer settlements and more adjudications is in accord with our findings on Individual Inventor case duration. Typically, settlements occur quicker than adjudications.

Consistent with the descriptive data presented in Figure 6, Large Aggregators were much more likely to settle their cases than Operating Companies. They are, depending on the model, about 7 percent and 18 percent (between 6–16 percentage points, with 16 percentage points in the model with least controls) more likely to settle. Large Aggregators are between 97 percent and 213 percent (between 6 and 10 percentage points) less likely to have their cases reach a substantive disposition.

Patent Holding Companies were different in a statistical sense from Operating Companies on substantive dispositions but not on voluntary dispositions or procedural dispositions. With respect to settlements (voluntary dispositions), only the least complete model showed statistically significant differences between Patent Holding Companies and Operating Companies. Patent Holding Companies were between 56.7 percent and 86.7 percent (between 3 and 5 percentage points) less likely to reach a substantive disposition relative to Operating Companies. However, the differences between Patent Holding Companies and Operating Companies was smaller than the differences between Individual Inventors and Operating Companies.

Further, Patent Holding Companies and Large Aggregators displayed the opposite behavior from Individual Inventors. Large Aggregators settled more than Operating Companies while Individual Inventors settled less. Patent Holding Companies and Large Aggregators were less likely to adjudicate to a substantive disposition than were

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[157]In the appendices, we report the *F* statistic for joint entity type effects in all models.

[158]One individual inventor patentee, Dr. Pieczenik, sued over 40 defendants in 2010. In unreported results, we excluded the doctor from our regressions and found the same variables statistically significant in the same direction. Thus, our results are robust regardless of whether he is included in the dataset.

Operating Companies, while Individual Inventors went to a substantive judgment more often than Operating Companies.

We pause here to briefly talk about selection concerns. Lawsuits are not randomly distributed among entity types, technologies, judicial districts, declaratory judgment actions, numbers of asserted patents, or a whole range of other variables. In fact, these attributes themselves may be correlated with our variable of interest, patentee entity status: PAEs may select patents in certain technologies such as software and file lawsuits in particular districts such as the Eastern District of Texas. Each of these separately or together may influence the propensity of a given lawsuit to settle. While we control for variables such as judicial district, judge, and law firm, our regression models cannot account for any of these intrinsic characteristics, and our results should be understood with this important caveat.

B. Relationship Between Patentee Entity Type and Early Settlement and the Merits

We now turn back to the policy-relevant questions of whether PAEs bring mainly frivolous charges of infringement, seeking nuisance fee settlements. We cannot directly answer these questions since we do not have any information on the amount of settlements. However, we can analyze how frequently different types of PAEs quickly settle their cases, perhaps with an eye to avoiding adjudication of their claims on the merits. In other words, it may be that cases that settle very early are settling for very small amounts of money, the so-called hit-and-run phenomenon.[159] We analyzed the amount of time it took for various defendants to have their cases disposed. We divided voluntary dispositions among various patentee entity types and looked at whether it took less than 60 days, less than 120 days, or more than 120 days to reach voluntary disposition. We also observed, by patentee entity type category, the number of defendants that had their cases terminated by the court or that still had their cases pending. We report the results in Figure 7.

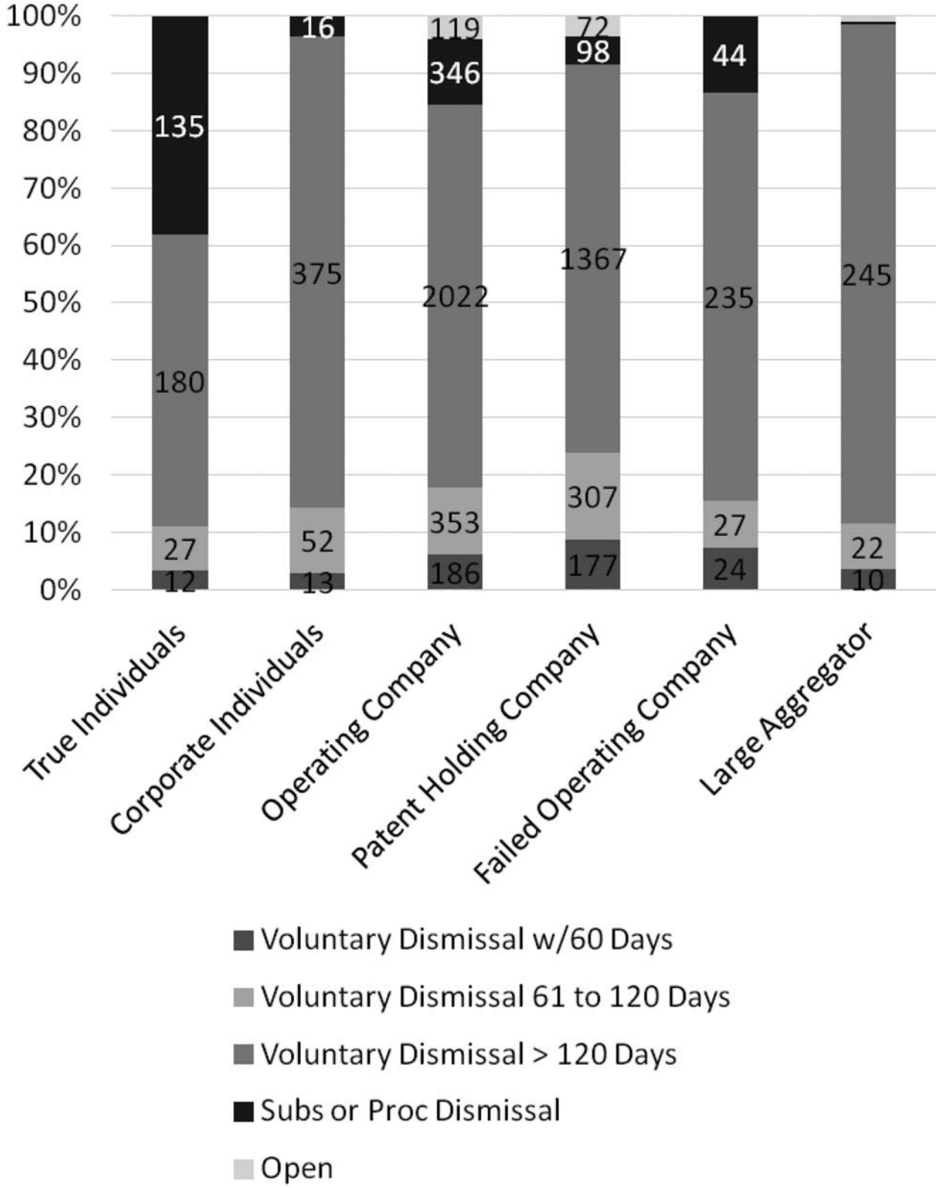
For the patentee entity type cases identified above, a large percentage of defendants were dismissed voluntarily, but after 120 days. In fact, over half the defendants were dismissed voluntarily after 120 days.

Just as we did with dispositions, we examined whether the difference in distribution of these times to voluntary dismissal was explainable by various control variables. We performed similar linear regressions as we did with the dispositions. However, this time, voluntary dismissal within 60 and within 120 days were the dependent variables with the wide range of control variables used in the earlier models.

As reported in full in Appendices C1 and C2, when using all the patentee category types shown in Figure 7, the difference between some entity types and other independent variables is statistically significant, and the length of time to voluntary disposition

[159]We recognize that the opposite may also be true. The early settlements may represent cases in which the parties agree that the patent is valid and infringed, and early settlement reduces both parties' litigation fees. We are skeptical that many defendants settle for large sums of money very early in litigation. Patent litigation is quite unpredictable, in our experience, and defendants are frequently unwilling to settle for significant amounts before serious litigation.

Figure 7: Time to disposition by patentee entity type.



when using Operating Companies, mechanical technology, and district courts other than those identified as the base categories. Of note, Patent Holding Companies are more likely to settle in every different time period.

Table 3: Outcomes by Patentee Entity Type

	Patentee Wins	*Alleged Infringer Wins*
University	0	0
Individuals	3 (6%)	47 (94%)
Large Aggregator	0	0
Failed Operating Company	8 (40%)	12 (60%)
Patent Holding Company	11 (20.4%)	43 (79.6%)
Operating Company	182 (47.1%)	204 (52.9%)
IP Holding Company	1 (14.3%)	6 (85.7%)
Technology Development Company	0 (0%)	15 (100%)

The regression models show statistically significant results for some of the entity types compared to the base category of Operating Company. Patent Holding Companies were more likely than Operating Companies to voluntarily settle a case within 60 days from the date the defendant was sued. Our regression models estimate that the rate of such an early settlement increases 62 percent and 82 percent (between 4–5 percentage points) compared to an Operating Company, although the differences are not statistically significant in our most complete model (which includes lawyer fixed effects) and at the low end (62 percent) for the next most complete model.

Voluntary dispositions within 120 days tells a different story. Only Patent Holding Companies are statistically significant in each of our regression models. Thus, there is robust evidence that in the patent lawsuits filed in 2010, Patent Holding Companies were more likely to settle early—within 60 or 120 days of suing a defendant—than were Operating Companies. Individual Inventors are significant, but only in one of our six models.

We also observed the ultimate result in those cases that were not voluntarily disposed. That is, we coded for whether the patentee or alleged infringer received a winning judgment in those cases with substantive or procedural dispositions. These are a very small percentage of all filed lawsuits, representing only 640 defendants out of 6,468 defendants sued (9.89 percent). The outcomes, by patentee entity type, are reported in Table 3.

When just looking at outcomes, the differences between Operating Companies and PAEs are quite stark. Operating Companies won just under half their cases. PAE entity types lost more cases than they won. Patent Holding Companies prevailed at adjudication on just over 20 percent of defendants. Individual inventors do extremely poorly in adjudicated cases, winning just 6 percent of those decisions. Unlike our data on case duration and settlement where Individuals and Patent Holding Companies were on opposite sides of Operating Companies, both types of PAEs lose much more in adjudications than do Operating Companies. This is consistent with the narrative that patent holding companies prosecute weaker cases or have fewer resources to prevail at trial. It is also generally consistent with findings from another study conducted by one of the present authors that analyzed lawsuits filed in other years, 2008 and 2009.[160]

[160]Allison et al., supra note 25.

Intriguingly, Large Aggregators took no cases to a final adjudication. There were no defendants who either won or lost, meaning that all their cases either settled or resulted in a procedural disposition. Figure 6 shows that procedural dispositions account for almost none of the distribution of Large Aggregator cases; Large Aggregators settle with almost every single defendant. The reasons for and amounts of the settlements, of course, are unknown to us. It is possible that these entities, with large portfolios of patents, have sizable bargaining power with defendants. Alternatively, these entities may settle for small cost-of-defense amounts, making settlement quite enticing to defendants. We note that there were no intellectual ventures lawsuits filed in 2010, but that Acacia Research Corporation was very active and its affiliates make up over half our Large Aggregator patent holders. Wi-Lan was also a frequent Large Aggregator litigant in 2010.

However, the adjudicated defendants represent a very small percentage, about 5 percent, of all the defendants sued. The settlement rates, while all high, differ by entity type. Unfortunately, we do not know the amount in dispute in these cases nor the settlement amounts. It is possible that the additional cases settled by Patent Holding Companies, for instance, were lawsuits they would have won if they reached a final ruling. If this is true (and we have no evidence, either way, on this point), it could explain the differences in win rates. Classic law and economics theory argues that the cases that reach judgment should be the closest cases, the 50–50 cases.[161] Our results for Operating Companies fit this theory, but our results for other patentee types do not. The Priest-Klein theory of litigation also asserts that when the parties have asymmetric stakes, the win rate will vary from 50–50. Here, Operating Companies can obtain injunctive relief in lawsuits while most PAEs cannot.[162] Injunctive relief may result in asymmetric stakes.[163] Priest-Klein predict that having more to gain will result in higher trial win rates,[164] which is consistent with what we observe. The long and the short is that because it is unlikely that the litigated to judgment cases are representative of the settled cases, we urge caution in drawing conclusions from them.

V. Implications

Our analyses of case progression, settlement, and adjudication, taken together, reveal a complicated settlement picture of litigation by different entity types. Some of this may be expected. For instance, cases where an Operating Company is the patentee plaintiff

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[161]Priest & Klein, supra note 36. Others have criticized parts of the Priest-Klein theory. See, e.g., Lee & Klerman, supra note 36.

[162]Seaman, supra note 50 at 1988, Fig. 3 (2016).

[163]Id. at 1980 ("The selection effect is compounded by the asymmetric stakes of injunctive relief, which typically 'harms the infringer more than it benefits the patentee.' These factors may result in underrepresentation of certain types of patent cases. For instance, injunction decisions involving PAEs appear to be underrepresented in the Decisions Dataset.").

[164]Priest & Klein, supra note 161.

may be more likely to have patent counterclaims, which increase the complexity and length of the litigation. Perhaps most interesting and counterintuitive is that the data suggest that not all PAEs are equal. When compared to Operating Companies, some PAE cases exhibit higher survivability—Individuals—and others lower survivability—Patent Holding Companies and Large Aggregators. Thus, different types of PAEs are on opposite sides of Operating Companies in terms of how long their cases last.

Individual Inventors are much less likely to settle overall. Large Aggregators are much more likely to settle overall, but there is no evidence that Large Aggregators settle early. Patent Holding Companies settle early and later. It may be that these early settlements represent nuisance value settlements. However, we offer two observations. First, while the common cost estimates of patent litigation are that it costs millions of dollars in attorney fees, cases that settle within a few months cost only a fraction of that amount. Second, the fact that we only observe early settlements for Individuals, but not for the later ones may relate to the selection of disputes for litigation. Although competitors may resolve some disputes before commencing formal litigation, non-competitors may not have that opportunity. It may be that the only way that large defendants, or at least their lawyers and corporate decisionmakers, will take a license from companies with whom they are not familiar is if the matter progresses to litigation.

Perhaps Large Aggregators want to settle, but seek larger sums. Perhaps they are well schooled in finding the optimal point to settle lawsuits, as repeat players in the business, and do not settle too early. Rather, they wait until they receive information during discovery or wait for important court rulings. Then they settle before trial to avoid uncertainty. Hence, we need to carefully consider various policy recommendations to make sure they will have the intended effect. For instance, because Large Aggregators are more likely to settle than other types of patentees, fee shifting upon an unsuccessful lawsuit will have less bite.

Individual inventors who have formed a corporate vehicle to enforce tend to litigate for a substantial duration. These individual inventors may be more sophisticated than the individual inventors who litigate without forming a corporate entity. They may be guided by more sophisticated counsel, which results in more strategic litigation. For instance, these patent holders may embark on a "war chest" model of litigation.[165] True individual inventors may be making small technical contributions to the field. Thus, they may be entitled to small compensation. Furthermore, as for trial win rates, perhaps this is explained by resources at trial. Large corporate defendants and plaintiffs have the financial resources to pay well-credentialed experts and prepare polished graphical presentations. One expects that this matters in terms of jury perception and outcomes.

Individual Inventors settle less frequently, and reach merits rulings more often, but have a shorter duration. At first glance, the shorter duration and more substantive rulings seem in direct conflict. However, many of the Individual Inventor lawsuits were

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[165]David L. Schwartz, The Rise of Contingent Fee Representation in Patent Litigation, 64 Ala. L. Rev. 335, 368–69 (2012) (describing the "war chest" model of enforcing a patent against multiple alleged infringers, which entails using settlement money from early defendants to build a "war chest" to pay experts and lawyers in subsequent cases. This permits the later cases to be litigated more aggressively).

resolved quickly, some even by motions to dismiss. Thus, even when the court resolved the case, it often occurred quickly (frequently finding against the Individual Inventor on the merits).

It is possible that true individual patent holders may be less sophisticated and reject reasonable settlement offers. Alternatively, perhaps there are differences in their litigation counsel, the underlying patents, or some other characteristic of the litigation system that may explain these results.

Why are true individuals different from individuals who chose to incorporate before litigating? It may be that true individuals lack sophistication if they bring a lawsuit without forming a corporate entity. As a litigant, they are subject to potential fee shifting as well as responsibility for litigation costs if they fail on the merits. If the individual incorporates, then the corporate entity will be liable for any award, not the individual. Thus, lack of incorporation may signal less sophistication. Alternatively, patents owned by an individual may be purchased by a Large Aggregator or Patent Holding Company. If these entities decline to purchase a patent from an individual, the individual may assert it herself in litigation. We would expect these patents to be weaker, however, since PAEs declined to purchase and enforce them.

VI. Conclusion

The actual litigation behavior of PAEs is much more complicated than the simple narratives portrayed in the media. Within the broad category of PAEs, there is tremendous heterogeneity. Entity types, particularly individual inventors and patent holding companies, behave differently than operating companies. However, individual inventors litigate longer, while patent holding companies litigate more quickly. The differences in litigation behavior, while contrary to the common narrative, are not altogether unexpected. The differences are indeed consistent with economic intuition. Different entity types likely have different risk profiles and different incentives, for instance, which drive settlement and litigation strategy. Our robust empirical study confirms that not all PAEs are alike.

Cries that PAEs are universally different from other types of patentee plaintiffs appear to be overstated with respect to case progression and settlement. Using granular data on a per-defendant basis, we analyzed the relationship between entity type in settlement behavior and litigation outcomes. The relationship is more complex than previously understood. Individual inventors play a larger role in the patent system than others have recognized, as do failed operating companies. Surprisingly, individual inventors and failed operating companies appear to be quite different from operating companies and even from other PAEs. Their cases pend longer, indicating that they litigate more, and they settle at lower rates. Why individual inventors and failed operating companies may be behaving differently is an important question, and one that we cannot fully answer with our data. That said, our analysis indicates that some of the "hit-and-run" complaints about patent trolls do not seem to apply to individual inventors or failed operating companies.

Turning to PAEs, we examine whether they settle cases more quickly compared to operating companies. We find that certain venues, technologies, and types of PAEs are correlated with early settlement, but other types of PAEs exhibited the opposite behavior. We cannot, unfortunately, analyze the amount of money included in settlement agreements, as that information is not publicly available and typically treated as confidential. Thus, we cannot directly confront the story that PAEs seek nuisance fee settlements, especially in ways that are meaningfully different from operating company patent holders. The duration data indirectly contradict this story, but further study is recommended. Finally, further study of the underlying patents in the disputes, including the origination of patents asserted by PAEs, will be useful.

Our study establishes that there is significant heterogeneity in litigation behavior and in litigation outcomes among various types of patent plaintiffs. As a result, any patent policy reform that targets specific patent plaintiff types or categories of patent plaintiffs (such as practicing entity vs. non-practicing entity) should be analyzed carefully to understand the disparate impacts that the proposed legislation might have on different categories of patent plaintiffs, for the proposed reform might well fail to meet its intended objectives.

Appendix

Appendix A1: Hazard Model Regression (All Dispositions)[a]

	Duration (Years)				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	0.065	0.041	−0.036	0.132	0.161
	(0.149)	(0.186)	(0.194)	(0.330)	(0.338)
Large Aggregator	0.303***	0.308***	0.337***	0.384***	0.599***
	(0.108)	(0.117)	(0.123)	(0.129)	(0.165)
Failed Operating Co.	−0.232	−0.484**	−0.420**	−0.767***	0.199
	(0.198)	(0.204)	(0.205)	(0.260)	(0.220)
Patent Holding Co.	0.436***	0.475***	0.507***	0.554***	0.543***
	(0.076)	(0.081)	(0.087)	(0.100)	(0.108)
Technology Development Co.	−0.101	−0.048	−0.019	0.069	0.121
	(0.159)	(0.157)	(0.165)	(0.252)	(0.215)
Individual	0.503***	0.371***	0.349***	0.398**	0.363**
	(0.090)	(0.110)	(0.119)	(0.172)	(0.178)
Ind. Lit. in Corp. Form	−0.221**	−0.371***	−0.311***	−0.379**	0.002
	(0.112)	(0.118)	(0.120)	(0.176)	(0.160)
Pro se Plaintiff					1.567**
					(0.764)
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FIÎ	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec Judge.	Yes	Yes	Yes	Yes	Yes

Appendix A1 *Continued*

	Duration (Years)				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,127	6,127	6,105	6,105	6,105

NOTE: Standard errors in parentheses. * p<0., ** p<0.05, *** p<0.01.
[a]The table in Appendix A1 reports five separate Cox hazard models that predict the hazard of case disposition for each defendant. The omitted patentee type is operating company. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. The models were created using Stata.

Appendix A2: Hazards Regression (Voluntary Dispositions Only)[a]

	Duration (Years)				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	−0.030	−0.108	−0.174	−0.268	−0.264
	(0.161)	(0.191)	(0.189)	(0.407)	(0.447)
Large Aggregator	0.226**	0.258**	0.274**	0.275**	0.349**
	(0.113)	(0.124)	(0.132)	(0.139)	(0.174)
Failed Operating Co.	−0.246	−0.480**	−0.417*	−0.853***	0.477**
	(0.230)	(0.238)	(0.239)	(0.308)	(0.227)
Patent Holding Co.	0.440***	0.495***	0.523***	0.527***	0.438"*
	(0.078)	(0.087)	(0.092)	(0.106)	(0.117)
Technology Development Co.	−0.137	0.004	0.043	0.033	0.159
	(0.201)	(0.204)	(0.213)	(0.263)	(0.252)
Individual	0.354***	0.163	0.142	0.112	0.060
	(0.113)	(0.137)	(0.145)	(0.169)	(0.164)
Ind. Lit. in Corp. Form	−0.244**	−0.373***	−0.320**	−0.368*	0.182
	(0.121)	(0.130)	(0.133)	(0.203)	(0.178)
Pro se Plaintiff					2.159***
					(0.557)
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court EE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	5,456	5,456	5,452	5,452	5,452

NOTE: Standard errors in parentheses.* p<0.1, ** p<0.05, *** p<0.01.
[a]The table in Appendix A2 reports five separate Cox hazard models that predict the hazard of voluntary case disposition for each defendant. The omitted patentee type is operating company. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. The models were created using Stata.

Appendix A3: Linear Regression on Duration[a]

	Duration (Years)				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	–0.027	–0.053	–0.005	–0.257	–0.247
	(0.153)	(0.220)	(0.244)	(0.270)	(0.304)
Large Aggregator	–0.354***	–0.327***	–0.342**	–0.248**	–0.363***
	(0.117)	(0.114)	(0.137)	(0.110)	(0.135)
Failed Operating Co.	0.243	0.572*	0.521*	0.674**	–0.077
	(0.432)	(0.290)	(0.309)	(0.262)	(0.218)
Patent Holding Co.	–0.522***	–0.506***	–0.539***	–0.419***	–0.347***
	(0.061)	(0.063)	(0.079)	(0.107)	(0.085)
Technology Development Co.	0.131	0.065	0.025	0.011	0.003
	(0.195)	(0.182)	(0.201)	(0.293)	(0.203)
Individual	–0.534***	–0.393***	–0.397***	–0.337**	–0.249**
	(0.101)	(0.103)	(0.111)	(0.155)	(0.113)
Ind. Lit. in Corp. Form	0.408	0.550**	0.504**	0.566**	0.055
	(0.253)	(0.233)	(0.241)	(0.227)	(0.152)
Pro se Plaintiff					–0.725***
					(0.278)
F statistic	15.49***	21.71***	40.58***	55.67***	3.01***
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,127	6,127	6,105	6,105	6,105
R^2	0.116	0.183	0.186	0.384	0.430
Dep Var Mean	1.29	1.29	1.29	1.29	1.29

NOTE: Standard errors in parentheses. *$p < 0.1$; **$p < 0.0$; ***$p < 0.01$.

[a]The table in Appendix A3 reports five linear regression models that predict the duration a particular defendant remains in a lawsuit. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix B1: Voluntary Dispositions[a]

	Voluntary Dispositions				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	0.112*	0.163**	0.158**	0.157	0.154
	(0.059)	(0.072)	(0.069)	(0.114)	(0.119)
Large Aggregator	0.158***	0.100***	0.094**	0.057***	0.132***
	(0.035)	(0.035)	(0.041)	(0.017)	(0.043)
Failed Operating Co.	0.035	0.002	0.014	–0.063*	–0.024
	(0.056)	(0.063)	(0.071)	(0.038)	(0.055)
Patent Holding Co.	0.067**	0.036	0.041	0.010	0.041*
	(0.033)	(0.029)	(0.033)	(0.026)	(0.025)
Technology Development Co.	–0.062	–0.044	–0.033	0.084	0.017
	(0.079)	(0.081)	(0.083)	(0.059)	(0.068)
Individual	–0.249**	–0.193*	–0.171	–0.114	–0.053
	(0.105)	(0.104)	(0.104)	(0.078)	(0.043)
Ind. Lit. in Corp. Form	0.138**	0.102	0.108	0.080***	–0.073
	(0.069)	(0.069)	(0.068)	(0.029)	(0.102)
Pro se Plaintiff					–0.118
					(0.103)
F statistic	25.38***	6.4***	5.27***	32.4***	2.12**
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,343	6,343	6,321	6,321	6,321
R^2	0.054	0.143	0.135	0.382	0.426
Dep Var Mean	0.86	0.86	0.87	0.87	0.87

NOTE: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

[a]The table in Appendix B1 reports five linear regression models that predict that a particular defendant exited the lawsuit because of a voluntary disposition. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix B2: Substantive Dispositions[a]

	Substantive Dispositions				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	–0.082***	–0.061***	–0.053**	–0.128***	–0.124**
	(0.015)	(0.021)	(0.026)	(0.034)	(0.051)
Large Aggregator	–0.075***	–0.073***	–0.070***	–0.058***	–0.102***
	(0.014)	(0.017)	(0.023)	(0.018)	(0.029)
Failed Operating Co.	–0.008	0.008	–0.005	0.004	0.070
	(0.020)	(0.022)	(0.024)	(0.024)	(0.056)
Patent Holding Co.	–0.049***	–0.047***	–0.052***	–0.034*	–0.044**
	(0.013)	(0.012)	(0.017)	(0.019)	(0.020)
Technology Development Co.	0.091	0.081	0.072	0.041	0.036
	(0.088)	(0.093)	(0.094)	(0.080)	(0.059)
Individual	0.225*	0.237*	0.204	0.122	0.065*
	(0.117)	(0.124)	(0.125)	(0.087)	(0.034)
Ind. Lit. in Corp. Form	–0.063***	–0.047**	–0.056**	–0.071**	–0.017
	(0.022)	(0.020)	(0.024)	(0.031)	(0.032)
Pro se Plaintiff					0.151
					(0.125)
F statistic	32.82***	22.5***	22.1***	24.23***	3.43***
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,343	6,343	6,321	6,321	6,321
R^2	0.073	0.127	0.108	0.337	0.380
Dep Var Mean	0.06	0.06	0.06	0.06	0.06

NOTE: Standard errors in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

[a]The table in Appendix B2 reports five linear regression models that predict that a particular defendant exited the lawsuit because of a substantive disposition. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix B3: Procedural Dispositions[a]

	Procedural Dispositions				
	(1)	(2)	(3)	(4)	(5)
University	–0.054***	–0.072**	–0.073**	–0.076**	–0.072
	(0.009)	(0.031)	(0.033)	(0.036)	(0.057)
Large Aggregator	–0.034**	–0.015	–0.024	–0.021*	–0.038**
	(0.014)	(0.014)	(0.017)	(0.013)	(0.019)
Failed Operating Co.	0.047*	0.052*	0.053*	0.074***	–0.038
	(0.026)	(0.029)	(0.031)	(0.025)	(0.026)
Patent Holding Co.	–0.004	0.004	–0.002	0.002	–0.007
	(0.015)	(0.019)	(0.019)	(0.016)	(0.017)
Technology Development Co.	0.003	0.003	0.008	–0.029	–0.028
	(0.029)	(0.032)	(0.035)	(0.054)	(0.036)
Individual	0.065	0.009	0.010	0.025	0.026
	(0.067)	(0.031)	(0.030)	(0.022)	(0.028)
Ind. Lit. in Corp. Form	0.001	0.010	0.007	0.025	0.117
	(0.022)	(0.023)	(0.030)	(0.021)	(0.106)
Pro se Plaintiff					–0.039
					(0.038)
F statistic	11.2***	8.21***	10.57***	25.46***	1.17
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,343	6,343	6,321	6,321	6,321
R^2	0.016	0.103	0.112	0.364	0.386
Dep Var Mean	0.04	0.04	0.04	0.04	0.04

NOTE: Standard errors in parentheses. *$p < 0.$; **$p < 0.05$; ***$p < 0.0$.
[a]The table in Appendix B3 reports five linear regression models that predict that a particular defendant exited the lawsuit because of a procedural disposition. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 200 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix C1: Voluntary Dispositions 60 Days or Less[a]

	Voluntary Dispositions 60 Days or Less				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	–0.018	–0.031	–0.036	0.015	0.018
	(0.067)	(0.063)	(0.066)	(0.073)	(0.059)
Large Aggregator	0.003	0.008	0.013	0.004	–0.011
	(0.024)	(0.025)	(0.026)	(0.015)	(0.029)
Failed Operating Co.	0.053	0.045	0.044	0.017	0.005
	(0.055)	(0.049)	(0.051)	(0.029)	(0.032)
Patent Holding Co.	0.046***	0.049***	0.048***	0.037*	0.022
	(0.017)	(0.018)	(0.018)	(0.020)	(0.021)
Technology Development Co.	–0.010	–0.005	–0.003	–0.010	–0.002
	(0.024)	(0.020)	(0.026)	(0.055)	(0.045)
Individual	–0.012	–0.013	–0.015	0.001	0.003
	(0.018)	(0.020)	(0.022)	(0.016)	(0.023)
Ind. Lit. in Corp. Form	0.016	0.019	0.019	0.017	0.031
	(0.018)	(0.021)	(0.022)	(0.032)	(0.049)
Pro se Plaintiff					0.010
					(0.070)
F statistic	2.06*	2.68**	2.32**	1.6	0.63
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,343	6,343	6,321	6,321	6,321
R^2	0.021	0.049	0.052	0.234	0.243
Dep Var Mean	0.06	0.06	0.06	0.06	0.06

NOTE: Standard errors in parentheses. *$p < 0.$; **$p < 0.05$; ***$p < 0.01$.
[a]The table in Appendix C reports five linear regression models that predict that a particular defendant exited the lawsuit within 60 days because of a voluntary disposition. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix C2: Voluntary Dispositions 120 Days or Less[a]

	Voluntary Dispositions 120 Days or Less				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	–0.087	–0.096	–0.128	–0.098*	–0.104
	(0.087)	(0.075)	(0.092)	(0.051)	(0.065)
Large Aggregator	–0.018	–0.020	–0.008	–0.044	–0.053
	(0.038)	(0.039)	(0.042)	(0.034)	(0.048)
Failed Operating Co.	0.056	0.044	0.061	0.014	0.009
	(0.064)	(0.057)	(0.057)	(0.032)	(0.044)
Patent Holding Co.	0.111***	0.112***	0.119***	0.077**	0.054*
	(0.025)	(0.029)	(0.030)	(0.031)	(0.031)
Technology Development Co.	–0.104**	–0.092**	–0.077	–0.061	–0.041
	(0.043)	(0.044)	(0.053)	(0.076)	(0.061)
Individual	–0.040	–0.052*	–0.040	–0.048	–0.059
	(0.027)	(0.028)	(0.031)	(0.044)	(0.042)
Ind. Lit. in Corp. Form	0.060	0.050	0.065	0.066	0.103
	(0.042)	(0.045)	(0.040)	(0.047)	(0.068)
Pro se Plaintiff					0.040
					(0.063)
F statistic	11.07***	12.93***	12.01***	22.41***	2.26**
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6,343	6,343	6,321	6,321	6,321
R^2	0.034	0.075	0.082	0.257	0.276
Dep Var Mean	0.18	0.18	0.18	0.18	0.18

NOTE: Standard errors in parentheses. *$p < 0.$; **$p < 0.0$; ***$p < 0.01$.
[a]The table in Appendix C2 reports five linear regression models that predict that a particular defendant exited the lawsuit within 120 days because of a voluntary disposition. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Appendix C3: Dispositions 121 Days or More[a]

	Dispositions 121 Days or More				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
University	0.096	0.098	0.131	0.089*	0.097
	–0.087	–0.077	–0.094	–0.052	–0.066
Large Aggregator	0.024	0.021	0.005	0.044	0.058
	–0.038	–0.038	–0.04	–0.031	–0.048
Failed Operating Co.	–0.052	–0.045	–0.061	–0.014	–0.009
	–0.063	–0.056	–0.055	–0.029	–0.045
Patent Holding Co.	–0.107***	–0.110***	–0.117***	–0.076***	–0.052*
	–0.025	–0.028	–0.027	–0.027	–0.031
Technology Development Co.	0.112**	0.098**	0.085	0.063	0.05
	–0.043	–0.043	–0.053	–0.073	–0.06
Individual	–0.031	–0.016	–0.035	–0.012	0.009
	–0.064	–0.078	–0.082	–0.079	–0.053
Ind. Lit. in Corp. Form	–0.056	–0.051	–0.066*	–0.065	–0.105
	–0.041	–0.046	–0.04	–0.046	–0.068
Pro se Plaintiff					–0.27
					–0.208
F statistic	10.22***	13.42***	12.32***	18.63***	1.86**
Controls					
Attorney FE	No	No	No	No	Yes
Litigious FE	No	No	No	No	Yes
Court FE	No	Yes	Yes	No	No
Judge FE	No	No	No	Yes	Yes
Dec. Judge.	Yes	Yes	Yes	Yes	Yes
No. Def.	Yes	Yes	Yes	Yes	Yes
Technology	No	No	Yes	Yes	Yes
No. Patents	Yes	Yes	Yes	Yes	Yes
Obs	6343	6343	6321	6321	6321
R^2	0.033	0.074	0.082	0.265	0.284
Dep Var Mean	0.81	0.81	0.81	0.81	0.81

NOTE: Standard errors in parentheses. *$p < 0.$; **$p < 0.05$; ***$p < 0.01$.
[a]The table in Appendix C3 reports five linear regression models that predict that a particular defendant exited the lawsuit after 120 days. The omitted patentee type is Operating Company. Standard errors were clustered at the district court level. The various controls are attorney fixed effects (Attorney FE), fixed effects for the most litigious patentees in 2010 (Litigious FE), court fixed effects (Court FE), judge fixed effects (Judge FE), declaratory judgment (Dec. Judge.), number of defendants (No. Def.), NBER technology category (Technology), and the number of patents in the lawsuit (No. Patents). "Obs" provides the number of observations present in the model. "*F* statistic" reports the results of an *F* test for joint entity type effects. The models were created using Stata.

Session 2: Does Patent Holdup Exist?

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AN EMPIRICAL EXAMINATION OF PATENT HOLD-UP

Alexander Galetovic
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ABSTRACT

A large literature asserts that standard essential patents (SEPs) allow their owners to “hold up” innovation by charging fees that exceed their incremental contribution to a final product. We evaluate two central, interrelated predictions of this SEP hold-up hypothesis: (1) SEP-reliant industries should experience more stagnant quality-adjusted prices than similar non-SEP-reliant industries; and (2) court decisions that reduce the excessive power of SEP holders should accelerate innovation in SEP-reliant industries. We find no empirical support for either prediction. Indeed, SEP-reliant industries have the fastest quality-adjusted price declines in the U.S. economy.

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1. Introduction

Economic theory offers conflicting perspectives on whether "patent hold-up" is slowing American innovation. Based on seminal work by Williamson (1967, 1979), Klein, Crawford, and Alchian (1978), Joskow (1985,1988) and Grossman and Hart (1986), the patent hold-up hypothesis asserts that patent holders charge licensing royalties to manufacturing firms that exceed the true economic contribution of the patented technology, thereby discouraging innovation by manufacturers and hurting consumers. Recent work, including by Shapiro (2001), Swanson and Baumol (2005), Farrell, Hayes, Shapiro and Sullivan (2007), Lemley and Shapiro (2007), Miller (2007) and Kobayashi and Wright (2009), emphasizes that the patent hold-up problem is particularly acute for Standard Essential Patents (SEPs).[1] SEPs are patents on inventions that form the standards essential for the inter-operability of connected systems, such as cell phones, personal computers, televisions, and audio-visual systems. Hold-up might be especially pronounced for SEPs because once manufacturing firms make large investments based on an accepted technological standard, SEP holders can extract the value of their patents being part of that standard, not merely the technical contribution of the patent to the final product. From this perspective, granting too much protection to SEP holders slows innovation.

Other work, however, argues that the proposed remedies to mitigate SEP hold-up, such as ex ante determination of royalty rates at the time a patent is declared standard essential, will result in royalty rates that are too low, thereby reducing the incentives for firms to innovate (Elhauge 2008, Ganglmair, Froeb, and Werden 2012). In a similar vein, Schmalensee (2009) Sidak (2009), and Kieff and Layne-Farrar (2013) argue that the ex post bargaining position of a monopsonistic collection of manufacturers—especially given their abundant legal resources—is much stronger than the bargaining position of patent holders. This reduces the expected returns to inventions and lowers investment in the costly, risky process of developing and patenting new technologies.

[1] See Egan and Teece (2015) for a comprehensive survey.

These scholarly debates shape policy disputes. Arguing that excessive protection of patent holders slows innovation, President Obama has issued five executive orders that reform the current system of patent review and award. In addition, Congress considered, but ultimately rejected, nine different patent reform bills in 2013-14. The current Congress is focused on two strikingly different bills—one that strengthens patent holder rights, and one that weakens those rights.

In this paper, we contribute to these debates by providing empirical evidence on whether SEP hold-up slows innovation. While an extensive theoretical literature examines the possibilities for SEP hold-up, Gerardin, Layne-Farrar, and Padilla (2008) and Barnett (2014) note that there is very little empirical evidence that SEP hold-up actually occurs, and that such evidence as exists is inconclusive. Although policy analysts, lawyers, and practitioners provide anecdotes about SEP hold-up, we are unaware of previous systematic evaluations of the core predictions emerging from IO-based theories of SEP hold-up.

We assess one of the central empirical implications of the SEP hold-up hypothesis: If SEPs are slowing the rate of innovation, then products that are highly reliant upon SEPs will experience more stagnant quality-adjusted prices than similar products that do not rely heavily on SEPs. That is, if the patenting system empowers SEP holders to negotiate excessive royalty payments and this in turn slows innovation by discouraging investment and market entry, then SEP hold-up will harm downstream consumers in the form of slower price declines and slower improvements in product quality and variety. This prediction emerges from a wide assortment of IO-based models of SEP hold-up. Furthermore, this prediction focuses on the essential issue in the policy debate: Are SEPs impeding improvements in consumer welfare by slowing reductions in quality adjusted prices?

To conduct our analyses, we use quality-adjusted price data on a variety of consumer and producer products. Most of our analyses cover the period between 1997 and 2013. We also examine the period from 1951 through 2013 for a smaller cross-section of products due to data availability. We primarily use Consumer Price Series (CPS) from the Bureau of Labor Statistics

(BLS). They provide quality-adjusted price data that reflects the prices paid by consumers, not the prices paid by intermediate producers. However, when firms primarily purchase the product (e.g., computers), we use the Producer Price Series from the Bureau of Economic Analysis (BEA), which also provides quality-adjusted prices. We describe these quality adjustments in Appendix A.

To assess whether SEP hold-up slows innovation, we use two methods. First, we examine the evolution of the quality-adjusted prices of different industries. We differentiate industries by the degree to which their products rely on SEPs. We compare the quality-adjusted price dynamics of SEP-reliant industries, non-SEP-reliant industries, and a textbook hold-up industry: electricity distribution.

We categorize SEP-reliant and non-SEP-reliant industries as follows. A rich literature emphasizes that the personal computer, smart phone, audio and video equipment, and TV industries rely heavily on SEPs.[2] These are all industries that require interoperability and thus have formal organizations that meet regularly to agree on industry-wide standards. Firms that own patents that read on these standards may then declare their patents as standard essential. Consequently, we categorize products as being SEP-reliant if they are meant to operate as part of a connected system and if there are one or more formal organizations that set technical standards for interoperability in that system. Smartphones provide a classic example: they must not only be interoperable across a variety of different manufacturers and phone service providers, but the photos and video they produce must be compatible with a variety of other products, such as personal computers and video monitors, while their internet capabilities must be compatible with

[2] For example, Lemley and Shapiro (2007: 1992) state that: "In the information technology sector in particular, modern products such as microprocessors, cell phones, or memory devices can easily be covered by dozens or even hundreds of different patents. As a striking example, literally thousands of patents have been identified as essential to the proposed new standards for 3G cellular telephone systems." Their case studies (2025-29) focus on 3G cellular technologies, Wi-Fi 802.11 technologies, DVD media, the MP3 music format, and RFID chips. Farrell, Hayes, Shapiro, and Sullivan (2007) also call attention to the potential problem in IT industries. They motivate their paper with seven cases: three of which are about computer technologies, two of which are about modems, and one of which is about cell phones. Swanson and Baumol (2005) point to "computers, software, telecommunications, consumer electronics, and the Internet…" Miller (2007) argues that standard setting organization pervade the information and communication technology industries.

the technical capabilities of various WiFi routers. Standards for smartphones are established by the 3rd Generation Partnership Project (3GPP), which includes a wide variety of network providers, phone manufacturers, component producers, and chip design firms.

We compare these SEP-reliant products against a set of industries whose products have high patent counts, but whose core functions do not require interoperability or compatibility—and therefore do not rely heavily on SEPs. Automobiles provide a classic example: there are SEPs in non-core functions such as Tire Pressure Monitoring Systems, or Rear Set Entertainment Systems, but core functions—most particularly the drive train—are self-contained and thus are proprietary across manufacturers. Table 1 presents summary information about each of the products included in each category: SEP-reliant industries, non-SEP-reliant industries, and a classic hold-up industry.

The second method for assessing whether SEP hold-up slows innovation involves a quasi-natural experiment in which we evaluate whether a Supreme Court decision that weakened the power of SEP holders accelerated the rate of quality-adjusted price reductions in SEP-reliant industries relative to other industries. The 2006 Supreme Court's *eBay Inc. v. MercExchange LLC* decision made it more difficult for SEP owners to obtain injunctions against infringers than the holders of non-SEP patents.[3] Critically for our analyses, proponents of the SEP hold-up hypothesis advocate for limiting injunctions by SEP holders (Lemley and Shapiro, 2007). They argue that such limits would spur innovation by reducing the excessive power of SEP holders. We examine the impact of this "eBay treatment" effect. Specifically, we employ a difference-in-differences specification and test whether quality-adjusted prices fall faster in SEP-reliant industries after the *eBay Case*, while controlling for industry and year effects. That is, if hold up had been slowing innovation in SEP-reliant industries prior to *eBay*, then we should see a more

[3] There is a broad consensus in the legal literature that the firms that license their patents, which by definition includes the holders of SEPs, face greater difficulty in meeting the Supreme Court's "four-factor test" for a permanent injunction. See Balganesh (2008), Beckerman-Rodau (2007), Ellis, Jarosz, Chapman and Oliver (2007), Diessel (2007), Hand (2007), Golden (2007), Grab (2006), Jones (2007), Klar (2006, 2008), Mersino (2007), Mulder (2007), Newcombe, Ostro, King and Ruben (2008), Reis (2008); Rendleman (2008), Solomon (2010), Stockwell (2006), and Tang (2006).

rapid decrease in the quality-adjusted prices of SEP-reliant products relative to non-SEP-reliant products after *eBay*.

In examining the dynamics of quality-adjusted prices, we do not find support for the SEP hold-up hypothesis. We find that products that are SEP-reliant have experienced rapid and sustained price declines over the past 16 years. In contrast, the quality-adjusted prices of a classic holdup industry—electricity distribution— *increased*. The differences in the movement of the quality-adjusted prices of electricity distribution and SEP-reliant products have to be expressed as orders of magnitude. The prices of SEP-reliant products have fallen at rates that are not only fast relative to a classic hold-up industry, they are fast relative to the patent-intensive products that are not SEP-reliant.

Two interrelated concerns are that SEP-reliant products might be more innovative than non- SEP-reliant products for technological reasons and the rate of innovation of SEP-reliant products would have been still faster if SEP hold-up were not slowing innovation. We address these concerns formally when we conduct the quasi-natural experiment based on the *eBay case*. We can address these concerns informally be examining only digital technologies that follow "Moore's Law."[4] If the SEP Hold-up hypothesis holds, we would find that the quality-adjusted prices of Moore's Law products that are non-SEP-reliant would fall faster than the quality-adjusted prices of products that are SEP-reliant. The data indicate the opposite, however: the prices of non-SEP-reliant Moore's Law products fall more slowly than the prices of SEP-reliant Moore's Law products. While illustrative, these graphs do not fully address the concern: among Moore's Law products, those that rely on SEPs might be more technologically dynamic than other such products. Thus, we examine the differential impact of the *eBay case* on SEP-reliant and non-SEP-reliant industries.

In examining the quasi-natural experiment involving the *eBay case*, we also cannot reject the null hypothesis of no SEP hold-up. The difference-in-differences results do not indicate that

[4] Moore's Law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.

quality-adjusted prices fall faster in SEP-reliant industries after the *eBay Case*. We use several specifications and try de-trending the data to control for potential differences in underlying innovation rates by product. But, in contrast to the SEP hold-up view, we cannot reject the null hypothesis that the *eBay case* did not differentially affect SEP-reliant industries.

It is important to emphasize that we are not claiming that the patent system as currently defined cannot be improved. Rather, we offer evidence on two interrelated predictions of the SEP hold-up hypothesis. First, if SEPs are holding up innovation, then products that are highly reliant upon SEPs should experience more stagnant quality-adjusted prices than similar non-SEP-reliant products. Second, if SEPs are holding-up innovation, then changes in the legal system (the eBay Case) that weaken the excessive negotiating strength of SEP holders should accelerate reductions in quality-adjusted prices in SEP-reliant industries relative to non-SEP-reliant industries. We find no evidence for either prediction.

The remainder of the paper is organized as follows. Section 2 describes patent hold-up and uses a simple theoretical model to frame its empirical implications. Section 3 evaluates the testable implications by simply graphing the evolution of quality-adjusted prices of the products in different industries. Section 4 assesses whether SEP-reliant industries experienced a decrease in quality-adjusted prices, relative to non-SEP-reliant industries, following the Supreme Court's eBay decision. Section 5 concludes.

2. Holdup and Its Testable Implications

2.1 Patent Hold-Up

The term "hold-up" describes the following situation. Firm A makes a large investment that is specific to an input produced by Firm B and difficult to redeploy to some other use. Firm A contracts with Firm B for the crucial input, but no contract is ever complete and there are always unforeseen contingencies. Thus, after Firm A has made its asset-specific investment, strategically-timed claims by Firm B allow it to engage in ex post opportunistic negotiation. Oliver Williamson (1985, p. 47) famously described this situation as "self-interest seeking with guile." Firm A is not a sheep to be fleeced, however; it knows that Firm B can behave opportunistically, and it therefore behaves in ways that protects itself, but that may increase costs, lower output, or slow the rate of innovation.

The quintessential example of hold-up is a mine located in a mountainous area accessible by a single pass. The miner sinks a huge investment in purchasing the subsoil rights, digging and reinforcing shafts and adits, purchasing specialized equipment, and the like—during which time the owner of the pass assures the miner of a reasonable toll for a right of way to get the ore to a distant processing plant. Once the miner has started to produce ore, however, and now faces large sunk costs, the owner of the pass demands a new, higher, toll by exploiting an incomplete element of the initial contract, such as differences in the size or weight of the trucks being used, changes in the constructions costs for necessary improvements to the roadway, or any number of similar "problems" that were not originally foreseen. Her new toll rates allow her to extract all of the quasi-rents of the mine, leaving the miner only enough income to cover her variable costs of production.

Knowing that this might happen, the mine owner either makes no investment in the mine in the first place, or invests in the mine in an inefficient fashion, resulting in less mining output at a higher cost of production than would occur otherwise. The result is an increase in the miner's fixed and average costs, which imply that the mine owner must receive a higher price for her minerals than would be the case otherwise. This scenario is played out across the mining industry, resulting in higher costs of production in the short run and less entry, competition, and incentives to innovate over the long run.[5]

SEP hold-up is a variety of this general hold-up problem. Instead of a land owner levying an excessive toll for a right of way, SEP hold-up takes place by an SEP holder erecting her own version of a toll booth—a licensing fee for the use of her patent in excess of its "true economic contribution" to a manufactured product. As defined by the Federal Trade Commission (2011, p. 191), "'Hold-up" is [...] a patentee's ability to extract a higher licensing fee after an accused infringer has sunk costs into implementing the patented technology than the patentee could have obtained at the time of design decisions, when the patented technology competed with alternatives." Since complex products involve hundreds, if not thousands, of SEPs, and because SEP holders do not know the royalties charged by one another, the SEP hold-up hypothesis implies that SEP holders may jointly extract most, if not all, of the quasi-rents of the manufacturing company via multiple "toll booths"—a theoretical construct known as "royalty stacking."

2.2 Implications of Patent Hold-Up

The extraction of the manufacturing firm's quasi-rents by the SEP holder (or holders) has at least four negative implications for the prices paid by consumers and the rate of innovation. First, the manufacturer might respond by accepting the demands of SEP holders, and then pass on the additional costs to consumers, resulting in higher prices than would obtain otherwise.

[5] The mine owner could respond by investing in lobbying in order to change the contracting environment, by, for example, getting the government to decree that miners can set toll rates ex ante for rights of way on other people's land—but this option requires the miner to share some of the quasi rents with politicians, again driving up both fixed and average costs, with an attendant drop in output and/or increase in price. During the Porfirio Díaz dictatorship in Mexico (1877-1911) miners successfully lobbied for such a property rights system; landowners were only entitled to price their land in its normal use (not as a right of way), and landowners could be forced to accept the miner's offer by a government agent via mandatory arbitration. For an analysis of that system, and its attendant political costs, see Haber, Razo, and Maurer (2003, ch. 7).

Second, the manufacturer might respond by investing inefficiently. She might, for example, employ an outdated technology in her product in order to avoid paying the excessive royalties, with a concomitant lack of improvement in product quality. Third, she might vertically integrate by purchasing all of the necessary SEPs—but that would allow the SEP holders to capitalize the quasi-rents they extract via royalties into the market price of their patents, thereby driving up the manufacturer's fixed and average costs. The manufacturer must either accept lower profit margins, with concomitant reductions in R&D spending for future rounds of innovation, or pass these additional costs on to consumers. Fourth, the manufacturer might infringe the SEP holders' patents, forcing them into expensive litigation, the cost of which will either be passed on to consumers or be absorbed by profit margins, hence reducing the R&D budgets for future rounds of innovation. These tough choices are then played out across the entire industry of which this manufacturer is a part, raising costs in the short run, and reducing market entry, competition, and the incentives to innovate in the long run.

In short, the equilibrium outcome of the SEP hold-up hypothesis is that consumers either face higher prices or lower quality products than they would if hold-up was not taking place. This yields the core testable hypotheses discussed in the Introduction:

(1) If SEPs are holding up innovation, then products that are highly reliant upon SEPs should experience more stagnant quality-adjusted prices than similar non-SEP-reliant products.

(2) If SEPs are holding up innovation, then changes in the legal or regulatory system that reduce the excessive power of SEP holders should accelerate reductions in quality-adjusted prices.

2.3 SEP Hold-Up and Quality-Adjusted Prices: A Model

In this subsection, we use a simple model to illustrate the impact of SEP hold-up on quality-adjusted prices. The model shows that under quite general conditions, factors that slow the rate of innovation will slow the rate of decline of the quality-adjusted price. The thrust of the result is as follows. Take two industries, A and B, and suppose that A's productivity and quality grow one percentage point faster than in B. Then, A's quality-adjusted relative price falls one percentage point faster than B's.

<u>2.3.1 A simple model</u>

Production Let

$$Y_i = \varphi_i A_i L_i^{\alpha_i} K_i^{1-\alpha_i}$$

be the aggregate Cobb-Douglas production function of industry i. Y is output, and L and K are labor and capital respectively; A is the standard total factor productivity parameter, and φ is a quality parameter.

Goods markets The inverse nominal demand for good *i* is P_i and

$$\eta_i \equiv -\frac{P_i}{Y_i P_i'}$$

is the elasticity of demand. Let c_i be the (constant) nominal marginal and average cost of producing good *i,* and p_i represents its nominal price. Then we assume that in equilibrium

$$\frac{p_i - c_i}{p_i} = \frac{\theta_i}{\eta_i}, \qquad (1)$$

where θ_i is a conduct parameter which summarizes the outcome of competition among firms in industry *i*. It is equal to one under monopoly, zero under perfect competition and equal to $1/n$ in a symmetric Cournot model with *n* firms. More generally, it nests most oligopoly models and summarizes the intensity of competition.[6]

Simple manipulation of (1) yields

$$p_i = \left(\frac{\eta_i}{\eta_i - \theta_i}\right) c_i \equiv m_i c_i$$

Thus the margin, m_i, measures markup over costs—a standard measure of market power.

Factor demands We assume perfectly competitive factor markets. Let w be the nominal wage r the nominal rental price of capital. Then profit maximization implies that K_i and L_i solve

$$\max_{L_i, K_i} \left\{ P_i(Y_i)\varphi_i A_i L_i^{\alpha_i} K_i^{1-\alpha_i} - rK_i - wL_i \right\}.$$

Now let y_{L_i} be the marginal product of labor in sector i and y_{K_i} the marginal product of capital. First order conditions imply that value marginal revenue products equal factor prices, viz.

$$w = \frac{p_i}{m_i} y_{L_i} \equiv \frac{p_i}{m_i} \alpha_i \varphi_i A_i \left(\frac{K_i}{L_i}\right)^{1-\alpha_i}, \qquad (2)$$

and

$$r = \frac{p_i}{m_i} y_{K_i} \equiv \frac{p_i}{m_i} p_i (1-\alpha_i)\varphi_i A_i \left(\frac{L_i}{K_i}\right)^{\alpha_i}, \qquad (3)$$

[6] We follow Genesove and Mullin's (1998) variation on Bresnahan (1989).

2.3.2 Some results

Define $\hat{x} \equiv d \ln x$. Total differentiation of (2) and (3) and some simple manipulation yield

$$\begin{aligned}\hat{p}_i &= \hat{w} + \hat{m}_i - \hat{y}_{L_i} \\ &= \hat{w} + \hat{m}_i - (\hat{A}_i + \hat{\varphi}_i) - (1-\alpha_i)(\hat{K}_i - \hat{L}_i)\end{aligned} \tag{4}$$

and

$$\begin{aligned}\hat{p}_i &= \hat{r} + \hat{m}_i - \hat{y}_{L_i} \\ &= \hat{r} + \hat{m}_i - (\hat{A}_i + \hat{\varphi}_i) - \alpha_i(\hat{L}_i - \hat{K}_i)\end{aligned} \tag{5}$$

The first line in (4) and (5) says that industry's *i* nominal price increases with nominal factor prices and market power but falls with factor productivity growth. The second line decomposes the change in factor productivity. Note that the nominal price of industry *i* falls one-for-one with $(\hat{A}_i + \hat{\varphi}_i)$, the sum of total factor productivity increases and quality improvements. That is, innovation directly influences prices.

Now it is easy to show that

$$\hat{y}_{L_i} - \hat{y}_{K_i} = \hat{K}_i - \hat{L}_i = \hat{w} - \hat{r}, \tag{6}$$

The first equality says that in equilibrium, differences in factor productivity growth reflect changes in factor proportions. The second equality links changes in factor proportions with changes in relative factor prices. Substituting (6) into (4) or (5) and rearranging yields

$$\hat{p}_i = -(\hat{A}_i + \hat{\varphi}_i) + \alpha_i \hat{w} + (1-\alpha_i)\hat{r} + \hat{m}_i. \tag{7}$$

Thus industry's *i* quality-adjusted nominal price falls one-by-one with increases in total factor productivity and quality growth, and rises with increases in factor prices and market power.

2.3.3. The differential rate of innovation and the rate of change of relative prices

Let p be a price index such that

$$p \equiv \Pi_i \left(p_i\right)^{\lambda_i}, \; (8)$$

where λ_i is the share of industry i in the index, and $\sum_i \lambda_i = 1$. Then p_i / p is industry's i relative price and $\hat{p}_i - \hat{p}$ is the rate of change of i's relative price. Now substituting (7) into (8), taking logs and differentiating yields

$$\begin{aligned}\hat{p} &\equiv \sum_{i=i}^{n} \lambda_i \left[-\left(\hat{A}_i + \hat{\varphi}_i\right) + \alpha_i \hat{w} + (1-\alpha_i)\hat{r} + \hat{m}_i \right] \\ &\equiv -\left(\hat{A} + \hat{\varphi}\right) + \overline{\alpha}\hat{w} + (\overline{1-\alpha})\hat{r} + \hat{m},\end{aligned}$$

which is the rate of change of the price index. Thus the price index varies inversely and one-by-one with average total factor productivity and quality growth. The change in its relative price is thus

$$\begin{aligned}\hat{p}_i - \hat{p} &= -\left[\left(\hat{A}_i + \hat{\varphi}_i\right) - \left(\hat{A} + \hat{\varphi}\right)\right] + (\alpha_i - \overline{\alpha})\hat{w} + (1 - \alpha_i - \overline{1-\alpha})\hat{r} + (\hat{m}_i - \hat{m}) \\ &\equiv -\left[\left(\hat{A}_i + \hat{\varphi}_i\right) - \left(\hat{A} + \hat{\varphi}\right)\right] + \varepsilon_i\end{aligned} \qquad (9)$$

with $\sum_{i=i}^{n} \varepsilon_i = 0$ by construction.

Expression (9) says that in equilibrium, the rate of change of industry i's relative price equals the inverse of industry's i differential rate of productivity and quality growth, $\left(\hat{A}_i + \hat{\varphi}_i\right) - \left(\hat{A} + \hat{\varphi}\right)$, up to a mean-zero error term. In other words, fast relative price declines are strong indicators of differences in the rates of innovation.

Similarly, the difference between the growth rate of two nominal prices,

$$\hat{p}_i - \hat{p}_j = (\hat{A}_i + \hat{\varphi}_i) - (\hat{A}_j + \hat{\varphi}_j) + (\varepsilon_i - \varepsilon_j),$$

reflects the differential rate of productivity and quality growth up to a mean-zero error term.

Hence, if productivity and quality in X grow one percentage point faster than in Y, then X's quality adjusted relative price should fall one percentage point faster than Y's on average.

Indeed, empirical studies show that there is virtually a one-to-one relationship between relative price changes and differential rates of productivity growth across industries. Salter (1960) found this when he examined the differential productivity performance of 28 British manufacturing industries between 1924 and 1950, as well as the differential productivity performance of 27 U.S. industries between 1923 and 1950. Oulton and O'Mahoney (1994) replicated this result by studying 136 manufacturing industries in Britain between 1953 and 1986. Kendrick and Grossman (1980) looked at the entire U.S. economy (20 manufacturing industries, plus agriculture, public utilities, construction, and several service industries) and found a coefficient that was similar to that in Salter (1960). Nordhaus (2008) extended Kendrick and Grossman's (1980) data to 2001, with similar results.

2.3.4. Relative price change and the hold-up hypothesis: observable implications

The hold-up hypothesis argues that hold-up will slow innovation. It follows that it should lead to a slower rate of decline $-\left[(\hat{A}_i-\hat{\varphi}_i)-(\hat{A}-\hat{\varphi})\right]$ of the quality-adjusted relative price. Hence, if hold-up is materially reducing the rate of innovation in SEP industries, the relative price of SEP goods should be stagnant relative to all other goods and to goods that exhibit fast rates of innovation but no holdup problem (e.g. those that benefit from Moore's law but are not SEP-reliant).

Second, if SEPs are holding up innovation, then changes in the legal system (the eBay Case) that reduce the power SEP holders should accelerate reductions in quality-adjusted prices.

3. Empirical Analyses: The Evolution of Quality-Adjusted Prices

In this section, we examine the implications of the SEP hold-up hypothesis regarding the movement of the quality-adjusted prices of SEP-reliant products relative to that of other products.

3.1 Categorizing Industries

SEPs have become particularly common over the past two decades in the production and operation of digital electronic products—e.g., personal computers, phones, televisions, and audio systems. The reason is that these products must be inter-operable and compatible; they are connected systems. The owner of Smartphone A must be able to talk with, and share pictures, video, and other media with the owner of Smartphone B—even though A and B are made by different manufacturers and operate on networks owned by different companies. The owner of Smartphones A and B must also be able to transfer that media to laptops C and D, and those laptops must be able to project the audio and video on televisions E and F, as well as burn them onto disks that can be played on DVD players G and H. The numerous technical problems created by the requirements of this connected system are solved by standard setting organizations (SSO's), which include upstream component manufacturers and downstream device manufacturers, as well as firms that operate the networks that link devices together. Owners of patents that read on the technical standards established by the SSO can then declare those patents as standard essential, and the SEP owner and a user of that SEP can then negotiate a royalty for its use. We therefore follow the SEP hold-up literature, by categorizing as SEP-reliant those products whose core functions require inter-operability and compatibility, and which also have at least one formal organization that sets technical standards for that industry. We categorize products that embody patents, but that do not meet this two-fold test, as non-SEP-reliant. We note that none of the products we place in the non-SEP-reliant category is mentioned in the SEP hold-up literature. Table 1 summarizes the information about the products in both categories.[7]

One potential concern with our examination is that SEP-reliant products tend to cluster in digital electronics, and those products might have inherently different rates of innovation than non-digital products that are non-SEP reliant. Fortunately, there are digital products that do not require high degrees of inter-operability and compatibility, such as watches, coin operated gaming machines, electrical test equipment, and multi-user (e.g., mainframe) computers. Quality-adjusted price data on these products therefore provides us with a second source of analytic leverage. When we turn to the difference-in-differences estimation in Section 4, we further control for inherent differences in rates of innovation across industries by de-trending each product's quality-adjusted price data.

As a benchmark, we use the evolution of the quality-adjusted long-run price data for a product that is a textbook case of hold-up, retail electricity. Retail electricity production has three stages: generation, high-voltage transmission, and low voltage distribution. Two of those stages, transmission and distribution are natural monopolies. Because the assets in each of these stages are site-specific, sunk for decades, and electrons, once produced, cannot be stored efficiently, electricity is particularly susceptible to ex-post contractual opportunism. For example, the generating companies, which tend to be located far from major consumption sites (large industrial users and cities), can be held up by the transmission companies that transport the power. What is to stop the transmission company from offering a lower price per kilowatt-hour by claiming that some circumstance has changed in an unexpected fashion? Similarly, what is to stop the generating company from reducing output, thereby holding up the transmission

[7] We checked our categorizations with expert practitioners. We are grateful to Lew Zaretzki of Hamilton IPV for guidance on the various standards and SSOs governing the products covered in this paper.

company and the distribution company for a higher price per kilowatt-hour when they need a rapid increase in power, say, on a hot day when demand for air conditioning skyrockets? The same problems of ex-post contractual opportunism plague the relationship between the transmission company and the distributors to households and business enterprises. What is to keep the transmission company from demanding higher prices from distributors when demand spikes?

Historically, many electricity systems were initially built and operated by unregulated private firms. High prices and coordination failures among generators, transmission companies, and distributors were pervasive (Gilbert and Khan 1996). Eventually, these problems were "solved" by the creation of vertically integrated regulated monopolies (in the United States) or state-owned firms (in Western Europe)—none of which were known for their innovativeness.

In order to spur efficiency and innovation, in recent decades governments around the world unbundled these vertically integrated monopolies and privatized them. What now tends to exist are independent and regulated monopolies in transmission and distribution, but multiple firms in generation. The fundamental problem of transmitting and distributing a product that cannot be stored and that is characterized by scale economies remains, however. Thus, the electricity industry is still characterized by hold-up and the potential for the exercise of market power, which governments have tried to prevent by regulating competition and the bidding process in markets for wholesale power. The results have been mixed at best and the possibilities for opportunistic behavior are numerous. For example, Enron's energy traders were able to encourage electricity generating companies in California in the early 2000s to reduce the supply of power during times of peak demand in order to "perform maintenance," producing both "rolling blackouts" and exponential increases in the prices charged to energy distribution companies. It is unsurprising that technological progress in the electricity industry has been slow: the last major breakthrough in generation technology was the introduction of combined-cycle gas generation in 1965; most homes and businesses still use a Shallenberger induction meter, invented in 1888; and the digital revolution has yet to reach energy management and use within homes, businesses, and public buildings.

Figure 1 shows the real (inflation adjusted) price of electricity for urban consumers in the United States from 1997 to 2013, and compares those prices against the quality-adjusted, real prices of seven SEP-reliant products; telephone equipment, televisions, portable / laptop computers, desktop computers, video equipment, audio equipment, and photographic equipment. All series are converted to a base year of 100, so as to make price movements relative to each other. We discuss the sources for each series in Appendix A. The data show that the price of electricity has barely moved over those 16 years, which is exactly what one would expect of a hold-up industry characterized by slow rates of innovation.

3.2 Do relative prices of patent-intensive SEP industries stagnate?

The contrast between the behavior of the relative price of products that are SEP-reliant and the price of electricity is stark. Even the product with the slowest decline in quality-adjusted relative prices, audio equipment, fell by 7 percent per year—a striking result considering that the maximum rate of long-run productivity growth for an industry is typically less than 6 percent per annum. The quality-adjusted relative price of telephone equipment fell 10 percent per annum. By 2013, the price of a phone, taking into account inflation, changes in the prices of phones, and improvements in phone technology, was 79 percent lower than in 1997. If you ever wonder why you see a massive, flat-screen television just about everywhere you look, consider the following fact: between 1997 and 2013, the relative, quality-adjusted price of TVs fell by 19 percent per year. The relative quality-adjusted price of portable and laptop computers fell fastest of all, by 31 percent per annum.

Figure 2 graphs the average of the quality-adjusted relative prices of the seven SEP-reliant products displayed in Figure 1 and compares them to another complex product of wide use, automobiles. Automobiles employ thousands of patents, but their core functions are non-interoperable and non-compatible: the drive trains of Porsches and Hondas are separate closed systems. Figure 2 reveals that on average, the relative, quality-adjusted price of SEP-reliant electronic products—the same goods that the literature claims to be subject to SEP Hold-up—fell by 14 percent per year. The contrast with automobiles is unambiguous: the quality-adjusted relative price of new cars fell by less than 3 percent per year between 1997 and 2013, roughly five times slower than SEP-reliant products.

These figures indicate that SEP-reliant industries do not stagnate relative to patent-intensive, non-SEP-reliant industries. These figures do not, however, address the possibility that patent-intensive SEP-reliant industries were—for technological reasons—more technology dynamic than other industries. If this is were the case, then the figures would not rule out the possibility that the rate of innovation in patent-intensive SEP-reliant industries would have been still faster if SEP hold-up were not slowing down the rate of innovation in SEP-reliant products. We address this potential concern in two ways. First, we focus only on digital technologies that follow "Moore's Law" and hence restrict our analysis to digital products that differ only in their reliance on SEPs. Second, we address this more formally by conducting a quasi-natural experiment based on the *eBay case*.

3.3 "Moore's Law" Digital Products

Perhaps, there are fundamental differences between digital electronic products and automobiles such that one would not expect them to display the same rates of innovation. Perhaps, the SEP-reliant, digital electronic products graphed in Figure 1 are all subject to "Moore's Law" (the observation that the number of transistors in a dense integrated circuit doubles approximately every two years), and hence—for technological reasons having nothing to do with the patent system—experience much faster rates of innovation than other products.

We can both address and exploit this "Moore's Law Critique." In terms of addressing it, there are two points. First, if the rate of innovation in digital electronic products is only dictated by some inherent characteristic of the underlying technology, then the entire debate about SEP hold-up is beside the point. The pace of technology is moving so fast that SEPs are irrelevant; today's "standard" is tomorrow's museum piece. Second, Moore's Law is not a law of nature, like the speed of light, but is a rule of thumb about an empirical regularity in a particular institutional context. An historical case illustrates the point. In 1984 Brazil tried to catch up in personal computer technology through infant industry protection and other supports to its IT sector, and the result was disastrous: there was no Brazilian version of "Moore's Law," just lots of high priced, badly-made, slow clock speed PCs. The implication is that the empirical regularity called "Moore's Law" is observed in the United States because the institutions that govern the specification of intellectual property rights here is conducive to very fast rates of innovation.

More importantly, we can exploit the "Moore's Law" critique by comparing the rate of innovation across a variety of products that all employ densely packed integrated circuits, but which vary in the intensity with which they employ SEPs because they require different levels of inter-operability and compatibility. For example, DVD player X must be able to play all the same music and video as DVD player Y—and both must be able to project images on televisions C and D, or load software onto personal computers E and F. This high degree of inter-operability and compatibility is, however, much less important in products such as digital watches, digital gaming machines, or multi-user computers. Digital watch A and digital watch B do not have to communicate with each other or any other device. Mainframe computers are constructed to run customized software on proprietary architectures. Thus, we ask whether digital products that make intensive use of SEPs demonstrate slower rates of innovation, as measured by quality adjusted relative prices, than digital products that make less intensive use of SEPs.

Figure 3 therefore presents data on the quality adjusted, relative prices of digital watches, test equipment for electrical radio, and communication circuits, and coin operated gaming machines against the average of the seven SEP-reliant products analyzed in Table 1. There are big differences in the series: the SEP-reliant products demonstrate differential rates of innovation between two and four times faster than less SEP-reliant digital products. In fact, even if we look at the SEP-reliant digital product with the slowest rate of innovation (audio equipment, whose quality adjusted relative price fell at a rate of seven percent per year), we still find that its rate of innovation is more than twice as fast as any of the three non-SEP-reliant products.

We can push this a bit further, since it might be the case that SEP-reliant products have greater innovation possibilities than digital products that are not SEP-reliant. For example, there might be fundamental differences between audio equipment and watches. Therefore, in Figure 4, we compare the quality adjusted relative prices of three products that perform similar functions using similar underlying technologies—but two (desktop and laptop computers) are SEP-reliant, while the third (multi-user computers, which includes mainframes, Unix computers and PC servers) is much less SEP-reliant. If the SEP hold-up hypothesis holds, we should expect to see slower rates of innovation in desktops and laptops than their more powerful, specific purpose cousins. Due to data availability, these analyses cover the period from 2004 through 2013. As Figure 4 demonstrates, however, we see exactly the opposite. In fact, laptops and desktops illustrate rates of innovation almost twice that of multi-user computers, with average annual quality adjusted price declines of 26 percent, 25 percent, and 14 percent per year respectively.

3.4 Taking a Longer-Run View of the Data

So far, we have restricted the analyses to the post-1996 period to have the broadest possible coverage of products. What happens if take an even longer time span to look at the data on a smaller number of products?

Figure 5 therefore compares the quality adjusted relative prices of electricity, telephone equipment, televisions, and an index of video, audio, photographic, and information processing equipment from 1951 to 2013 (with 1951 equal to 100 for all series, so as to make price movements relative to each other).[8] The relative price of electricity declined only slightly over this six-decade period, which is exactly what one would expect of an industry characterized by hold-up. The quality adjusted relative price of televisions, however, fell like a stone. By 2013, the price of a television (taking into account inflation, price changes, and improvements in quality) was less than one percent of what it had been in 1951. The same is true for the index of video, audio, photographic, and information processing equipment.

[8] Video (other than televisions), audio, photographic, and information processing equipment were grouped together by the BLS prior to the 1990s.

Telephone equipment displays an interesting pattern, one that allows us to get analytic leverage on what happens when a product changes from being produced by a vertically-integrated monopoly to a SEP-reliant industry. Until 1982, local telephone services in the United States were provided by a single company, ATT, which leased telephones made by its Western Electric subsidiary to businesses and households. Until the FCC's 1968 Carterphone Decision, equipment produced by other manufacturers could not be operated on ATT's network. Not surprisingly, the quality adjusted, relative price of phone equipment barely moved at all. Once business enterprises and households began to purchase equipment made by other manufacturers in the 1970s, the quality adjusted relative prices of phone equipment began to fall gradually. Between 1970 and 1980, the price of a phone, adjusting for inflation and quality, fell by 14 percent.

This pattern reversed in the 1980s when the first mobile phones—all produced by a single manufacturer, Motorola—entered the U.S. market. Motorola's initial product, the DynaTAC 8000X, had a price of $3,995 (about $9,000 in today's dollars), weighed more than a kilo, and had a battery life of half an hour. The quality adjusted relative prices of phones continued to climb until 1997, by which point there were multiple manufacturers of 2G cell phones competing for market share. From that point onwards, through both the 3G and 4G revolutions, the quality-adjusted price of telephone equipment fell by ten percent per year.

Note that the trajectory of the relative price of telephone equipment is the opposite of what the patent hold-up hypothesis would predict. As long as telephone equipment was produced by a subsidiary of ATT, and thus by definition could not have been subject to hold-up, its relative price remained constant. Once the cell phone diffused in the late 1990s, however, and telephone equipment became the quintessential SEP industry, prices plummeted, the opposite prediction of the SEP hold-up hypothesis.

While illustrative, these figures do not fully address the concern that technologies that rely on standards are technologically more dynamic. Thus, next we study the differential effect of the *eBay case* on SEP-reliant and non-SEP-reliant industries.

4. Empirical Analyses: The *eBay Case* as a Quasi-Natural Experiment

One argument made in the SEP hold-up literature is that the ability to obtain injunctions against manufacturers allows SEP owners to extract royalties above their "true economic contribution." In 2006, however, the Supreme Court decision in *eBay Inc. v. MercExchange LLC* made it relatively more difficult for SEP owners to obtain injunctions against infringers.[9] The eBay decision therefore allows us to leverage variance across time as well as variance across products. If hold-up was taking place in the manufacture of products that were highly reliant on SEPs prior to *eBay*, after *eBay* we should see a more rapid decrease in the quality-adjusted prices of those products, relative to the quality-adjusted prices of products that that are non-SEP-reliant. If we fail to detect that more rapid decrease, it implies that hold-up was not slowing the rate of innovation prior to the eBay decision.

We use the following difference-in-differences structure to assess whether *eBay* spurred the relative rate of innovation in SEP-reliant industries:

$$P_{i,t} = \alpha + \beta\left[\mathrm{SEP}_i \times \mathrm{Post2006}_t\right] + \gamma \mathrm{SEP}_i + \delta_i + \delta_t + \varepsilon_{i,t}, \qquad (10)$$

[9] As numerous legal scholars have pointed out, the eBay decision has made it more difficult for a firm that licenses its patents rather than practices them to meet the "four-fold test" for an injunction, particularly the ability to demonstrate "irreparable injury" from infringement. See Balganesh (2008), Beckerman-Rodau (2007), Ellis, Jarosz, Chapman and Oliver (2007), Diessel (2007), Hand (2007), Golden (2007), Grab (2006), Jones (2007), Klar (2006, 2008), Mersino (2007), Mulder (2007), Newcombe, Ostro, King and Ruben (2008), Reis (2008); Rendleman (2008), Solomon (2010), Stockwell (2006), and Tang (2006).

where $P_{i,t}$ is the quality-adjusted price of products in industry i in year t, SEP_i is a dummy variable that equals one if industry i is a SEP-reliant industry and zero otherwise, Post2006_t is a dummy variable that equals zero until 2006 and one from 2007 onward, and δ_i and δ_t represent the fixed effects on industry and year dummy variables. If β enters negatively and significantly, then this would be consistent with the view that the *eBay Case* spurred the comparative rate of innovation in SEP-reliant industries. If the regression analyses do not reject the hypothesis that $\beta=0$, then we the data would not reject the null hypothesis that the eBay Case did not influence the relative rate of innovation in SEP-reliant industries. The regression is estimated over the period from 1997 through 2013. We experimented with different ways of clustering the standard errors, including no clustering, clustering at the industry level, and clustering at the year level. We obtain similar results and report the results with no clustering.

Table 2 indicates that the analyses do not reject the null hypothesis that the *eBay Case* did not accelerate the relative rate of innovation in SEP-reliant industries. The eBay decision coefficient on $\text{SEP}_i \times \text{Post2006}_t$ is positive and insignificant in column (1). In searching to find a specification that is consistent with the SEP hold-up hypothesis, we extend the analyses in two ways. One might think that different products have inherently different potential rates of innovation (i.e., that automobiles cannot be improved as quickly as smartphones). In Column 2, we therefore de-trend the data, by subtracting from each observation that product's pre-2007 average price decline. This did not alter the results. We also extend the analyses by restricting the sample to products that are subject to "Moore's Law." In Column 3, we therefore truncate the data so that the non-SEP-reliant category only includes digital electronic products. Once again, we get a coefficient with the "wrong" sign that is not statistically significant. We also employ a jackknife approach, serially dropping products from the regression, and never obtain a statistically significant negative coefficient on $\text{SEP}_i \times \text{Post2006}_t$. In short, we could not reject the null hypothesis that there was no change in the relative rates of innovation in SEP-reliant industries after the *eBay* decision.

5. Conclusions

In this paper, we find that the rate of innovation—as reflected in quality adjusted relative prices—has rarely, if ever, been faster than it is today in exactly those products that scholars agree are theoretically subject to SEP hold-up. We find that prices of SEP-reliant products have fallen at rates that are not just fast compared to a classic hold-up industry, but that are fast against patent-intensive, non-SEP-reliant products. Moreover, when the courts made it harder for SEP holders to hold-up manufacturing firms, we find that this did not accelerate the rate of innovation in SEP-reliant industries relative to other industries. We cannot reject the hypothesis of no SEP hold-up.

One might wonder why there is such a noticeable mismatch between the evidence and theories that articulate how SEP holders can charge royalty rates that capture the value of the standard itself, rather than just their patent's technical contribution to it. We would speculate that markets find ways of ameliorating the adverse effect from patent hold-up. A decentralized system of incomplete contracts involving actors engaged in a repeated game and who coordinate around a focal point in order to expand the boundaries of the market—in this case a standard setting organization—is particularly well suited for facilitating innovation (Egan and Teece, 2015). Indeed, such a defuse system in which the common interest dominates conflicts of interest describes one of the modern world's most innovative organizations: the American research university.

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Appendix A: CPI Series Definitions and Quality Adjustment Methods[10]

In this appendix we describe each price series that we use and mention the method used to adjust for quality. Column references are to the spreadsheet "Basic Data" in the file Consolidated Data Set for Holdup.xlsx which holds the data we use.

Our default source is the BLS's Consumer Price Series. We prefer this data because it reflects prices paid by consumers, not prices paid by intermediate producers. We only depart from this rule if two conditions are met. First, there is a much longer non-Consumer Price series. Second, the Non-Consumer Price Series and the Consumer Price Series are materially similar for the overlapping years, suggesting that the underlying data is pulled from the same source. In choosing an alternative series (when the CPI has a shorter run of data), we give priority to series the Bureau of Economic Analysis, Personal Consumption Expenditures by Type of Product, from Table 2.4.4 of the Department of Commerce, Bureau of Economic Analysis (2013).

Electricity; CPI code: CUUR0000SEHF01

ELI[11] definition: Data are collected on service charges (a fixed charge per bill); consumption charges (for total monthly energy usage); additional charges and credits; taxes.

The prices for electricity include seasonal changes, such as summer or winter rates. Also included are additional charges and credits, such as purchase fuel adjustments. It also includes electricity service to individually-metered residential units.

Quality adjustment method: Electricity is not quality-adjusted.

[10] Series definitions come from BLS's internal ELI series definitions. They were retrieved by email from Steve Reed of the CPI office.

[11] "The CPI item structure has four levels of classification. The 8 major groups are made up of 70 expenditure classes (ECs), which in turn are divided into 211 item strata. Major groups and ECs do not figure directly in CPI sample selection [...]. Within each item stratum, one or more substrata, called entry-level items (ELIs), are defined. There are a total of 305 ELIs, which are the ultimate sampling units for items as selected by the BLS national office. They represent the level of item definition from which data collectors begin item sampling within each sample outlet." (Department of Commerce, Bureau of Labor Statistics 2013, ch. 17, p. 13).

Telephone hardware, calculators, and other consumer item; BEA code: DCTERG3

The BEA uses the CPI series for telephone hardware, calculators, and other consumer items (code: CUUR0000SEEE04), which is subdivided into two subcomponents:

Subcomponent (i): Telephones, peripheral equipment, and accessories (ELI: EE041) ELI definition: Home-based and cellular telephones, telephone answering devices, Caller ID units, additional cordless handsets, and accessories. Excluded are home telephone and cellular telephone *services.*

This price series is divided into 3 specification clusters: Cluster 01C: Cellular telephones; Cluster 02B: Home-based telephones; Cluster 03B: Telephone peripheral equipment and accessories.

Subcomponent (ii): Calculators, typewriters, and other information processing equipment (ELI: EE042). ELI definition: Calculators, typewriters, and other information processing equipment for non-business use. ELI excludes equipment referred to as Personal Digital Assistants (PDA's) or handheld PC's. These items are priced in ELI EE011. This ELI is divided into 2 specification clusters: Cluster 01A: Calculators; Cluster 02A – Typewriters and other information processing equipment. The CPI office at the BLS states that this subcomponent price series is primarily comprised of calculators.

Quality adjustment method: The BEA does not adjust the series for quality. However, the CPI does a hedonic quality adjustment.

Televisions CPI code: CUUR0000SERA01

ELI definition: All non-portable, electronic video displays with television tuners. Televisions with built-in DVD or other media players are included. Televisions included in component systems are eligible as long as there is an individual price for the TV. Televisions including separate speakers or stands are also included.

ELI excludes: Computer monitors (displays without television tuners), and televisions designed for portable viewing (those with battery power) are priced in RA031. Also excluded are television/audio component systems (audio components are priced in RA051) and television/video component systems (video components are priced in RA031).

Quality adjustment method: Quality is adjusted with the hedonic price method since 1999 (Kokoski, Waehrer and Wright (1999)).

Other video equipment –CUUR0000SERA03

ELI definition: Includes purchased hardware used for displaying or making video. Set-top boxes, devices used to stream video between devices (Apple TV, Slingbox, etc.), video cassette recorders (VCRs), digital and personal video recorders (DVR or PVR), video disc players/recorders (DVD or Blu-ray), portable DVD players and other portable video players with screens larger than 7", handheld portable TVs that are designed to operate on batteries, video cameras (camcorders), satellite television equipment, video accessories, and other video products.

ELI excludes: Excludes all stationary televisions including televisions designed to be installed in an automobile. Also excluded are video tapes and discs for sale or rent, rental of video equipment, digital video recorder services, and satellite dish programming services. Portable media players with screens smaller than 7" are excluded unless they include a DVD player. Also excluded are digital/personal video recorder subscription services. Cameras primarily intended for still photography are excluded even if they have a video feature.

Cluster Definitions: This list is divided into four clusters: Cluster 01D - Video Players/Receivers: Devices that obtain video from another source-whether through a telecommunications line such as cable or the internet, or from another home device such as a personal computer-so that the video can be displayed or recorded for display on a television, monitor, or projector. Examples include VCRs, DVD players, cable set-top boxes, DVRs, and Apple TV. Portable video players belong in cluster 02C. Cluster 02C - Portable Video Players: Devices that combine a screen, a video source, and battery power so video can be viewed on the go. Included are DVD players, televisions, satellite TV players, and DVRs designed for portable viewing. Cluster 03C - Video Cameras/Camcorders: Motion photography devices used to record video. Cameras primarily intended for still photography are excluded from this ELI. Cluster 04B - Other Video Products/Accessories: All video products eligible in the ELI that do not fall in one of the above clusters. Examples include video cables, antennas, and television remote controls. Quality adjustment method: The BLS does a hedonic quality adjustment since 2000 (Kokoski, Waehrer and Wright (1999)).

Audio equipment CPI Code: CUUR0000SERA05

ELI definition: All types of home, portable, and automobile audio equipment and accessories. ELI excludes: Portable media players with screens larger than 7" are excluded (these are priced as video equipment). Personal audio players that can run Apps and browse the internet are priced under handheld computers. DVD, Blu-Ray, video streamers, and all other video players are excluded unless the unit functions primarily as receiver or is part of a bundled "Home Theater System."

This price series is divided into five clusters: Cluster 01B - Personal audio devices: Audio players and recorders designed for mobile use with headphones. Cluster 02B - Audio systems, components, and speakers: Receivers, stereo components and systems, speakers, and home theater systems. Cluster 03B - Automobile audio equipment: Audio equipment designed for installation and use in an automobile. Cluster 04A - Compact audio including boomboxes and docks: Complete audio systems that include built-in speakers including clock radios and docks for personal audio devices. Cluster 05 – Accessories: Headphones, audio cables, and other accessories.

Quality is adjusted using imputation, wherein the BLS estimates the price change between a newly discontinued stereo and the new stereo via the price change of all other comparable stereos in the area. Since 2000, the BLS uses the hedonic price method to adjust quality. (Kokoski et al. (1999).)

Video, audio, photographic, and information processing equipment and media (75, 76, and part of 93) BEA code: DVAPRG3

Quality adjustment method: Quality is adjusted with the hedonic price method since 2000.

Photographic equipment CPI code: CUUR0000SS61023

ELI definition: Digital cameras and lenses intended primarily for still photography. Included in ELI but excluded from pricing: Other photographic equipment (including film cameras, tripods, and camera bags) are included in the ELI but not priced. ELI excludes: in ELI RD011 digital memory cards and readers (included in ELI EE021), office/document printers and scanners (included in ELI EE011), photo printer paper (included in ELI GE011), photo printer ink cartridges (included in ELI EE021), and digital picture frames (included in ELI HL012)

This price series is divided into two specification clusters: CLUSTER 01C - Fixed lens cameras: Cameras with a built-in lens. These cameras may be referred to as point-and shoot. CLUSTER 02C - SLR, interchangeable lens cameras, and lenses: Cameras designed to work with removable lens including SLRs and mirrorless ILC (interchangeable lens camera). This cluster also includes lenses designed to work with these cameras.

Quality adjustment method: Quality adjusted using imputation, wherein the BLS estimates the price change between a newly discontinued piece of photography equipment and the new piece of photography equipment via the price change of all other comparable photography equipment in the area.

Electronic computers and workstations PPI code: WPU11510114; *Portable Computers, Laptops, PDAs, and other single user Computers* PPI code: WPU11510115; *Portable Computers, Laptops, PDAs, and other single user Computers* PPI code: WPU11510116 (See International Monetary Fund (2004, pp. 261-263)).

Quality adjustment method: Hedonic price method (See Department of Commerce, Bureau of Labor Statistics (2008) and Wasshausen and Moulton (2006)).

Test equipment for electrical, radio, & communication circuits & motors PPI code: WPU11720501

Quality adjustment method: Production cost-based quality adjustment

Coin operated amusement machines PPI code: WPU119308

Includes electronic casino gaming devices, slot machines, juke boxes, arcade games, pinball machines, "wood machines" that could be in an arcade (such as a wooden shuffle board), ticket dispensers, and parts for the aforementioned machines. Excludes games that require a computer, personal gaming devices, or games that could be considered a sport.

Quality adjustment method: Production cost-based quality adjustment

Watches – CPI code: CUUR0000SEAG01

ELI definition: All types and styles of wrist watches, pocket watches, and other types of watches meant to be worn on the body (i.e. ring watches) for men, women, and children. ELI excludes: Single purpose stopwatches which are not part of a standard watch.

Quality adjustment method: Imputation. The BLS estimates the price change between a discontinued watch and new watch via the price change of all other comparable watches in area.

New cars – CPI code: CUUR0000SS45011

ELI definition: All new automobiles, trucks and multi-purpose vehicles purchased for personal use. The vehicles are classified as either car or light truck segment. The light truck cluster includes pickup, vans, and sport utility vehicles. The body style term "crossover vehicle" is used in the industry to describe both cars and light trucks and to assist you with the appropriate cluster placement, please reference the SO 725 New Car and Truck List. ELI excludes: Optional extended warranties, titling, and registration; Used, commercial, "demonstrator", and recreational vehicles.

Quality adjustment method: Production cost-based quality adjustment.

Table 1: Products by category

Hold-Up Industry	SEP-Reliant Industries	Non-SEP-Reliant Industries
Electricity, Urban Consumers	Telephone and facsimile Equipment merged with Telephone Hardware	Test equipment for electrical, radio, and communication circuits and motors
	Calculators, & Other Consumer Information Items	Watches
	Televisions	New Cars
	Other Video	Host Computers, Multi-users (Mainframes, UNIX, and PC Servers)
	Computers and Workstations (excluding portable)	Coin Operated Amusement Machines
	Audio Equipment	
	Photographic Equipment	
	Portable Computers, Laptops, PDAs, and Other Single User Computers	
	Video, audio, photographic, and information processing equipment and media (Figure 5 only)	

Note: For precise definitions and BLS or BEA Code see Appendix A.

Table 2: The effect of e-bay on the rate of price change in SEP industries

	(1) Price change	(2) Price change (detrended)	(3) Price change (detrended, Moore's law only)
Dummy SEP*Post 2006	0.012	0.012	0.013
	(0.012)	(0.012)	(0.014)
SEP industry	−0.058***	0.0094	−0.053**
	(0.013)	(0.013)	(0.019)
Constant	-0.039	−0.035	0.050
	(0.021)	(0.021)	(0.032)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	201	201	169
R-squared	0.807	0.311	0.344

Note: The dependent variable is the quality adjusted change in the price of products in a particular industry and year. SEP industry is a dummy variable that equals one if the industry is a SEP-reliant industry, as defined in the text and listed in Table 1, and equals zero otherwise. Post 2006 is a dummy variable that equals one before 2007 and one from 2007 onward. Robust standard errors are reported in parentheses, and the designations, *, **, ***, indicate statistical significance at the ten, five, and one percent, respectively.

Figure 1
Quality-Adjusted Relative Prices of SEP-Intensive Consumer Products Compared to Electricity Prices 1997-2013

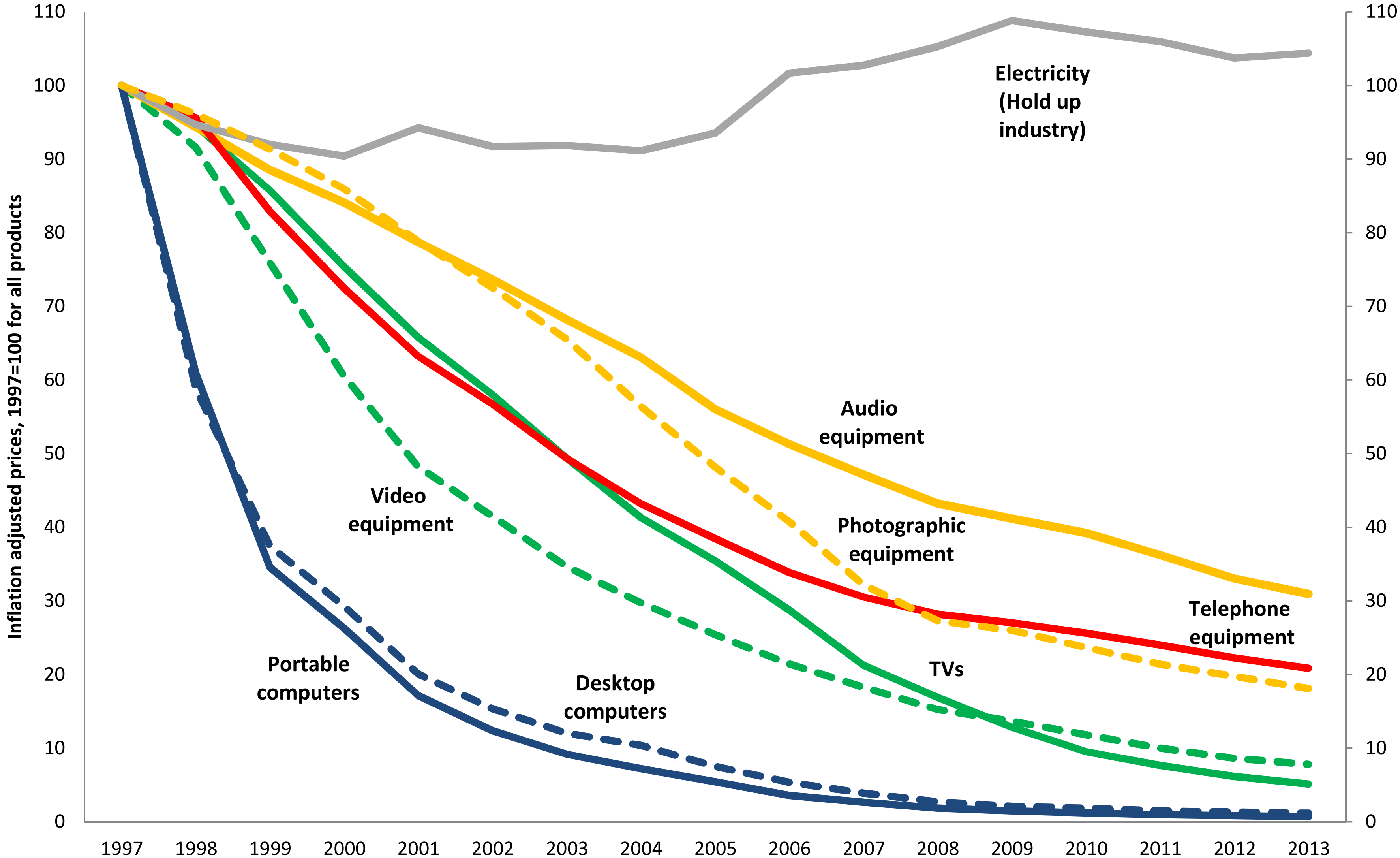


Figure 2
Quality-Adjusted Relative Prices of SEP-Intensive Products Versus Automobiles , 1997-2013

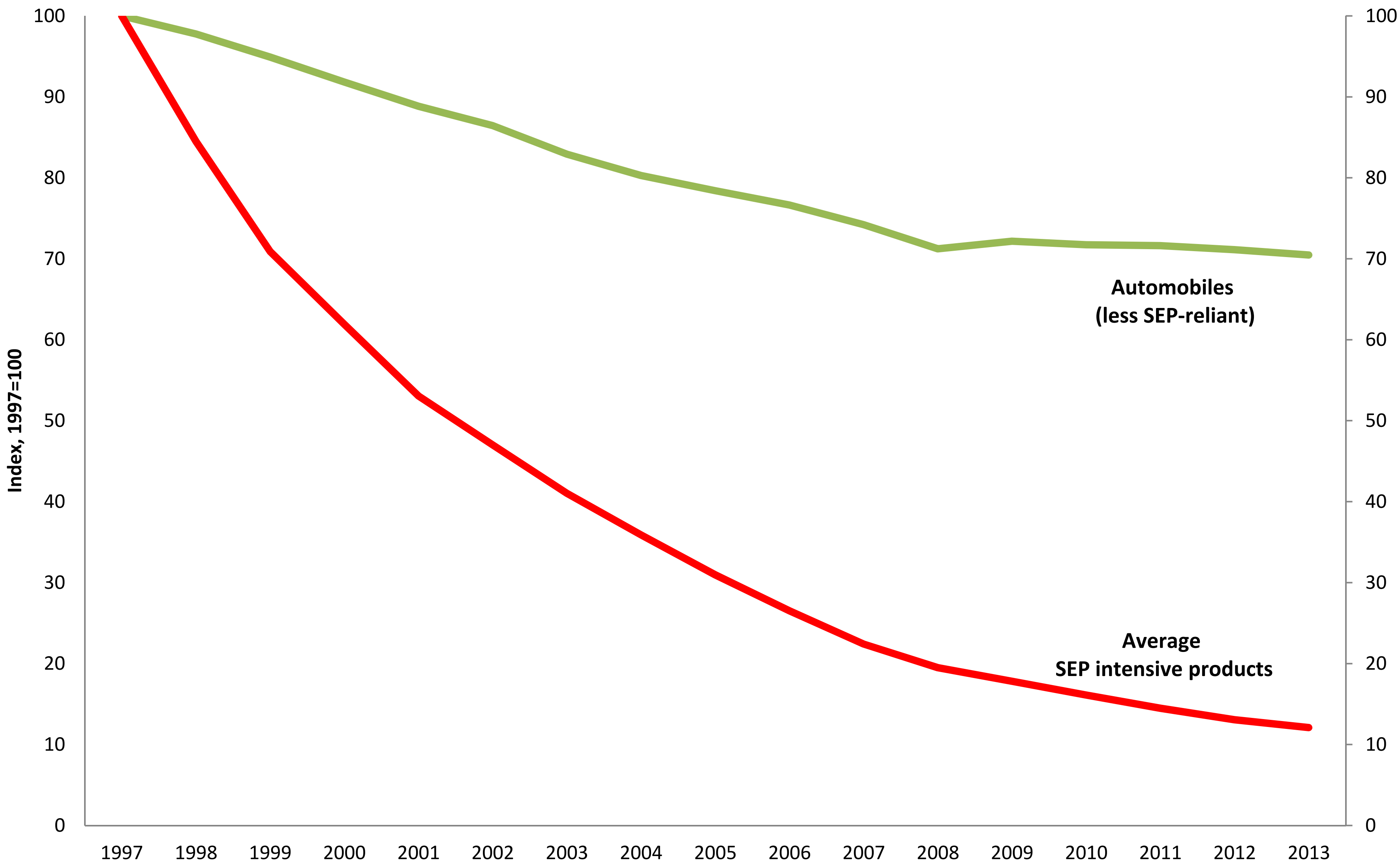


Figure 3
Quality-Adjusted Relative Prices of SEP-Intensive Products Compared with other "Moore's Law" Products, 1997-2013

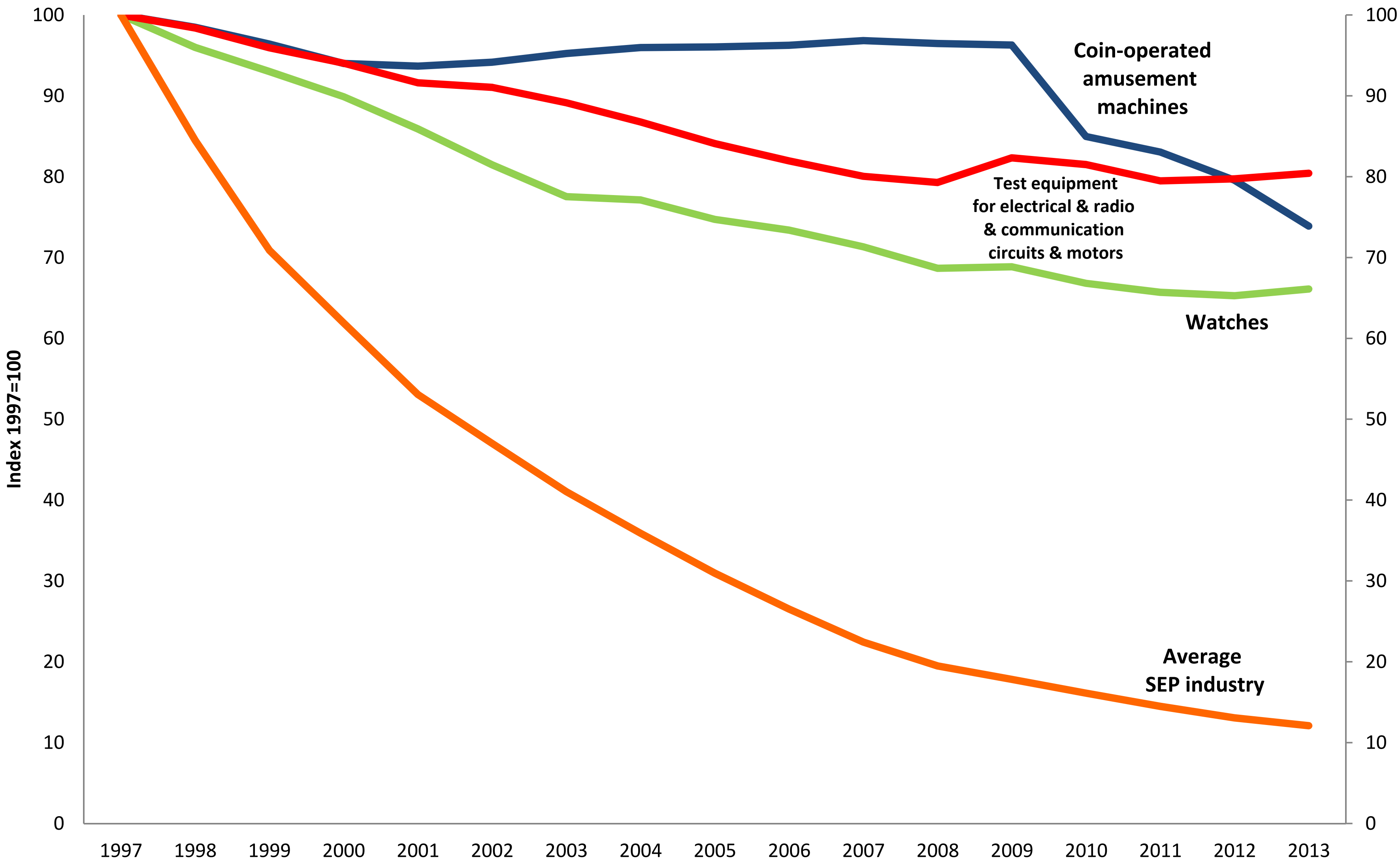


Figure 4
Quality Adjusted Relative Prices of Multi-User Mainframe Computers & Servers Compared with SEP-Intensive Desktop and Portable Computers, 2004-2013

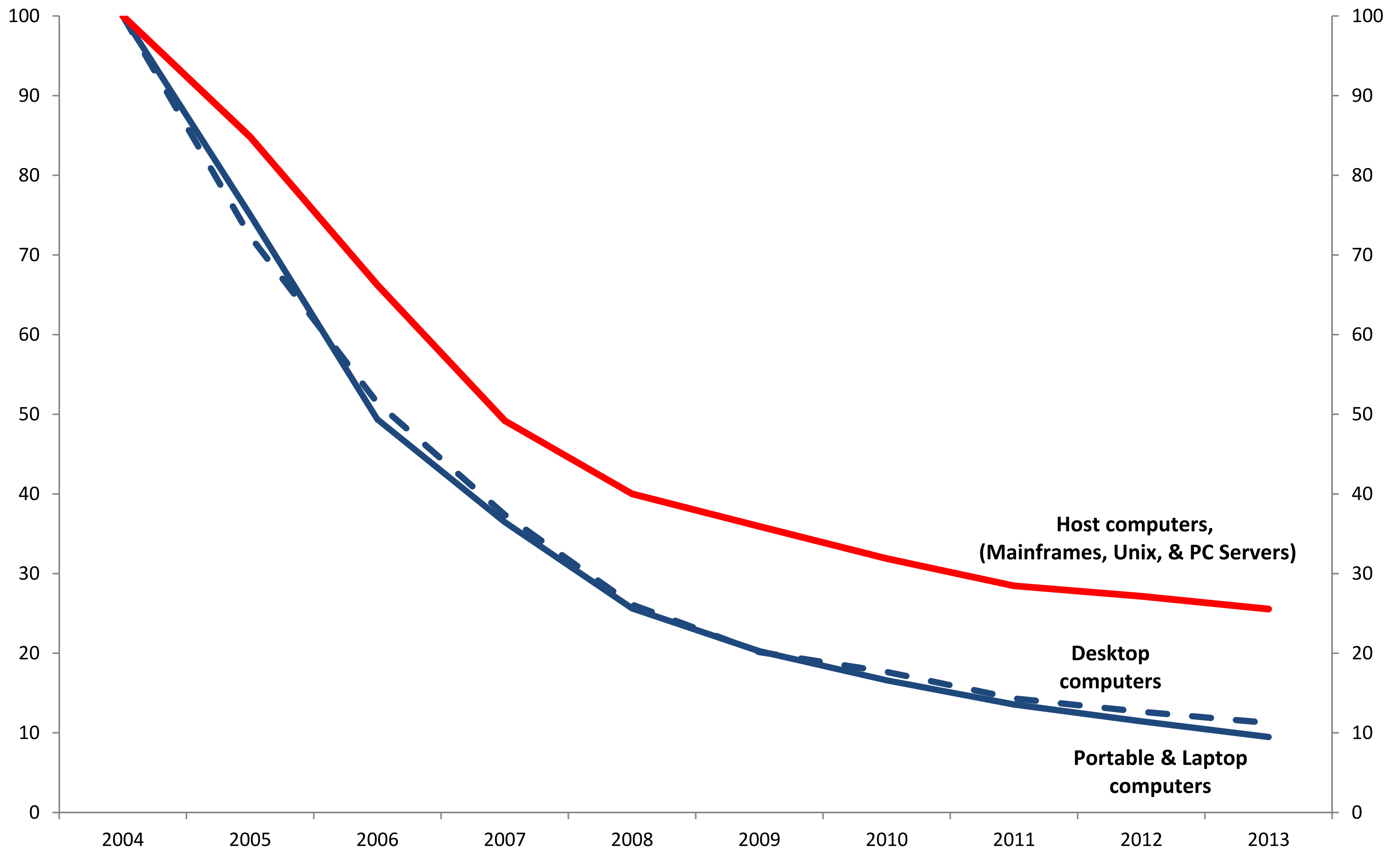
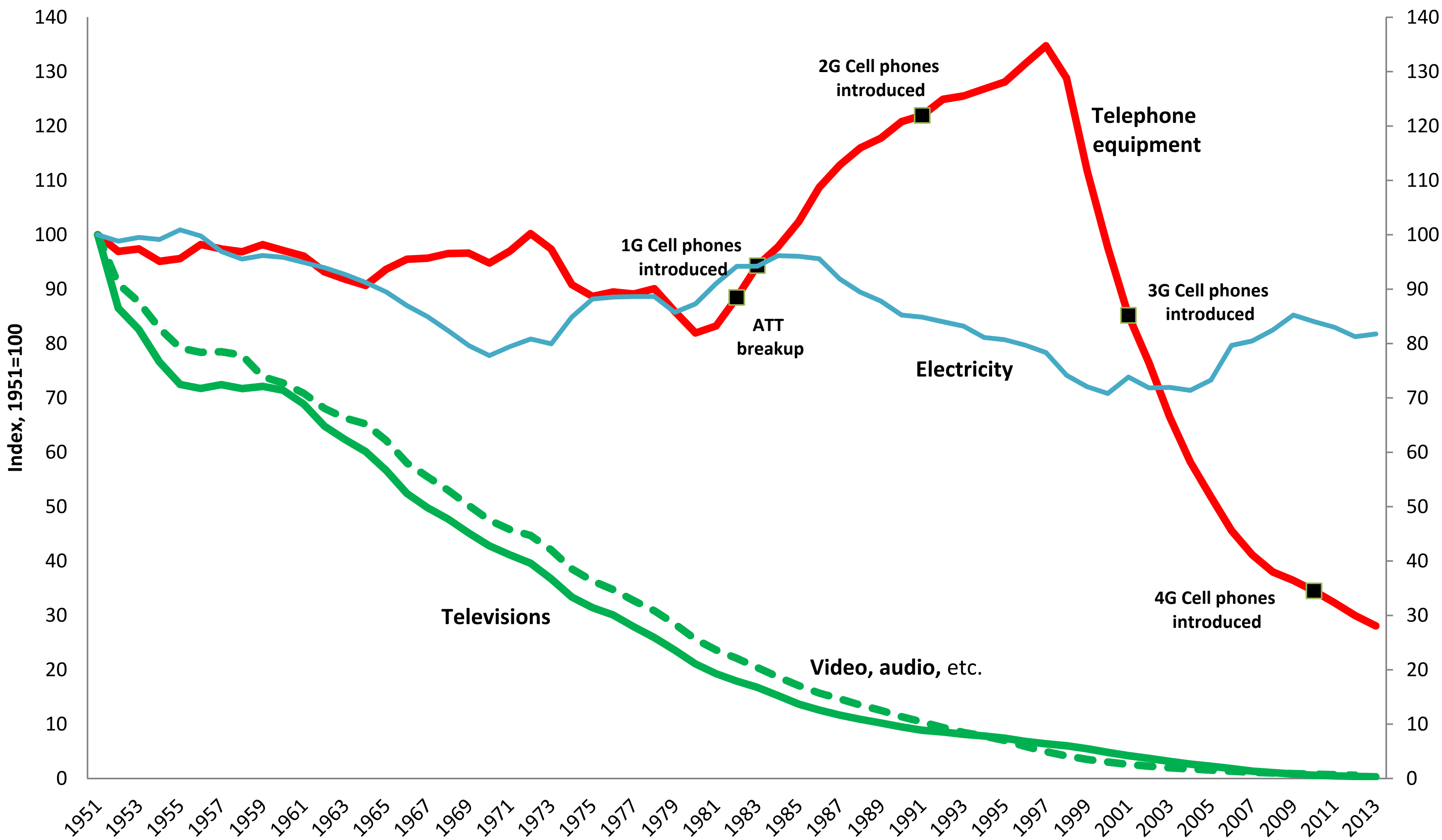


Figure 5
Quality-Adjusted Relative Prices of Electricity, Telephone Equipment , TVs and an Index of Video, Audio, Photographic and Information Processing Equipment and Media, 1951-2013



MUCH ADO ABOUT HOLD-UP

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Draft for Comment: July 3, 2018

ABSTRACT

The policy debate surrounding patent hold-up in markets for standardized products is now well into its second decade with no end in sight. Fundamental questions including the definition of hold-up, whether it exists in the marketplace, and what impact it has on innovation, continue to bedevil scholars, policy makers and industry. Yet it is not clear that this debate needs to continue. Patent hold-up is a pattern of market behavior, not a legally-cognizable wrong. Whether it is commonplace or rare is largely irrelevant to liability in any given case. To the extent that hold-up behavior constitutes an abuse of market power, with resulting harms to competition, longstanding doctrines of antitrust and competition law exist to sanction it. To the extent that hold-up impedes the efficient operation of standard-setting processes, SDOs can, and have, adopted internal procedures, including disclosure and licensing requirements, to curtail that behavior. Thus, the ongoing debate over the empirical evidence for systemic patent hold-up in standardized product markets, or a lack thereof, seems a fruitless academic exercise. The presence or absence of systemic hold-up actually tells us little about individual firm behavior that can and should be sanctioned by the law, and it may thus be time to close the debate over the systemic prevalence of this form of behavior.

* Professor, University of Utah S.J. Quinney College of Law. The arguments made in this article draw on presentations made by the author, *inter alia*, at the NYU-ABA Next Generation of Antitrust Scholars Conference (New York, Jan. 2018), National Law University, Delhi's Second Annual Roundtable on Innovation, Intellectual Property and Competition (Bangalore, July 2017), Stanford University Hoover Institute's Conference on Patent Holdup Theory: Implications for the Courts, Government, and the Legislature (Washington, DC, Oct. 2016); the University of Liege, Competition and Innovation Institute Conference on Regulating Patent Hold-Up (Brussels, Mar. 2016), and the Global Competition Review (GCR) Live, IP and Antitrust Asia-Pacific Conference (Seoul, June 2015). The author thanks the participants in and organizers of each of these conferences for valuable feedback, discussion and debate and is particularly grateful to Michael Carrier, Dave Djavaherian, Andy Gavil, Jon Jacobson, Julian Nowag, Tim Simcoe and Jeralyn Trujillo for their helpful comments on this article. Partial support for the research and writing of this article was provided by the Albert and Elaine Borchard Fund for Faculty Excellence at the University of Utah.

INTRODUCTION

The technical innovations embodied in industry standards such as Wi-Fi, MP3 and LTE are covered by hundreds, if not thousands, of patents.[1] To manufacture and sell a product that complies with such a standard, a manufacturer[2] will necessarily infringe each patent that is "essential" to the standard (a standards-essential patent or SEP).[3] Therefore, the manufacturer must either obtain a license to operate under such SEPs or risk an infringement suit by the SEP holders.[4] In many cases, the relevant standards development organization (SDO) requires that this license be on terms that are "fair," "reasonable," and "non-discriminatory" (FRAND).[5]

But even with a commitment to license on FRAND terms, situations may arise in which a SEP holder seeks to charge the manufacturer a royalty that exceeds value of its technical contribution. Nevertheless, the manufacturer may have little choice but to include a broadly-adopted standard in its product in order to be viable in the marketplace. And because the manufacturer may already have made specific non-recoupable investments in the design, manufacture and sale of the standard-compliant product, it may be willing to concede to a SEP holder's demands for excessive royalties in order to avoid losing these sunk investments. This scenario has been referred to as patent "hold-up".[6]

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[1] *See* note 22, *infra*, and accompanying discussion.

[2] For convenience, I use the term "manufacturer" to refer to the entire class of entities that would theoretically require a license under a standards-essential patent, including product manufacturers, component suppliers, assemblers, OEMs, resellers, wholesalers, distributors, retailers and end users.

[3] Given the complexity of standardized technologies, the large numbers of patents involved and the significant incentives to declare patents as being "essential" to standards, there is significant debate regarding the actual essentiality of many patents to standards. *See* Jorge L. Contreras, *Essentiality and Standards-Essential Patents* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND PATENTS, Ch. 12 (Jorge L. Contreras, ed., 2017).

[4] In actuality, many holders of SEPs do not actively enforce their SEPs against manufacturers of standardized products, but rather hold these SEPs "defensively" for use if they are themselves sued. *See* Jorge L. Contreras, *Fixing FRAND: A Pseudo-Pool Approach to Standards-Based Patent Licensing*, 79 ANTITRUST L.J. 47, 62 (2013) (referring to such SEP holders as "sleeping dogs").

[5] For convenience, I also use the term FRAND to cover the alternative formulation "Reasonable and Nondiscriminatory" (RAND). These terms are largely viewed as synonymous. *See* U.S. DEPT. JUSTICE & U.S. PATENT & TRADEMARK OFFICE, POLICY STATEMENT ON REMEDIES FOR STANDARDS-ESSENTIAL PATENTS SUBJECT TO VOLUNTARY F/RAND COMMITMENTS (2013), *available at* http://www.justice.gov/atr/public/guidelines/290994.pdf.

[6] For a discussion of the different definitions of "hold-up", see Part II.A, *infra*. The legal and economic literature on hold-up in the context of patented standards has become extensive. For a detailed review of the theoretical literature, see Norman V. Siebrasse, *Holdup, Holdout and Royalty Stacking: A Review of the Literature* in PATENT REMEDIES AND COMPLEX PRODUCTS: TOWARD A GLOBAL CONSENSUS, Ch. 7 (C. Bradford Biddle et al, eds., 2019, forthcoming), and for a summary of empirical studies, see Jorge L. Contreras, *Technical Standards, Standards-Setting Organizations and Intellectual Property: A Survey of the Literature (With an Emphasis on Empirical Approaches),* in RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW, VOL. II – ANALYTICAL METHODS (Peter S. Menell & David Schwartz, eds., 2018, forthcoming). Academic articles on the topic of hold-up in standard-setting include: Thomas F. Cotter, Erik Hovenkamp, Norman Siebrasse, *Switching Costs, Path Dependence, and Patent Holdup* (working paper Feb. 21,2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3127933; Alexander Galetovic & Stephen Haber, *The Fallacies of Patent Holdup Theory*, 13 J. COMPETITION L. & ECON. 1 (2017); Norman V. Siebrasse & Thomas F. Cotter, *The Value of the Standard*, 101 MINN. L. REV. 1159

As discussed in greater detail in Part I below, hold-up can cause a variety of market inefficiencies and is generally viewed as detrimental to the smooth operation of the standardization process.

Though most commentators seem to agree that hold-up *could* occur in markets characterized by patented standards, there is significant disagreement over the extent to which hold-up actually *does* occur in such markets. On one hand, industry participants have identified patent hold-up as a significant issue. As early as 2002, the leader of the Worldwide Web Consortium (W3C), a prominent SDO, testified before the U.S. Department of Justice (DOJ) and Federal Trade Commission (FTC) that:

> patent holdup has been a real problem, introducing delay, inefficient allocation of resources intended for innovation, and the possibility for individual patent holders to exercise unjustified control over the design of fundamental technology infrastructure on which the entire marketplace depends.[7]

Other technology industry leaders have made similar claims over the years.[8] In response to the threat of hold-up, scholars including Carl Shapiro, A. Douglas Melamed, Fiona

(2017); Alexander Galetovic, Stephen Haber & Ross Levine, *An Empirical Examination of Patent Holdup*, 11 J. COMPETITION L. & ECON. 549 (2015); Colleen V. Chien, *Holding Up and Holding Out*, 21 MICH. TELECOMM. & TECH. L. REV. 1 (2014); Dennis W. Carlton & Allan L. Shampine, *An Economic Interpretation of FRAND*, 9 J. COMPETITION L. & ECON. 531 (2013); F. Scott Kieff & Anne Layne-Farrar, *Incentive Effects from Different Approaches to Holdup Mitigation Surrounding Patent Remedies and Standard-Setting Organizations*, 9 J. COMP. L & ECON. 1091 (2013); Contreras, *Fixing FRAND, supra* note 4; Bernhard Ganglmair, Luke M. Froeb & Gregory J. Werden, *Patent Hold-Up and Antitrust: How a Well-Intentioned Rule Could Retard Innovation*, 60 J. INDUS. ECON. 249 (2012); Colleen V. Chien & Mark A. Lemley, *Patent Holdup, the ITC, and the Public Interest*, 98 CORNELL L. REV. 1 (2012); Suzanne Michel, *Bargaining for RAND Royalties in the Shadow of Patent Remedies Law*, 77 ANTITRUST L.J. 889 (2011); Carl Shapiro, *Injunctions, Hold-Up, and Patent Royalties*, AM. L. & ECON. REV. (2010); Thomas F. Cotter, *Patent Holdup, Patent Remedies, and Antitrust Responses*, 34 J. CORP. L. 1151, 1197 (2009); Einer Elhauge, *Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties*? 4 J. COMP. L & ECON. 535 (2008); J. Gregory Sidak, *Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro*, 92 MINN. L. REV. 714 (2008); Joseph Farrell, et al., *Standard Setting, Patents, and Hold-Up*, 74 ANTITRUST L.J. 603 (2007); Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991 (2007); Damien Geradin & Miguel Rato, *Can Standard-Setting Lead to Exploitative Abuse? A Dissonant View on Patent Hold-Up, Royalty Stacking and the Meaning of FRAND*, 3 EURO. COMP. J. 101 (2007); Robert A. Skitol, *Concerted Buying Power: Its Potential For Addressing The Patent Holdup Problem In Standard Setting*, 72 ANTITRUST L. J. 727 (2005); David J. Teece & Edward F. Sherry, *Standards Setting and Antitrust*, 87 MINN. L. REV. 1913 (2003); Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, in 1 INNOVATION POLICY AND THE ECONOMY 121, 126 (Adam B. Jaffe, Josh Lerner & Scott Stern eds., 2001).

[7] Daniel J. Weitzner, Supplemental Comments, Before the United States Department of Justice and United States Federal Trade Commission Joint Roundtables on Competition and Intellectual Property Law and Policy in the Knowledge-Based Economy: Standards and Intellectual Property; Antitrust Law and Patent Landscapes (Nov. 15, 2002). The Worldwide Web Consortium (W3C) is involved in the development of standards for the Worldwide Web including HTML and XML.

[8] *See, e.g.*, Letter from Industry and Academic Writers to Assistant Attorney General Makan Delrahim, U.S. Dept. Justice Antitrust Div., dated Jan. 24, 2018, at 1 ("patent hold-up is real, well documented, and harming US industry and consumers"); Letter from Apple, Inc. to Hon. Patrick J. Leahy and Hon. Chuck Grassley dated July 18, 2012, at 2 ("The heart of the problem is that a handful of FRAND

Scott-Morton, Joseph Farrell, Michael Carrier, Mark Lemley and others (including the author) have urged positive intervention by policy makers.[9]

On the other hand, critics including Stephen Haber, Richard Epstein, Anne Layne-Farrar, David Teece, Joshua Wright, F. Scott Kieff, and J. Gregory Sidak have argued that that there is little, if any, empirical evidence that hold-up is a pervasive or even a real problem in modern technology markets.[10] Two then-sitting commissioners of the FTC, Maureen Ohlhausen and Joshua Wright, summarized this position in 2015, asserting that "there is no empirical evidence to support the theory that patent holdup is a common problem in real world markets."[11] This purported lack of evidence has led some commentators to dismiss individual firms' complaints regarding hold-up as anecdotal and to conclude that, if hold-up occurs at all in the market, it is sporadic.[12] As a result, these commentators argue, policy initiatives focused on preventing hold-up are unnecessary at best and harmful at worst.[13]

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patent holders are using their standard essential patents as leverage to extort either (i) a share of the monetary value of nonstandardized, product-differentiating technology or (ii) the right to use, themselves, proprietary nonstandardized technology owned by other companies.")

[9] *See* A. Douglas Melamed & Carl Shapiro, *How Antitrust Can Make FRAND Commitments More Effective*, 127 YALE L.J. 2110 (2018); Commissioner Terrell McSweeny, Holding the Line on Patent Holdup: Why Antitrust Enforcement Matters (Mar, 21, 2018), https://www.ftc.gov/system/files/documents/public_statements/1350033/mcsweeny_-_the_reality_of_patent_hold-up_3-21-18.pdf; Fiona Scott Morton & Carl Shapiro, "Patent Assertions: Are We Any Closer to Aligning Reward to Contribution?*" NBER Working Paper No. 21678* (2015); Farrell et al., *supra* note 6; Lemley & Shapiro, *supra* note 6; Shapiro, Navigating, *supra* note 6, at 125 ("both patent and antitrust policymakers should regard holdup as a problem of first order significance in the years ahead").

[10] *See, e.g.,* J. Gregory Sidak, *The Antitrust Division's Devaluation of Standard-Essential Patents*, 104 GEORGETOWN L.J. ONLINE 48, 61 (2015) (collecting studies at n.49) ("By early 2015, more than two dozen economists and lawyers had disapproved or disputed the numerous assumptions and predictions of the patent holdup and royalty stacking conjectures."); Galetovic, Haber & Levine, *supra* note 6, at 572 ("We cannot reject the hypothesis of no SEP holdup"); Anne Layne-Farrar, *Patent Holdup and Royalty Stacking Theory and Evidence: Where do we Stand After 15 Years of History?*, OECD Directorate for Financial and Enterprise Affairs, Note DAF/COMP/WD(2014)84 (18 Nov. 2014) (after 15 years, "empirical studies conducted thus far have not shown that holdup or royalty stacking is a common problem in practice"); Sidak, *Holdup*, *supra* note 6, at 718 (2008) ("Despite Lemley and Shapiro's insistence to the contrary, there is little evidence of the existence of the holdup and royalty stacking problems that concern them"); Vincenzo Denicolò, Damien Geradin, Anne Layne-Farrar, & Jorge Padilla, *Revisiting Injunctive Relief: Interpreting eBay in High-Tech Industries with Non-Practicing Patent Holders*, 4 J. COMPETITION L. & ECON. 571 (2008) ("we point out the lack of hard evidence that patent holdup and other licensing problems are pervasive, not sporadic").

[11] Reply Submission on the Public Interest of Federal Trade Commissioners Maureen K. Ohlhausen and Joshua A. Wright, In re. Certain 3G Mobile Handsets and Components Thereof, ITC Case No. 337-TA-613 (on remand) (Jul. 2015).

[12] Denicoló et al, *supra* note 10, at 576 ("lack of hard evidence that patent holdup and other licensing problems are pervasive, not sporadic"); Ohlhausen & Wright, *supra* note 11, at 4 (acknowledging "the possibility of anticompetitive patent holdup in a given instance").

[13] Beyond a lack of empirical evidence, Galetovic and Haber, *supra* note 6, at 9-11, criticize what they term "Patent Holdup Theory" as relying on several faulty assumptions: the exercise of market power by an upstream supplier can be a long-run equilibrium, Patent Holdup can occur many times over to the same firm, resulting in "royalty stacking," and patented technologies themselves add little or nothing to the markets that they help create. Despite the authors' assertions, it is not clear that these assumptions (other than a recognition of the risk of royalty-stacking, though not its actual manifestation) are actually necessary to, or even promoted by, commentators who warn of patent hold-up. A full discussion of these theoretical issues is, however, beyond the scope of this article.

Recently, a third view regarding hold-up in technology markets has emerged, arguing that although evidence of widespread hold-up, under some definitions of the term, is not evident in technology markets, we should not expect to find this evidence, both because prophylactic measures already taken by SDOs and enforcement agencies may have eliminated the most blatant forms of abuse, and because detecting and documenting such behavior is inherently difficult, if not impossible.[14]

These fundamental disagreements over the extent and existence of hold-up[15] were recognized by the DOJ and FTC as early as 2002, when participants in a series of hearings convened by the agencies presented widely divergent views on this question:[16]

> Some panelists said hold up was the rare exception in a system that otherwise works well. Other panelists questioned this assertion, suggesting that hold up may be more widespread.[17]

These disagreements continue today, more than a decade and a half later.[18] To be sure, existential inquiries such as these are intellectually stimulating, and the industries involved – wireless telecommunications, computer networking, consumer electronics – have huge amounts at stake. Yet, despite the vehemence with which opinions are expressed and the frequency with which such conferences, symposia and debates are convened, questions about the existence of hold-up have changed very little over the last decade and a half. As such, it is worth asking whether the debate, and the questions being asked, remain meaningful, and whether the continued search for market-wide evidence of patent hold-up, or the refutation thereof, is a useful exercise.

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[14] Carl Shapiro, Presentation made at IEEE-SIIT 9th Intl. Conf. on Standardization and Innovation in Information Technology, Oct. 6-8, 2015, Sunnyvale, CA; Nancy Rose, Deputy Asst. Atty. Gen. for Economic Analysis, Antitrust Div., U.S. Dept. Justice, Speech given at Patents in Telecoms Conference, Nov. 5, 2015, Washington, DC.

[15] For purposes of this article, references to the "existence" of hold-up relate solely to its manifestation in modern technology-driven markets that rely heavily on industry standards, such as wireless telecommunications, networking and semiconductors. The large economics literature exploring issues of hold-up and opportunism in other industries speaks for itself and is not the focus of the present debate.

[16] U.S. Dept. Justice & Fed. Trade Comm'n, Competition and Intellectual Property Law in the Knowledge-Based Economy, Feb. 6 – Nov. 6, 2002 [hereinafter DOJ-FTC, 2002 Hearings] https://www.ftc.gov/news-events/events-calendar/2002/02/competition-ip-law-policy-knowledge-based-economy-hearings.

[17] U.S. Dept. of Justice & Fed. Trade Comm'n, Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition 39-40 (2007) [hereinafter DOJ-FTC, Antitrust & IPR] (reporting on 2002 hearings).

[18] In 2016, I attended a conference (Liege Competition and Innovation Institute, *Regulating Patent "Hold-Up"? An Assessment in Light of Recent Academic, Policy and Legal Evolutions*, Brussels, 29 Feb. 2016) devoted entirely to the topic of patent hold-up in the context of technical standard-setting. An impressive line-up of international experts from government, academia and the private sector vigorously debated questions such as: Does patent hold-up exist? If it exists, what impact does it have on technology innovation? And what, if anything, can and should be done about it by regulatory and enforcement agencies?

In this article, I do not examine the theories underlying patent hold-up or the evidence for or against patent hold-up in standard setting, but rather the contours of the long-running debate surrounding hold-up and whether it matters at all. Part I offers some essential background for those who are uninitiated in the world of technical standard setting and standards-essential patents. Part II explores the interrelated questions that form the core of the current hold-up debate: how is hold-up defined, and what can empirical evidence tell us about hold-up today's technology-driven markets? And in Part III, I challenge the underlying premise that evidence of systemic market hold-up matters, either in assessing the liability of individual firms that have engaged in abusive conduct, or in formulating meaningful policy reform. I introduce key analogies to illustrate the fallacies inherent in the arguments seeking to refute the hold-up thesis based on a purported lack of empirical evidence. First, as with a public health threat such as Ebola, the absence of widespread contagion does not imply that the threat is not a real one, only that existing preventative measures are working. Likewise, as with historical markets in commodities such as steel, coal and sugar, evidence that today's markets for standardized products (computers, smart phone) are thriving does not imply that anticompetitive conduct is not occurring, nor that it should not be the subject of ongoing regulatory scrutiny and policy. I conclude by recommending continued vigilance and enforcement by governmental agencies in accordance with existing antitrust and competition laws and ending the pointless (though invigorating) academic debate over patent hold-up.

I. PATENTS, STANDARDS, AND LOCK-IN

Technical standards such as Wi-Fi, USB, html and 4G LTE enable products manufactured by different vendors to interoperate with each other without significant user intervention. A device with a USB connector will work when plugged into a USB socket anywhere in the word. The broad deployment of such standards reduces product development and manufacturing costs, expands consumer choice, fosters innovation, and produces market efficiencies known as "network effects."[19]

Most of the standards currently implemented in technology products were developed by firms, often competitors, collaborating within groups known as standards-development organizations (SDOs).[20] Because of the significant market and consumer benefits that technical standards can confer, this degree of cooperation among market participants has been viewed favorably by antitrust and competition law authorities, who might otherwise condemn such large-scale coordination efforts among competitors.[21]

[19] *See* DOJ-FTC, ANTITRUST & IPR, *supra* note 17, at 33; CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY 45–46 (1999).

[20] SDOs include a broad range of organizations, from large, semi-governmental bodies such as the International Telecommunications Union (ITU) and the European Telecommunications Standards Institute (ETSI), to large trade associations such as the IEEE Standards Association and the Internet Engineering Task Force (IETF), to smaller groups often referred to as "consortia" that focus on one or a handful of related standards (e.g., the DVD 6C Forum, and Bluetooth Special Interest Group). *See generally* Brad Biddle, *No Standard for Standards: Understanding the ICT Standards-Development Ecosystem* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND PATENTS, Ch. 2 (Jorge L. Contreras, ed. 2017) (describing organizations involved in standard-setting).

[21] *See, e.g.*, DOJ-FTC, ANTITRUST & IPR, *supra* note 17, at x.

It is well-documented that many key interoperability standards, particularly in the wireless telecommunications and networking industries, are covered by patents, sometimes hundreds or thousands of them.[22] Ordinarily, if the manufacturer of an infringing product is unable or unwilling to obtain a license to operate under that patent, the manufacturer may either design around the patent (rendering the product non-infringing), or stop selling the infringing product.[23] With standards-compliant products, however, the manufacturer's options are more limited: designing around the patent may prevent the product from complying with the standard, thus reducing its functionality or making it unmarketable (e.g., a laptop computer without Wi-Fi or a smartphone without 4G connectivity). Thus, in order to sell a standards-compliant product, the prudent manufacturer must obtain permission from the patent holder (known as a license).

If necessary patent licenses are obtained before a new standard is approved by the SDO, then a manufacturer wishing to implement the standard in its products can do so without fear of infringement. If the royalty rates sought by the patent holder are too high for the market to bear, then the SDO participants designing the standard can work around the patented technology and choose a lower cost alternative or omit the patented technology from the standard entirely. In this way, different technologies can compete to be included in a standard, and patent holders will be constrained from demanding unreasonable terms.[24]

However, once a standard is approved by the SDO and adopted in the marketplace (and sometimes even earlier), manufacturers may invest significant amounts in product design, marketing and production based on that standard (e.g., the addition of a next-generation USB port to every laptop computer). And, given the combination of competitive pressure to place new products on the market, the length and complexity of patent licensing negotiations, inherent uncertainty regarding the meaning of the vaguely-defined term FRAND,[25] and the further uncertainty regarding which patents may actually cover a standardized technology, many manufacturers make these investments and begin to design, produce and sell standardized products before obtaining licenses from all holders of patents covering the standard.[26]

At this point, the patent holder is no longer at risk of being designed-out of the standard and the manufacturer's cost of switching from the standardized technology to an

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[22] Justus Baron & Tim Pohlmann, *Mapping Standards to Patents Using Declarations of Declared Standard-Essential Patents and Systems of Technological Classification* at Table 5, Northwestern Law & Econ. Research Paper 18-10 (2018); KNUT BLIND ET AL., STUDY ON THE INTERPLAY BETWEEN STANDARDS AND INTELLECTUAL PROPERTY RIGHTS (IPRS), FINAL REPORT 62 (2011).

[23] The manufacturer may also challenge the patent's validity. However, for purposes of this article, I will assume that at least some of the patents covering most technical standards are valid and enforceable.

[24] *See, e.g.*, Farrell et al., *supra* note 6, at 616.

[25] No SDO of which I am aware actually defines the level of a FRAND royalty for its standards. And those SDOs that have taken even small steps toward defining FRAND, e.g., by offering suggested measures for the appropriate royalty base, have been met with substantial opposition. *See, e.g.*, Sidak *Antitrust*, *supra* note 10.

[26] *See* Contreras, *Fixing FRAND*, *supra* note 4, at Part I.B ("Why FRAND Licenses are not Negotiated in Advance (Even though they Should Be)").

alternative may be prohibitive (a situation often referred to as "lock-in").[27] Lock-in dramatically increases the patent holder's leverage in any ensuing licensing negotiation, as the locked-in manufacturer would, in theory, be willing to pay the patent holder any amount up to its switching costs simply to avoid losing the investment already made in adopting the patented technology and the standard, more broadly.[28]

As discussed above, a patent holder's attempt to seek rent in excess of the value of its technology is termed patent "hold-up".[29] In addition to harming potential competitors, the predicted consequences of patent hold-up include increased prices for product inputs and consumer prices, as well as reductions in innovation and product improvement, and reduced adoption of interoperability standards leading to reduced interoperability and network effects.[30]

The risk of hold-up is likely to increase as the number of parties holding patents that cover a single standard rises. Complex technological products today may implement dozens, if not hundreds of standards, each of which may be covered by hundreds or thousands of patents held by a wide range of parties.[31] As such, the aggregation of royalty demands by multiple patent holders could lead to cost-prohibitive burdens on implementing standards-compliant products. This situation is sometimes referred to as "royalty stacking". Royalty stacking can arise "when a standard implicates numerous patents, perhaps hundreds, if not thousands," each of which bears a royalty that must be paid by product manufacturers and which "may become excessive in the aggregate."[32]

SDOs have been aware of the possibility of lock-in and patent hold-up for decades[33] and have responded by adopting policies designed to lessen the threat of hold-up behavior.[34] Such policies have included an affirmative requirement that SDO participants grant product manufacturers licenses to operate under patents that cover the

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[27] *See* SHAPIRO & VARIAN, *supra* note 19, at 116–30; Farrell et al., *supra* note 6, at 616–17.

[28] *See* Cotter, Hovenkamp, Siebrasse, *supra* note 6; Shapiro, Navigating, *supra* note 6, at 125.

[29] *See* notes 5-6, *supra*, and accompanying text.

[30] *See, e.g.*, Renata Hesse, Deputy Assistant Att'y Gen., Antitrust Div., U.S. Dep't of Justice, Remarks at the ITU-T Patent Roundtable: Six "Small" Proposals for SSOs Before Lunch, at 5 (Oct. 10, 2012), http://www.justice.gov/atr/public/speeches/287855.pdf; Shapiro, Navigating, *supra* note 6, at 125-26; DOJ-FTC, ANTITRUST & IPR, *supra* note 17, at 28; Farrell et. al, *supra* note 6, at 647; Lemley & Shapiro, *supra* note 6, at 2012; Scott Morton & Shapiro *supra* note 9, at 124 (applying hold-up reasoning to innovation and adoption of Internet of Things).

[31] *See* Brad Biddle, Andrew White & Sean Woods, *How Many Standards in a Laptop? (And Other Empirical Questions),* 2010 INT'L TELECOMM. UNION SEC. TELECOMM. STANDARDIZATION, KALEIDOSCOPE ACAD. CONF. PROC. (finding 251 standards embodied in an out-of-the-box laptop computer).

[32] Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1229 (Fed. Cir. 2014).

[33] *See, e.g.,* TCL Comms. v. Telefonaktiebolaget LM Ericsson, Memorandum of Findings of Fact and Conclusions of Law, slip op. at 11-12 (C.D. Cal., Dec. 21, 2017) (noting that the European Telecommunications Standards Institute (ETSI) was "concerned" with the problem of hold-up as early as 1993, when it formulated its first intellectual property policy).

[34] For a historical account of the development of such licensing policies in the U.S. and Europe, *see* Jorge L. Contreras, *Origins of FRAND Licensing Commitments in the United States and Europe,* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND PATENTS, Ch. 9 (Jorge L. Contreras, ed., 2017).

SDO's standards (standards-essential patents or SEPs[35]), or that standards not be approved by the SDO unless SEP holders agree to make such licenses available. In order to prevent excessive pricing of these licenses, SDOs generally require that they be granted on terms that are royalty-free or, if they are royalty-bearing, at rates that are FRAND.[36] All SDOs that are accredited by the American National Standards Institute (ANSI) must impose these requirements[37] and they are widely utilized among other SDOs worldwide.[38]

But despite the prophylactic measures adopted by SDOs, not to mention a number of antitrust and competition law enforcement actions in the U.S. and Europe, it is not clear that hold-up has been eliminated from the standard-setting environment. The debate regarding hold-up, and its existence in the marketplace, thus continues, as discussed below.

II. THE HUNT FOR PATENT HOLD-UP

As noted above, there is sharp disagreement within industry, academia and government regarding the existence of pervasive, market-wide patent hold-up in technology markets. On one hand, product manufacturers claim that they have experienced hold-up and that it imposes significant costs and inefficiencies on their businesses.[39] On the other hand, some empirical studies claim that there is a lack of convincing evidence of hold-up at a systemic level.[40] One possible reason for the divergence of opinion regarding the prevalence of hold-up in the market is the large variance among definitions of hold-up. That is, if different studies actually look for *different things*, then it is not surprising that their results vary.

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[35] The question which patents are "essential" to a standard is a complex one. *See* Contreras, *Essentiality, supra* note 3.

[36] *See* Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CALIF. L. REV. 1889, x (2002). A few SDOs require that such licenses be granted on terms that are royalty-free. *See* DOJ-FTC, ANTITRUST & IPR, *supra* note 17, at x. There has been significant debate and litigation concerning the precise meaning of "FRAND" royalty rates, a discussion of which is beyond the scope of this essay. *See, e.g.*, Chryssoula Pentheroudakis & Justus A. Baron, *Licensing Terms of Standard Essential Patents: A Comprehensive Analysis of Cases*. JRC Science for Policy Report EUR 28302 (2017) (collecting cases).

[37] AM. NAT'L STANDARDS INST., ANSI ESSENTIAL REQUIREMENTS: DUE PROCESS REQUIREMENTS FOR AMERICAN NATIONAL STANDARDS § 3.1.1(b), at 10 (2016).

[38] *See* Baron & Pohlmann, *supra* note 22, at x; Rudi Bekkers & Andrew Updegrove, A Study of IPR Policies and Practices of a Representative Group of Standards Setting Organizations Worldwide 89 tbl.13 (2012), http://sites.nationalacademies.org/xpedio/groups/pgasite/documents/webpage/pga_072197.pdf (of ten major SDOs studied, eight explicitly specify FRAND licensing as an option in their IPR policies); Lemley, *supra* note 36, at 1906 (of 36 SDOs studied, 29 required, and three encouraged, FRAND licensing).

[39] *See* note 8, *supra*, and accompanying discussion.

[40] *See* note 10, *supra*, and accompanying discussion.

A. Hold-Up Defined

At first blush, it might seem that a generally-accepted definition of patent hold-up should not be difficult to achieve. After all, the law is replete with vague terms like "due process", "good faith" and "market power" that, despite continued wrangling, have been defined with sufficient clarity to enable market actors to order their affairs. And if subtle definitional variations might make a difference at the margins, these do not materially alter the general parameters of the conduct in question. But with "hold-up", this is not the case. As it turns out, what might appear to be minor definitional gradations have had severe consequences both in terms of empirical studies of hold-up behavior and policy responses to potential hold-up. If nothing else, this diversity of definitions has given rise to a cottage industry of academic studies and articles discussing the theory and practice of patent hold-up.[41]

The notion of economic hold-up did not originate with technical standard-setting, nor with patent law at all. Though earlier treatments exist, economists considering hold-up in standard-setting often look to Oliver Williamson's leading work on transaction costs and information asymmetry in the 1980s.[42] Williamson defines opportunism (an analog of hold-up) as "self-interest seeking with guile," which includes "calculated efforts to mislead, deceive, obfuscate, and otherwise confuse."[43] He identifies resources, such as banana, sugar cane and other volatile crops, that cannot easily be re-deployed to alternative uses (the notion of asset specificity).[44] The owners of specific assets are vulnerable to opportunistic behavior by potential transaction partners who act dishonestly (e.g., by using deceptive means to argue for a lower price). As explained by Kieff and Layne-Farrar, Williamson predicts that the confluence of "asset specificity on the one hand and opportunism on the other … is what causes the serious problem of holdup."[45]

Despite the rich intellectual heritage that economics owes to Williamson and subsequent researchers,[46] the term "hold-up" has taken on a different and more straightforward meaning in the context of standard-setting. Shapiro is generally credited with introducing the notion of hold-up to the lexicon of standard-setting in 2001.[47] Courts adjudicating disputes between patent holders and manufacturers have subsequently adopted streamlined definitions of hold-up such as: "[t]he ability of a holder of [a] SEP to demand more than the value of its patented technology,"[48] and "when the

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[41] *See* note 6, *supra*.

[42] Kieff & Layne-Farrar, *supra* note 6, at 1094-97; Galetovic & Haber, *supra* note 6, at 17-23.

[43] OLIVER E. WILLIAMSON, THE MECHANISMS OF GOVERNANCE 378 (1996). *See also* OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM 47 (1985).

[44] *Id*. at 52-56.

[45] Kieff & Layne-Farrar, *supra* note 6, at 1095.

[46] It is worth noting that Williamson himself used the term "opportunism" to describe the particular set of behaviors under discussion. The term "hold-up" was introduced by later scholars to describe the same conduct. *See, e.g.,* Farrell, et al., *supra* note 6, at 603 (equating "opportunism" and "hold-up").

[47] *See* Shapiro, Navigating, *supra* note 6, at 125. *See also* Galetovic & Haber, *supra* note 6, at 4 (tracing current hold-up theories in standard-setting to Shapiro).

[48] Microsoft Corp. v. Motorola, Inc., Findings of Fact and Conclusions of Law, No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013).

holder of a SEP demands excessive royalties after companies are locked into using a standard."[49]

Many of these definitions emphasize the manufacturer's sunk costs and lock-in to a particular technical solution. Thus, according to the U.S. Federal Trade Commission (FTC), hold-up is based on "a patentee's ability to extract a higher licensing fee after an accused infringer has sunk costs into implementing the patented technology than the patentee could have obtained at the time of design decisions, when the patented technology competed with alternatives."[50]

From an economic standpoint, Layne-Farrar, Llobet and Padilla define hold-up as occurring "when two parties contract on the provision of a good and one of the parties (typically the buyer) needs to make a specific investment ex ante before negotiating the price. After the party makes the specific investment … the other party may have increased bargaining power and it may, therefore, choose a price that does not reward the sunken investment."[51] This type of hold up, they argue, "destroys the incentives to invest in the first place".[52]

A related focus of these hold-up formulations is the inappropriate leverage that SEP holders could obtain by threatening to obtain judicial injunctions to prevent manufacturers from producing standardized products, usually after lock-in has occurred.[53] The threat of an injunction, it is argued, may persuade a manufacturer to pay the SEP holder a higher rate than is otherwise warranted by the value of its patented technology. As such, the SEP holder engages in hold-up.

Williamson's element of guile, which implies deception or duplicity on the part of the resource holder, is not generally a part of these more recent or standards-specific definitions of hold-up. While this definitional divergence can initially cause confusion, it is clear from an examination of the literature that Williamson and transaction cost economists, on one hand, and courts, agencies and commentators who are considering conduct relating to standardization, on the other hand, are using the term hold-up to refer

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[49] Ericsson Inc. v. D-Link Sys., 773 F.3d 1201, 1209 (Fed. Cir. 2014).

[50] Fed. Trade Comm'n, The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition n.62 (2011) [hereinafter FTC, Evolving IP Marketplace]. *See also* Farrell et al, *supra* note 6, at 604 (associating hold-up with lock-in "when one party makes investments specific to a relationship before all the terms and conditions of the relationship are agreed"); Carlton & Shampine, *supra* note 6, at x ("By making a sunk investment, the party worsens its bargaining position and later can be held up by its negotiating partner, which can drive a harder bargain than would have been possible before the investment was made.").

[51] Anne Layne-Farrar, Gerard Llobet & A. Jorge Padilla, *Preventing Patent Hold Up: An Economic Assessment of Ex Ante Licensing Negotiations in Standard Setting*, 37 AIPLA Q.J. 445, 455 (2009).

[52] *Id*.

[53] *See* Michel, *supra* note 6, at x; Lemley & Shapiro, *supra* note 6, at 2008 ("The potential for an injunction against a whole product can and does permit so-called patent trolls to hold up defendants by threatening to enjoin products that are predominantly noninfringing"); Shapiro, Navigating, *supra* note 6, at 125 ("if the manufacturer has already designed its product and placed it into large scale production before the patent issues. … [t]he patentee can credibly seek far greater royalties, very likely backed up with the threat of shutting down the manufacturer if the Court indeed finds the patent valid and infringed and grants injunctive relief").

to *different* types of market behavior. While early theorists of patent hold-up may have made an unfortunate terminological choice when describing the phenomenon that they observed in the market, the term used to describe the phenomenon is not fatal to its existence. Attempts to discount theories about patent hold-up solely on the basis that they are inconsistent with similarly-named transaction cost economics theories of hold-up have little purchase and only serve to muddy the debate.[54] For purposes of the remainder of this article, I will assume that a SEP holder can engage in hold-up, as the term is described above and generally understood, without attempting to deceive or otherwise exhibit guile.[55]

B. Hold-Up and Royalty Stacking

As discussed in the preceding Part, patent hold-up is a potentially abusive behavior that may be exhibited by individual SEP holders. Royalty stacking, on the other hand, is a phenomenon that may arise when multiple SEP holders[56] each charge royalties on different features of a single product, thereby yielding an aggregate royalty rate that can be excessive in terms of the overall product's value.[57] As the U.S. Court of Appeals for the Federal Circuit has explained,

> [r]oyalty stacking can arise when a standard implicates numerous patents, perhaps hundreds, if not thousands. If companies are forced to pay royalties to all [patent] holders, the royalties will 'stack' on top of each other and may become excessive in the aggregate."[58]

As has been discussed extensively in the literature, royalty stacking is a variant of the classical Cournot complements problem in which different firms each control

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[54] *See, e.g.*, Galetovic & Haber, *supra* note 6, at 10 and 12-29 (lengthy analysis arguing that patent hold-up theory "contradicts the established theory of holdup" as established by transaction cost economics).

[55] It is worth noting, however, that deception in standard-setting can itself subject a SEP holder to significant antitrust liability, both as exclusionary conduct under Section 2 of the Sherman Act and as an unfair method of competition under Section 5 of the Federal Trade Commission Act. *See* Gil Ohana, Marc Hansen & Omar Shah, *Disclosure and Negotiation of Licensing Terms Prior to Adoption of Industry Standards: Preventing Another Patent Ambush*? 12 EURO. COMPETITION L. REV. 644 (2003) (describing deceptive conduct and the willful concealment of patents, sometimes referred to as "patent ambush"). These forms of conduct, however, go beyond what is typically considered to constitute hold-up.

[56] The threat of royalty stacking is not unique to SEPs or standardized products and stacking issues have been discussed in industries ranging from biotechnology to semiconductors. *See, e.g.,* Lemley & Shapiro, *supra* note 6, at 2010.

[57] *See* Shapiro, Navigating, *supra* note 6; Lemley & Shapiro, *supra* note 6.

[58] Ericsson, Inc. v. D-Link Sys., 773 F.3d 1201, 1209 (Fed. Cir. 2015). *See also* In re. Innovatio IP Ventures, LLC Patent Litig., U.S. Dist. LEXIS 144061 at *62 (N.D. Ill. 2013) ("quote"); Farrell et al., *supra* note 6, at 642 ("This is because the sum of the incremental values of [multiple] patents exceeds their value in combination"); William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385, 427 (2014) ("When thousands of patents or other inputs are involved in the same device, judges and juries consistently and systematically overemphasize the value of the single patent (or patents) at issue as compared to all the other inputs").

necessary inputs to production and act in an uncoordinated manner when charging a manufacturer for the use of those inputs.[59]

Hold-up and royalty stacking are related phenomena, inasmuch as they can each result in elevated royalties for standardized products. Yet they are different, both in their manifestation and in the behavior that may produce them. For example, royalty stacking can exist entirely independently of hold-up, simply because a product embodies multiple patented technologies and each patent holder seeks to maximize its individual return. Likewise, hold-up can occur with respect to products that are covered by only one patent, so long as that patent is essential to the exploitation of that product. Needless to say, when both hold-up and royalty stacking occur in tandem, the result can be even higher aggregate royalty rates for the relevant products. But, for analytical purposes, it is important to remember that hold-up and royalty stacking need not occur in tandem.

Given their seeming relatedness, hold-up and royalty stacking are frequently discussed together, if not conflated, in the literature.[60] In this essay, however, my focus is on hold-up. Accordingly, I do not address in detail the arguments raised either by proponents or opponents of theories addressing royalty stacking.[61]

C. Examples of Hold-Up from FRAND Litigation

As discussed in the previous section, hold-up is defined in the context of standard-setting as a SEP holder's attempt to extract excessive compensation from a manufacturer after the manufacturer has become locked-in to a standard. Using this definition, examples of hold-up can be found throughout the case law dealing with disputes over the licensing of standards-essential patents.

As noted in Part I, many SDOs require SEP holders to license their SEPs to manufacturers on terms that are fair, reasonable and non-discriminatory (FRAND). In some cases, a SEP holder and a manufacturer may disagree whether the royalty rate demanded by the SEP holder for such a license is FRAND, and the manufacturer may sue the SEP holder for breaching its FRAND commitment.[62] In other cases, a SEP holder may sue a manufacturer for infringing its SEPs, and the manufacturer may raise as an

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[59] *See* Shapiro, Navigating, *supra* note 6, Lemley & Shapiro, *supra* note 6 at 2013–15 (describing the well-known problems of Cournot complements and double marginalization and their potential to lead to hold-up in SEP markets),

[60] *See, e.g.*, Shapiro, Navigating, *supra* note 6; Lemley & Shapiro, *supra* note 6; Galetovic & Haber, *supra* note 6.

[61] I view royalty stacking as a greater threat than patent hold-up to innovation and efficient technology markets. *See* Jason R. Bartlett & Jorge L. Contreras, *Rationalizing FRAND Royalties: Can Interpleader Save the Internet of Things*, 36 REV. LITIG. 285 (2017); Jorge L. Contreras, *Standards, Royalty Stacking and Collective Action*, 3 CPI ANTITRUST CHRON. (2015).

[62] Because FRAND commitments are typically made by a SEP holder directly to an SDO, such suits are often brought by a manufacturer under a third party beneficiary theory whereby the manufacturer (which may or may not be a member of the SDO) argues that it is an intended beneficiary of the SEP holder's promise to the SDO. *See* J. Gregory Sidak, *A FRAND Contract's Intended Third-Party Beneficiary*, 1 CRITERION J. INNOVATION 1001 (2016); Jorge L. Contreras, *A Market Reliance Theory for FRAND Commitments and Other Patent Pledges*, 2015 UTAH L. REV. 479, 508-14 (2015).

affirmative defense the SEP holder's obligation to grant the manufacturer a license on FRAND terms. In both of these scenarios, one of the central questions is whether the royalty rate that the SEP holder sought to charge the manufacturer for the required SEP license was FRAND.[63]

In several such cases, courts have determined that the initial royalty demands of SEP holders have been far in excess of FRAND rates. For example, in *Microsoft v. Motorola*, with respect to its SEPs covering the H.264 audio-video encoding standard, Motorola initially demanded a royalty of 2.25% of the end price of Microsoft products embodying the standard.[64] Thus, for a low-end $500 computer, the per-unit royalty would have been $11.25.[65] The court, in assessing the value of Motorola's patents to the H.264 standard and the value of the standard to the overall products in which it was embodied, determined a FRAND royalty rate of $0.00555 per unit.[66] Based on these results, Motorola's initial royalty demand to Microsoft was more than 2,000 times higher than the "reasonable" royalty rate determined by the court.

Likewise, in *In re. Innovatio IP Ventures LLC*, Innovatio, the holder of twenty-three SEPs covering the 802.11 Wi-Fi wireless networking standard, sent demand letters to hundreds of coffee shops, motels, supermarkets and other retail establishments that offered public Wi-Fi access, in each case seeking a monetary settlement.[67] The case was consolidated and the court considered Innovatio's proposed royalty of 6% of the end price of products such as wireless access points, laptops, tablets and bar code scanners, resulting in potential royalties ranging from $3.39 to $36.90 per unit.[68] But after assessing the value of Innovatio's SEPs, the court held that the appropriate FRAND royalty was only $0.0956 per unit, making Innovatio's initial royalty proposals between 35 and 386 times higher than the adjudicated FRAND royalty rate.

Though these cases present extreme examples in which SEP holder royalty demands exceeded judicially determined FRAND rates by orders of magnitude, there are additional examples, both in the U.S. and elsewhere, in which the alleged behavior of SEP holders is consistent with a model in which a SEP holder attempts to extract excessive compensation from a manufacturer after the manufacturer has become locked-in to a standard.[69]

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[63] Other questions include whether the asserted patents are, indeed, essential to the relevant standard and thus subject to the FRAND commitment in the first place.

[64] Microsoft Corp. v. Motorola, Inc., Microsoft's Motion for Partial Summary Judgment of Breach of Contract at 22, Case 2:10-cv-01823-JLR filed Mar. 30, 2012 (W.D. Wash.). The effective per-unit royalty would have been $4.48 for an X-Box retailing for $199. *Id.*

[65] *Id*.

[66] Microsoft Corp. v. Motorola, Inc., No. C10-1823JLR, 2013 U.S. Dist. LEXIS 60233, at *20.

[67] 2013 U.S. Dist. LEXIS 144061 at *38 (N.D. Ill. 2013).

[68] *Id*. at *74-75.

[69] *See, e.g.*, TCL v. Ericsson (C.D. Cal. 2018) (SEP holder proposed effective 4G U.S. royalty rates of 1.074% and 1.988%, compared to court's determination of 0.450% FRAND rate); Unwired Planet v. Huawei (2017 EWHC 711 (Pat) at Para. 5, 7, 807(13)) (SEP holder proposed effective 4G major market royalty rates of 0.2% compared to court's determination of 0.052% FRAND rate); Lemley & Shapiro (2007) (discussing earlier cases including Rambus and RIM-Blackberry). *But see* Denicoló et al, *supra* note 10, at 597-99 (contesting Lemley-Shapiro characterization of these cases).

On the other hand, there have been cases in which adjudicatory bodies have found that SEP holders did *not* engage in hold-up. As explained by the Federal Circuit in *Ericsson v. D-Link*, an accused infringer seeking to raise the issue of hold-up to a jury must introduce actual evidence of the SEP holder's hold-up behavior.[70] Because this evidence was not introduced by the alleged infringer, the court did not instruct the jury on the question of hold-up.[71] Thus, while hold-up may not be found in every case, its potential existence is clearly acknowledged by courts that have considered the issue.

D. *The Search for Systemic Patent Hold-Up*

1. Why Seek Systemic Hold-up?

In addition to data provided by litigated cases, researchers have sought evidence demonstrating (or refuting) the existence of patent hold-up at a systemic level. In other words, whether or not hold-up is a pervasive phenomenon affecting the market as a whole. While individual case data may exist, Ohlhausen and Wright observe that "the outcome of a handful of litigated cases says nothing about whether holdup is a widespread problem for competition and consumers".[72] Layne-Farrar is yet more explicit, arguing that litigation results, such as those in *Innovatio* (discussed above) are "highly fact specific and should not be used as a benchmark for ecosystem reform."[73] And Kieff and Layne-Farrar go so far as to argue that virtually *any* intervention by governmental agencies in the operation of markets should be viewed with suspicion and even as a form of "government hold-up".[74]

Accordingly, in response to commentators such as Shapiro, Farrell and Lemley, these commentators argue that only empirical evidence of pervasive, systemic hold-up in relevant markets should justify policy interventions intended to reduce the threat of hold-up. That is, in order to form a rational basis for policy making, systemic data is needed in addition to litigation data.

2. Evidence of a Lack Evidence

Researchers seeking evidence of systemic hold-up have focused largely on the market for wireless communications devices, which is heavily dependent on standards

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[70] Ericsson, Inc. v. D-Link Sys., 773 F.3d 1201, ___ (Fed. Cir. 2015).

[71] *Id*.

[72] Ohlhausen & Wright, *supra* note 11, at 3. Ohlhausen and Wright argue that evidence of pervasive systemic hold-up is needed to "shift the burden" of proof at the ITC to the SEP holder to prove that its potential licensee is unwilling to accept a license on FRAND terms (*id*. at 7-8). But this is not necessarily so. While Ohlhausen and Wright present the case for a lack of evidence of pervasive hold-up, it is not clear that in order for the ITC to adapt its public interest inquiry to SEPs there must be evidence of pervasive hold-up.

[73] Layne-Farrar, *supra* note 10, at 5.

[74] Kieff & Layne-Farrar, *supra* note 6, at 1098-1100 ("This sort of industrial policy, where courts and government agencies intervene in commercial disputes to pick the winners and losers, would distort competition in the marketplace and would alter firm's *ex ante* incentives to negotiate reasonable solutions in good faith. These would be harmful unintended consequences worth trying to avoid.")

covered by large numbers of SEPs. These studies fall into two general categories. The first draw conclusions based on positive characteristics of the market. For example, Ohlhausen and Wright observe that "wireless prices have dropped relative to the overall consumer price index (CPI) since 2005, output has grown exponentially, features and innovation continue at a rapid pace, and competition between mobile device manufacturers has been highly robust with meaningful entry over time."[75] Galetovic and Haber expand on these observations with a wealth of data relating to innovation and pricing in technology product markets, all of which, they argue, suggest that hold-up cannot be producing a meaningful drag on innovation, consumer choice or economic welfare:

> [F]rom 1997 to 2013 rates of innovation in phone equipment (which includes such low tech items as fax machines and landline phones, as well as wireless phones) was 10 percent per annum faster than the economy-wide average. The data show that the rate of innovation in portable and laptop computers was faster still, 31 percent per annum faster than the economy-wide average. Similar rates of innovation are observed in other SEP-intensive IT products such as video equipment, audio equipment, desktop computers, and televisions. In addition, rates of innovation in SEP-intensive IT products have not slowed over time relative to the rates of innovation in similar, non-SEP- intensive IT products. For example, the rate of innovation in SEP-intensive laptop computers compared to non-SEP-intensive mainframe computers shows that SEP-intensity was associated with faster innovation…
>
> Between 1994 and 2013 the number of SEP holders [in the wireless telecom sector] increased from 2 to 128. Patent Holdup Theory would predict that this increase should have dramatically slowed the rate of innovation. That prediction did not obtain in reality, however: prices of mobile devices dropped like stones, while output grew 62-fold. During this same period there was rapid entry of new firms into the manufacture of phones and tablets—so much so that the level of industrial concentration actually fell in this industry over time.[76]

In addition to the general health of these product markets, commentators have pointed to the known royalty burdens borne by product manufacturers to assess whether predictions regarding hold-up (and royalty stacking) have led to excessive royalty burdens.[77] Gupta observes that the profit margins of leading mobile phone manufacturers such as Apple, Samsung and Nokia, are significant (in the range of 40%, 37% and 23%,

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[75] Ohlhausen & Wright, *supra* note 11.

[76] Galetovic & Haber, *supra* note 6, at 6-7 (summarizing prior studies and data, internal citations omitted). *See also* Kirti Gupta, *The Patent Policy Debate in the High-Tech World*, 9 J. COMP. L. & ECON. 827 (2013), Keith Mallinson, *Patent Licensing Fees Modest in Total Cost of Ownership for Cellular*, IP FINANCE (June 12, 2011), http://ipfinance.blogspot.co.uk/2011/06/patent-licensing-fees-modest-in-total.html.

[77] While these studies appear to be directed principally at the question of royalty stacking (which is not the primary focus of this essay), they are described briefly here for the sake of completeness.

respectively), implying that neither hold-up nor the stacking of SEP royalties are having a meaningful effect on such manufacturers' financial returns.[78] Galetovic, Haber and Zaretzki, extending earlier methodologies developed by Mallinson, adopt a revenue-based approach. They divide the aggregate global patent licensing revenue reported by the twenty largest publicly-traded firms with significant licensing arms by the total sales prices of all mobile phones sold globally. They conclude that the resulting ratio (approximately 3.3%) represents the aggregate patent royalty burden borne by mobile phone manufacturers.[79] Mallinson[80] and Sidak[81], using similar methodologies, arrive at aggregate royalty burdens in the range of 4-5%.

In sum, the studies described above all reach the conclusion that there is no empirical evidence of systemic patent hold-up in wireless telecom or other markets characterized by SEPs and standards. In most cases, the authors use this finding to discourage governmental agencies from intervening in the market by enacting regulations or taking other action intended to prevent hold-up from occurring. While the methodologies and theoretical underpinnings of these studies have been challenged,[82] the force and frequency with which they have recently been presented is sure to be influential.

E. And what about Holdout?

In the debate over patent hold-up, a common refrain by those who challenge the existence of hold-up has become "but what about holdout?" Holdout, also called 'reverse hold-up' in this context, refers to "the practice of companies routinely ignoring patents and resisting patent demands because the odds of getting caught are small."[83] As described by Kieff and Layne-Farrar, holdout by potential SEP licensees presents a

[78] Gupta, *supra* note 76, at 845.

[79] Alexander Galetovic, Stephen H. Haber, Lew Zaretzki, *An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results,* 42 TELECOMMUNICATIONS POLICY 263 (2018).

[80] Keith Mallinson, *Don't Fix What Isn't Broken: The Extraordinary Record of Innovations and Success in the Cellular Industry Under Existing Licensing Practices*, 23 GEO. MASON L. REV. 967 (2016).

[81] J. Gregory Sidak, *What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents*? CRITERION J. INNOVATION 701 (2016).

[82] *See, e.g.*, Shapiro, SIIT, *supra* note 14, and Rose, *supra* note 14. I too have some concerns, for example, with the characterization of technology markets without accounting for the value of cross-licensed technology in overall royalty burdens. In some industries, such as semiconductor devices, many large players are cross-licensed, with no-fee, reciprocal cross-licenses representing significant transfers of value that are seldom reflected in a firm's income statement. *Cf.* Layne-Farrar, *supra* note 10, at 9 ("cross licensing cannot be ignored"). A full methodological critique is, however, beyond the scope of this article.

[83] Chien, *supra* note 6, at 5. This use of the term 'holdout' in the standards context is different than the well known holdout problem in real property, in which the assembly of multiple fragmented property rights (e.g., in a parcel of land) is difficult because each individual owner can "hold out" for an amount approaching the total value. *See* Abraham Bell & Gideon Parchomovsky, *The Evolution of Private and Open Access Property*, 10 THEORETICAL INQUIRIES L. 77, 83 (2009); Robert P Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations,* 84 CAL. L. REV. 1293, 1298 n.9 (1996). *See also* Bowman Heiden & Nicolas Petit, *Patent 'Trespass' and the Royalty Gap: Exploring the Nature and Impact of Patent Holdout*, 34 SANTA CLARA HIGH TECH L.J. 179, 185 (2017) (suggesting the term 'patent trespass' in lieu of 'patent holdout').

mirror-image problem to alleged hold-up by SEP holders: "By holding out for unreasonable deal terms, these potential infringers can cause a holdup problem in the opposite direction: against the patentees and all those who have invested in the patentee".[84] Numerous other commentators have likewise insisted that any investigation into the prevalence of hold-up is incomplete without a similar investigation into holdout and its perpetrators.[85] Even the current head of the DOJ Antitrust Division has taken up this call, stating that "collective hold-out" behavior in standard-setting may be even more pernicious than unilateral hold-out by SEP holders.[86]

Holdout undoubtedly exists in the marketplace, as product manufacturers are capable of acting just as opportunistically as patent holders.[87] But hold-up and holdout are different species of behavior. As discussed above, hold-up arises from a SEP holder's potential violation of its commitment to license its SEPs on FRAND terms so as to extract from manufacturers more value than can be attributed to the SEP holder's technical contribution. As such, hold-up is integrally tied to the standardization process and the commitments made therein. Holdout, on the other hand, is simply willful patent infringement. A manufacturer, whether or not it is a member of the SDO that developed a standard, has no obligation to accept a FRAND license or to manufacture a standardized product.[88] The manufacturer that elects not to accept a SEP license on FRAND terms but nevertheless sells standardized products, assuming that the SEPs are valid and actually cover the relevant standard, infringes those SEPs and runs the risk that the SEP owner will sue and avail itself of available remedies for such infringement – the same risk that every manufacturer that fails to obtain a necessary patent licenses faces.[89] Thus, as explained by Melamed and Shapiro, in the case of holdout, "The issue … is not whether

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[84] Kieff & Layne-Farrar, *supra* note 6, at 1097, n.18.

[85] *See, e.g.*, Richard Epstein & Kayvan Noroozi, *Why Incentives for 'Patent Holdout' Threaten to Dismantle FRAND, and Why It Matters*, 32 BERKELEY TECH. L.J. (2018).

[86] Assistant Attorney General Makan Delrahim, Remarks at the USC Gould School of Law's Center for Transnational Law and Business, Nov. 10, 2017, https://www.justice.gov/opa/speech/assistant-attorneygeneral-makan-delrahim-delivers-remarks-usc-gould-school-laws-center. *But see* McSweeny, *supra* note 9, rejecting this position.

[87] Though holdout likely exists it is, like hold-up, difficult to detect. *See* Melamed & Shapiro, *supra* note 9, at 8. Likewise, there is a lack of empirical evidence demonstrating market-wide prevalence of holdout behavior in the standards context.

[88] It is important to note that, in most cases, the use of technical interoperability standards is voluntary. There are very few mandatory standards of this nature (with a few exceptions, for example, in broadcast high definition television (HDTV), and standards implicating public health or safety (see Unocal)). In Europe, under the European Court of Justice's ruling in *Huawei v. ZTE*, Eur. Court of Justice, Case C-170/13 (2015), certain conduct parameters for potential SEP licensees are established. However, it is important to remember that these parameters are not affirmative conduct obligations on potential licensees, but merely procedures that must be followed if potential licensees wish to avoid being subject to an injunction sought by the SEP holder. *See, e.g.*, Pierre Larouche & Nicolo Zingales, *Injunctive Relief in the EU – Intellectual Property and Competition Law at the Remedies Stage* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND PATENTS, Ch. 25 (Jorge L. Contreras, ed., 2017).

[89] These remedies include reasonable royalty damages, as well as the potential for costs, attorneys' fees, interest and enhanced (up to treble) damages if the infringement is willful (see Jorge L. Contreras et al., *The Effect of FRAND Commitments on Patent Remedies* in PATENT REMEDIES AND COMPLEX PRODUCTS: TOWARD A GLOBAL CONSENSUS, Ch. 5 (C. Bradford Biddle et al, eds., 2019, forthcoming). Moreover, if a manufacturer refuses to accept a genuine FRAND license offered by a SEP holder, the SEP holder may be able to seek and obtain injunctive relief against the unwilling licensee.

the implementer would prefer not to pay for a license, but whether there is a need for special rules in patent infringement cases, not available in other settings, to deal with alleged debtors that would rather litigate than settle on the terms offered to them."[90] Accordingly, this article focuses on the debate regarding the existence of hold-up and leaves the question of holdout to discussions of patent infringement and remedies more broadly.[91]

III. CAN WE PLEASE STOP SEARCHING FOR SYSTEMIC HOLD-UP?

It is not the purpose of this article to critique the data or methodologies used by researchers who claim that there is no evidence of systemic hold-up. Though questions remain, the data presented in the cited studies finding no empirical evidence of systemic hold-up present plausible descriptions of current markets for products such as smart phones and other connected technology devices. Instead, this critique is directed at the core assumption that runs through each of these studies: that a lack of evidence of systemic hold-up means that hold-up does not represent a threat that justifies policy intervention. In this Part, I argue that, notwithstanding the findings of these studies, patent hold-up in standardized product markets may indeed be a threat that merits preventative policy measures, but that those measures should be directed toward the prevention of well-understood and actionable forms of anticompetitive conduct rather than the economic phenomenon of hold-up.

A. The Absence of Systemic Hold-Up Does Not Mean that Hold-Up Does Not Occur

In a 2017 article, Galetovic and Haber utilize an extended analogy drawn from the field of Mayan archeology to make the point that scholars sometimes ignore the facts in front of them in order to cling to pre-formed (and empirically unsupported) beliefs.[92] In this analogical tradition, I will use a hypothetical from public health epidemiology to illustrate a related point. Let us consider the often fatal and highly contagious viral infection Ebola. U.S. public health officials, aware of the dangerous effects of Ebola, might propose the implementation of prophylactic measures to prevent the spread of Ebola in the United States. Such measures might include early detection systems at U.S. hospitals, a network of Ebola experts ready to investigate suspected cases, and potential vaccines for particularly vulnerable populations. All of these measures, of course, would come at a cost. Those opposing the incurrence of this cost might argue that such measures are unjustified because there is no empirical evidence that Ebola is a problem in the U.S. After all, there are no documented outbreaks of the disease, and the only reported cases have been sporadic and linked to other factors (such as health workers returning from abroad). In fact, both lifespan and overall health in the United States have been improving steadily over the past several decades. Most declines in population health can

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[90] Melamed & Shapiro, *supra* note 9, at 8.

[91] Raising the issue of holdout in response to concerns over hold-up is an example of the fallacious argumentation technique *ignoratio elenchi* (irrelevant conclusion) first identified by Aristotle in *On Sophistical Refutations*. *See* STANFORD ENCYCLOPEDIA OF PHILOSOPHY, "Fallacies" (May 29, 2015).

[92] Galetovic & Haber, *supra* note 6.

be traced to causes such as tobacco use, poor dietary choices, lack of exercise and the like, but not to Ebola. Thus, because there is no evidence that Ebola outbreaks have occurred in the United States nor any linkage between decreased health and Ebola, and because the overall health of the United States population continues to improve, there is no justification for preventative measures to stop Ebola outbreaks in the United States.

This reasoning is, of course, fallacious[93] and, in the case of a disease like Ebola, dangerously so. In the field of public health, prophylactic measures are often taken *before* a health risk affects a significant portion of the population. This is the reason for prophylactic measures in the first place. In the field of public health, it is widely recognized that risks arising from any number of environmental and pathogenic sources can be assessed based on laboratory analysis and test cases, without population-level epidemiological data. In fact, once population level data for such outbreaks is available, it is often too late: an epidemic has broken out and millions are at risk. Luckily, it is doubtful that public health officials would apply the fallacious reasoning outlined above to important public health decisions.

Curiously, however, this "Ebola fallacy" has taken root in the debate over patent hold-up. As discussed above, the purported lack of empirical evidence of system-wide patent hold-up is used as a justification for abandoning or forestalling policy interventions aimed at reducing the risk of hold-up. Because hold-up has not been detected at a systemic level, so the argument goes, it must not be a problem. Therefore, measures designed to prevent hold-up from occurring must be the result of gratuitous or over-zealous policy making. The logical fallacies in this argument should be apparent.

In fact, there are numerous examples of anticompetitive conduct by individual firms in markets that are not otherwise overrun by anticompetitive behavior. For example, in 2009, the Federal Trade Commission brought an action against pharmaceutical manufacturer Solvay and a group of generic drug manufacturers for violating Section 5 of the FTC Act by entering into an arrangement whereby the generic manufacturers agreed not to challenge Solvay's patent on its AndroGel product and not to market their generic versions of AndroGel, in exchange for a significant payment by Solvay to each of the generic manufacturers (a so-called "pay for delay" scheme).[94] The Supreme Court held in 2013 that such conduct was actionable and reversed the Eleventh Circuit's dismissal of the FTC's claim.[95] Yet even in 2009, the year in which the FTC brought its action, of the 68 agreements settling patent disputes filed by pharmaceutical manufacturers with the FTC,[96] the FTC estimated that only 19 of these (28%) were potential pay for delay agreements; and by 2014, the year after the *Actavis* decision, only 21 out of 160 such agreements (13%) were deemed by the FTC likely to represent illegal

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[93] In terms of formal logic, this is a form of fallacy of consequent: Ebola is a problem because it causes widespread death. We do not have widespread death. Therefore, Ebola is not a problem. *See, generally*, Stanford Encyclopedia of Philosophy, *supra* note 91.

[94] F.T.C. v. Actavis, 133 S. Ct. 2223 (2013), slip op. at 6.

[95] *Id*.

[96] Patent settlements within the pharmaceutical industry must be filed with the FTC pursuant to the Medicare Prescription Drug, Improvement, and Modernization Act of 2003.

pay for delay schemes.[97] Thus, while pharmaceutical industry patent settlements have attracted significant attention as potentially anticompetitive arrangements, most such settlements do not merit investigation by the FTC.[98]

An even more telling example is found in the area of mergers and acquisitions. During fiscal year 2016, a total of 1,832 merger and acquisition transactions were reported to the FTC and DOJ under the Hart-Scott-Rodino Antitrust Improvements Act.[99] Of these, the FTC challenged only twenty-two (1.2%).[100] Thus, while some anticompetitive mergers may exist, the vast majority are not anticompetitive.[101] But the absence of market-wide anticompetitive conduct in the area of mergers and acquisitions hardly excuses the handful of transactions that do present antitrust risks, nor does it suggest that mergers should not be subject to governmental monitoring and, when merited, enforcement.

B. Protective Measures May Already Be Working to Reduce Hold-Up

Another important factor that should be considered regarding the purported lack of empirical evidence of systemic hold-up is the effect that existing policy measures have already had in reducing hold-up. As noted above, the threat of patent hold-up was a primary motivating factor for many SDOs to adopt policies requiring the disclosure and licensing of SEPs. These policies have been in place for decades. In the United States, the first such policy was adopted in 1959 by the American Standards Association (the predecessor to today's American National Standards Institute (ANSI).[102] Today, every one of the more than 200 ANSI-accredited developers of American National Standards must adhere to ANSI's essential requirements, including the adoption of such a licensing policy for SEPs. Similar policies have existed in European and international standards organizations since at least the 1980s.[103] These policies, which were developed by SDOs in large part to reduce the likelihood of hold-up within standard-setting systems, have had several decades to work, and it is likely that the lack of observed hold-up in some studies can be attributed to the successful operation of these policies.

Similarly, antitrust and competition enforcement agencies in the U.S. and Europe have been aware of the potential for hold-up connected with standardization for many years. Accordingly, they have brought enforcement actions when it has been alleged that

[97] Fed. Trade Comm'n, Agreements Filled with the Federal Trade Commission Under the Medicare Prescription Drug, Improvement, and Modernization Act of 2003: Overview of Agreements Filed in Fiscal Year 2014: A Report by the Bureau of Competition, Ex. 1 (2016). *See also* Michael A. Carrier, *Five Arguments Laid to Rest After* Actavis, ANTITRUST SOURCE, Oct. 2013.

[98] The author is grateful to Prof. Michael Carrier for this insight.

[99] Federal Trade Commission (Bureau of Competition) and Department of Justice (Antitrust Division): Hart-Scott-Rodino Annual Report: Fiscal Year 2016: Section 7A of the Clayton Act (The Hart-Scott-Rodino Antitrust Improvements Act of 1976) at 1 (2017).

[100] *Id*. at 2.

[101] The author is grateful to Prof. Andy Gavil for this insight.

[102] Am. Standards. Assn., Procedures of American Standards Association (1959). *See, generally*, Contreras, *Origins*, *supra* note 34 at x (describing historical development of policy).

[103] *See* Contreras, *Origins*, *supra* note 34, at 163 (discussing early FRAND requirements at ISO/IEC and CEN/CENELEC).

hold-up behavior has resulted in a violation of the antitrust laws. High-profile enforcement actions against patent holders such as Rambus,[104] Google[105] and Qualcomm[106] send powerful deterrent signals to the market and warn others not to engage in similar behavior lest they, too, become the subject of agency enforcement. Like SDO policies, it is likely that the general market awareness of agency interest in standard-setting and hold-up has, to a degree, limited the amount of hold-up that is actually attempted in the marketplace, thereby limiting the direct evidence of hold-up as a systemic problem.

But do the deterrent effects of SDO and agency efforts to reduce hold-up signify that hold-up is not a problem? Certainly not. To reach such a conclusion would be perverse: akin to claiming that burglary is not a problem in a neighborhood that experiences reduced burglary rates after it has implemented an active neighborhood watch program and enhanced policing.

C. *Indicia of Healthy Markets do not Prove the Absence of Anticompetitive Conduct*

As noted above, one of the principal arguments advanced by commentators seeking to refute the "hold-up theory" is that markets for telecommunications products, namely smart phones, are robust – evidenced by increasing product functionality, decreasing consumer prices and rapid innovation -- and that this degree of robustness indicates that hold-up cannot be a problem in these markets.[107] If hold-up were a problem in these markets, they reason, we would see product stagnation, stable (but high) prices, and a lack of competition – features associated with classic examples of hold-up in markets for products such as natural resources and agricultural goods.[108]

But this argument relies on a false syllogism: hold-up results in market dysfunction; if a market functions well, then it cannot be subject to hold-up. The weaknesses in this argument are multifold. First, hold-up may exist in individual instances without sufficient weight to affect overall market characteristics, particularly in a large global market such as mobile telecommunications. Thus hold-up may exist, even in a market that outwardly appears to be functioning well. Second, there is no valid counterfactual to use to compare the health and robustness of the market for mobile telecommunications products.[109] Other consumer electronics devices, such as televisions and DVD players, do not compare well with mobile telecommunications devices, which have taken on a unique character in the modern networked economy. Thus, observing the strength of the market fails to answer the critical questions "compared to what?" and how much stronger the market might be (through more product diversity, functionality, price reduction) without hold-up?

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[104] *Rambus, Inc. v. FTC*, 522 F.3d 456 (D.C. Cir. 2008).

[105] In re. Motorola Mobility LLC & Google Inc., FTC Docket No. C-4410 (Jul. 23, 2013) (decision and order).

[106] Fed. Trade Comm'n v. Qualcomm, Inc., Case 5:17-cv-00220 (N.D. Cal. Filed Jan. 17, 2017).

[107] *See, e.g.,* Galetovic & Haber, *supra* note 6; Mallinson, *supra* note 80.

[108] *See* Galetovic & Haber, *supra* note 6.

[109] *See* Melamed & Shapiro, *supra* note 9.

A simple historical illustration is useful in this context. During the decade leading up to the enactment of the Sherman Antitrust Act of 1890, several major U.S. commodity markets (e.g., steel, salt, petroleum, coal, sugar, lead, and others) came under intense scrutiny for a variety of allegedly anticompetitive industrial arrangements. One might have argued that these markets, had they been subject to the sorts of anticompetitive collusion that the Sherman Act sought to address, should have seen reductions of output and increases in price. Yet, between 1880 and 1890, U.S. output of salt, petroleum, steel, and coal all increased significantly, and prices of steel, sugar and lead all dropped significantly.[110] Do these positive market indicia demonstrate that the subject markets were not subject to anticompetitive collusion, and that the Sherman Act was not necessary? Certainly, investigations of these industries revealed significant cartel behavior. I would suggest that few commentators today would argue that the coal, steel, sugar and other major industrial producers of the late nineteenth century were innocent of collusive and anticompetitive conduct, or that the Sherman Act was not a necessary and beneficial measure for the U.S. economy.[111] Yet, had we relied solely on the positive characteristics exhibited by these markets as proof that anticompetitive conduct did not exist, then perhaps the Sherman Act never would have been enacted.

By the same token, the fact that global markets for standardized products such as computers and smart phones appear to be thriving does not itself refute the possibility of hold-up nor the existence of anticompetitive conduct in these markets. Nor does it allow regulators and policy makers to drop their guard or cease to monitor these important industries.

D. The Occurrence of Individual Instances of Hold-Up is Sufficient to Justify Policy Intervention

As discussed in Part II.C, the litigation record demonstrates the repeated occurrence of patent hold-up, both with and without deception, in standardized product markets.[112] Critics refer to this evidence as “anecdotal” and “sporadic”,[113] and so it may be. However, the law is not made through generalizable economic models. It is a fundamental characteristic of modern legal systems that both private litigation and public enforcement are directed toward individual actors with respect to specific and provable violations of law.

This being said, it is also well-established that aggregations of litigation data can reflect market trends and behaviors that are more pervasive. Moreover, litigation data and trends have often served as legitimate bases for policy review and reform. Examples abound and have ranged from the imposition of stricter mortgage lending requirements

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110 Thomas J. DiLorenzo, *The Origins of Antitrust: An Interest Group Perspective*, 5 INTL. REV. L. ECON. 73, 80 (1985) (citing US Bureau of the Census, Statistical Abstract of the U.S., various years).

111 Interestingly, DiLorenzo, who compiled the above figures in a 1985 article, did question the need for the Sherman Act.

112 *See* Part x, *supra*.

113 Ohlhausen & Wright, *supra* note 11; Denicoló et al, *supra* note 10.

following evidence of egregious predatory lending practices during the 2000s[114] to a host of proposed legislative and regulatory reforms in the field of patent law that have been informed by litigation data regarding, among other things, strategic venue selection and suits by non-practicing entities.[115]

Accordingly, given the expanding litigation record showing that patent hold-up exists, at least in cases that the parties value sufficiently to litigate to a final decision, there is no reason to reject that data as a basis for policy reform. On the contrary, the appearance of hold-up behavior in cases litigated in the United States and elsewhere is a strong indicator that hold-up is not a sporadic occurrence, but a systemic problem that deserves the attention of policy makers.

E. Hold-Up Itself is not a Cognizable Legal Offense

Another area in which the debate over hold-up has become muddled is the attempt to prosecute hold-up in individual legal cases. As discussed above, hold-up behavior has arguably been identified in cases such as *Microsoft v. Motorola* and *Innovatio*. In *Ericsson v. D-Link*, the court pointed to insufficient evidence of hold-up. Yet in each of these cases, both courts and litigants seem to have lost sight of the fact that hold-up itself *is not a cognizable legal offense*. That is, even if patent hold-up is undesirable for the efficient operation of markets, or hinders the broad adoption of technical interoperability standards, or effects wealth transfers from some market participants to others or impedes market entry and innovation, these effects alone do not demonstrate that illegal conduct has occurred.

Antitrust and competition laws exist to sanction anticompetitive behavior in standard setting and otherwise. For example, Section 2 of the Sherman Act prohibits exclusionary conduct by actors having monopoly power,[116] Section 5 of the Federal Trade Commission Act prohibits unfair methods of competition,[117] and Article 102 of the Treaty on the Functioning of the European Union (TFEU) prohibits abuse of a dominant position.[118] Each of these legal regimes has played a prominent role in policing conduct in standard-setting.[119] In many cases, these offenses may overlap with the exercise of patent hold-up, but in other cases they may not. In order for a violation of law to occur, a defendant must be shown to have engaged in legally prohibited conduct using established standards of conduct, not the ill-defined economic concept of hold-up.

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[114] *See, e.g.*, Commonwealth of Mass. v. Fremont Inv. & Loan (Mass. 2008).

[115] *See, e.g.*, Jorge L. Contreras & Ryan Schneer, *Current Proposals to Amend U.S. Patent Law*, (Working Paper, Nov. 6, 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2350240 (summary of legislative initiatives).

[116] Sherman Antitrust Act of 1890, Sec. 2.

[117] Fed. Trade Comm'n Act, Sec. 5.

[118] Treaty on the Functioning of the European Union, Art. 102.

[119] *See, e.g.*, Renata B. Hesse & Frances Marshall, *U.S. Antitrust Aspects of FRAND Disputes* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: ANTITRUST, COMPETITION AND PATENTS, Ch. 16 (Jorge L. Contreras, ed., 2017); Nicolas Petit, *EU Competition Law Analysis of FRAND Disputes* in CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: ANTITRUST, COMPETITION AND PATENTS, Ch. 17 (Jorge L. Contreras, ed., 2017).

Thus, the Federal Circuit in *Ericsson v. D-Link*, in holding that a jury should not be instructed about patent hold-up absent the presentation of sufficient evidence regarding actual hold-up conduct by the patent holder, may have missed the mark. The principal matter being adjudicated in that case was whether or not the SEP holder complied with its contractual duty to grant a license on FRAND terms and what that FRAND royalty should be. The existence of hold-up behavior as an independent matter is not dispositive of these claims, and antitrust claims were not being adjudicated in the proceedings that formed the basis for the Federal Circuit's opinion. If they had been, then evidence relating to the SEP holder's violation of, or compliance with, the antitrust laws would have been probative. Thus, whether or not evidence of hold-up existed, it would not have been relevant to the dispute absent some underlying legal claim that it could have helped to prove or refute.

This is not to say, of course, that there is general agreement regarding the extent to which antitrust and competition law can and should be used to police conduct in standard setting. On the contrary, this question is hotly debated, with some calling for greater antitrust scrutiny in this area[120] and others calling for less.[121] Nonetheless, antitrust and competition law exist as positive and legally-recognized boundaries on private behavior. To the extent that the broader concept of hold-up is not coterminous with these existing causes of action, it should not factor heavily in the analysis of party conduct.

CONCLUSIONS

The policy debate surrounding patent hold-up in markets for standardized products is now well into its second decade with no end in sight. Fundamental questions including the definition of hold-up, whether it exists in the marketplace, and what impact it has on innovation, continue to bedevil scholars, policy makers and industry. Yet it is not clear that this debate needs to continue. Patent hold-up is a pattern of market behavior, but not necessarily a legally-cognizable wrong. Whether it is commonplace or

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[120] *See, e.g.*, Melamed & Shapiro, *supra* note 9; Scott Morton & Shapiro, *supra* note 9; George S. Cary et al., *The Case for Antitrust Law to Police the Patent Holdup Problem in Standard Setting*, 77 ANTITRUST L.J. 913, 921 (2011) ("[I]t is unsurprising that antitrust has long been applied to the conduct of standard-setting organizations … Indeed, because the opportunistic conduct resulting in patent holdup specifically 'concerns the inefficient acquisition of market power,' many commentators have 'generally assumed that [such] opportunism in the standard-setting process is an antitrust problem"); Michel, *supra* note 6.

[121] *See, e.g.,* Delrahim, *supra* note 86; Maureen K. Ohlhausen, *The Elusive Role of Competition in the Standard-Setting Antitrust Debate*, 20 STANFORD TECH. L. REV. 93 (2017); Herbert Hovenkamp, *Antitrust and the Patent System: A Reexamination*, 76 OHIO ST. L.J. 467, 555 (2015) ("Fundamentally, these are problems best addressed through the patent system rather than by antitrust law"); Douglas H. Ginsburg, Taylor M. Owings & Joshua D. Wright, *Enjoining Injunctions: The Case Against Antitrust Liability for Standard Essential Patent Holders Who Seek Injunctions*, ANTITRUST SOURCE, Oct. 2014; Bruce H. Kobayashi & Joshua D. Wright, *Federalism, Substantive Preemption, and Limits on Antitrust: An Application to Patent Holdup*, 5 J. COMPETITION L. & ECON. 469, 506–16 (2009) (discussing the comparative advantage of tort and contract law over antitrust law in regulating breaches of FRAND commitments).

rare is largely irrelevant to liability in any given case. To the extent that hold-up behavior constitutes an abuse of market power, with resulting harms to competition, longstanding doctrines of antitrust and competition law exist to sanction it. To the extent that hold-up impedes the efficient operation of standard-setting processes, SDOs can, and have, adopted internal procedures, including disclosure and licensing requirements, to curtail that behavior. Thus, the ongoing hunt for empirical evidence of systemic patent hold-up in standardized product markets, or a lack thereof, seems a fruitless academic exercise. The absence of systemic hold-up actually tells us little about individual firm behavior that can and should be sanctioned by the law, and it may thus be time to close the debate over the systemic prevalence of this form of behavior.

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What is the Probability of Receiving a U.S. Patent?

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WHAT IS THE PROBABILITY OF RECEIVING A U.S. PATENT?

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ABSTRACT

What proportion of patent applications filed at the U.S. Patent and Trademark Office (USPTO) are eventually granted? Many experts have suggested that the USPTO approves nearly all applications, blaming this apparent leniency for many problems with the U.S. patent system. To test this assumption, we follow the prosecution histories of 2.15 million U.S. patent applications from 1996 to mid-2013. We find that only 55.8% of the applications emerged as patents without using continuation procedures to create related applications. The allowance rate has decreased substantially over time, particularly for applications in the "Drugs and Medical Instruments" and "Computers and Communications" fields. Furthermore, applications filed by small firms were less likely to emerge as patents than those filed by large firms. We discuss the implications of our findings for inventors, policymakers, and legal scholars.

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INTRODUCTION

Inventors choose to protect their inventions with patents for a variety of reasons.[1] A key element of inventors' cost-benefit calculus regarding patents is the expectation that their applications will succeed. Unfortunately, there is little information about the historical rates at which the United States Patent and Trademark Office (USPTO) grants patents. This lack of information about the probability of obtaining a patent makes it difficult for inventors to determine the best way to protect their intellectual property.

The absence of systematic evidence on patent allowance rates also skews policy discussions about the patent examination standards employed by the USPTO. Some scholars argue that the USPTO grants patents too easily, pointing to patents like the "Beerbrella" (U.S. Patent #6637447), swinging methods (U.S. Patent #6368227), and a user-operated amusement apparatus for kicking the user's buttocks (U.S. Patent #6293974). These scholars argue that a large number of such frivolous, "rubber-stamped" patents are hindering, rather than promoting, the U.S. innovation system.[2] For example, some entities, often referred to as "patent trolls," allegedly obtain patents with dubious claims solely to extract rents from genuine inventors who may appear to be infringing on the entities' patents. Judge Posner recently opined that "the problem of patent trolls is a function in part of the promiscuity with which the patent office has issued patents."[3]

Despite numerous allegations of USPTO laxity and calls for reforms based on anecdotal observations of silly patents, few studies have attempted to calculate the actual percentage of U.S. patent applications that succeed. The calculation of patent allowance rates, while seemingly simple, is complicated by several aspects of the patent examination process. First, patent applications that are initially rejected after examination can produce "new," closely related applications called "continuations." Continuations are difficult to track, but may ultimately emerge as patents. Second, the USPTO publishes examination outcomes only for granted applications, if filed before November 29, 2000, or for applications pending eighteen

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1 *See, e.g.*, Wesley Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (or Not)*, (Nat'l Bureau of Econ. Research, Working Paper W7552, 2000).

2 *See, e.g.*, JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 3 (2008); ADAM B. JAFFE & JOSH LERNER, INNOVATION AND ITS DISCONTENTS: HOW OUR BROKEN PATENT SYSTEM IS ENDANGERING INNOVATION AND PROGRESS, AND WHAT TO DO ABOUT IT 25-26 (2004); STEPHEN A. MERRILL ET AL., COMMITTEE ON INTELLECTUAL PROPERTY RIGHTS IN THE KNOWLEDGE-BASED ECONOMY, A PATENT SYSTEM FOR THE 21ST CENTURY 52-55 (2004).

3 Richard Posner, *Patent Trolls—Posner*, THE BECKER-POSNER BLOG (July 21, 2013, 5:12PM), http://www.becker-posner-blog.com/2013/07/patent-trollsposner.html.

months after application date if filed on or after November 29, 2000.[4] Third, applicants alter the claims in their applications during the examination process. The allowance of some patentable claims within an application is not the same as the allowance of an application as it was filed, and this distinction should be taken into account in any discussion of allowance rates, particularly as it pertains to the extent of scrutiny associated with the examination process.

In this study, we address the above challenges by analyzing unique application-level data available internally at the USPTO. The data tracks 2.15 million utility patent applications filed from 1996 to 2005 and examined until June 30, 2013, by which time 99.8% of the progenitor applications had been granted or abandoned.[5] "Progenitor applications" are applications unrelated to any previously filed U.S. patent applications. This allows us to link each progenitor application to related subsequent applications produced by various continuation procedures. We can thereby accurately estimate the probability of allowance without the limitations of previous studies based on partial samples of published applications or exit cohorts.[6]

In order to capture the complexity of the examination process, we calculate three measures of patent allowance rates: (i) *first-action allowance rate*, the proportion of progenitor applications allowed without further examination; (ii) *progenitor allowance rate* (or simply, allowance rate), the proportion of progenitor applications allowed without any continuation procedure, and (iii) *family allowance rate*, the proportion of progenitor applications that produce at least one patent, including the outcomes of continuation applications that emerge from progenitor applications.

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4 *See* 35 U.S.C. § 122(b)(2)(B) (2012) (describing when applicants can request that applications not be published); Domestic Publication of Foreign Filed Patent Applications of 1999, Pub. L. No. 106-113 § 4502, 113 Stat. 1501 (1999).

5 Since the average patent application pends for four to five years at the USPTO before it is granted, a non-trivial fraction of applications filed after 2005 are still pending, making it impossible to calculate definitive allowance rates for applications filed in the latter years of our sample.

6 Data on unpublished applications is not made available in order to protect applicants who may abandon their applications prior to the 18-month publication date. If unpublished applications are more likely to be abandoned, then allowance rates based on publicly available data (i.e., published applications) would be biased upwards. *See* Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 101, 106-07 (2009) (analyzing a small sample of 9,960 published applications); Cecil D. Quillen, Jr. & Ogden H. Webster, *Continuing Patent Applications and Performance of the U.S. Patent and Trademark Office—Extended*, 12 FED. CIR. B.J. 35, 36-37 (2002) [hereinafter Quillen & Webster, *Continuing Patent Applications*] (noting that data for applications filed before 1980 is not available); Cecil D. Quillen, Jr. & Ogden H. Webster, *Continuing Patent Applications and Performance of the U.S. Patent Office—One More Time*, 18 FED. CIR. B.J. 379 (2009) [hereinafter Quillen & Webster, *One More Time*] (explaining the difficulties associated with linking original applications to their corresponding continuations).

I. DATA AND METHODOLOGY

The data for our analysis are drawn from the USPTO's internal databases, which provide the essential records for the public Patent Application and Information Retrieval (PAIR) system. These internal databases include information on the prosecution histories of every published patent application filed at the USPTO, including application filing dates, pending application status, and continuation applications. The USPTO publishes examination outcomes through its PAIR system for applications pending 18 months after application date, if filed on or after November 29, 2000, with exceptions made for applications that are filed with a non-publication request.[7] The chief advantage of this internal data is that it permits us to observe the patent prosecution histories of applications filed at the USPTO before November 29, 2000, as well as those of unpublished applications filed after this date. We refined our sample population of all patent applications filed at the USPTO after January 01, 1996 to retain only utility patent applications.

We then tracked the allowances, abandonments, and continuations for all progenitor applications that entered patent examination for the first time during 1996-2005. For most applications, we did not observe the final examination outcome until four to five years after the filing date. Our choice of 2005 as the last cohort year limits the number of applications still pending as of June 30, 2013 in our study to 18,270 (less than 1% of the 2.15 million applications), thereby minimizing censoring errors.

We identified certain application characteristics based on the information contained in USPTO internal guidelines as well as other publicly available sources. First, we determined the application origin (U.S. or foreign) based on the address of the first named inventor on each application. We then determined if the application was filed by a "large" or "small" entity based on USPTO information about the fees paid by the applicants at the time of filing.[8] Finally, we used the National Bureau of Economics Research (NBER) classification scheme to aggregate the more than five hundred USPTO technology classes into six broad technology fields (Chemical; Drugs and Medical; Electrical and Electronics; Computers and Communications; Mechanical; and a miscellaneous "Other") for ease of discussion.[9]

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[7] *See* 35 U.S.C. § 122 (2012). For an analysis of the percentage of inventors who file non-publication requests, see Stuart Graham & Deepak Hegde, *Disclosing Patents' Secrets*, SCIENCE, Jan. 16, 2015, at 236-237.

[8] Small entities, defined as those with five hundred or fewer employees, qualify for a discount on patent application fees.

[9] *See* Bronwyn H. Hall, Adam B. Jaffe & Manuel Trajtenberg, The NBER Patent Citations Data File: Lessons, Insights (Nat'l Bureau of Econ. Research, Working Paper W8498, 2001), *available at* http://www.nber.org/papers/w8498.pdf.

II. PATENT EXAMINATION IN THE UNITED STATES

A. *The Examination Process*

We simplify our description of the patent examination process to discuss only events relevant to our objective.[10] Accordingly, Figure 1 presents a stylized version of the patent examination process using data from the 1996-2005 filing cohorts of progenitor applications. Each application is queued for examination and then docketed to an examiner. Incomplete or unpaid applications are considered abandoned and are not docketed to an examiner. The first substantive examination of the application is called the "first action on the merits" (or simply "first action"). The first action includes a search report listing relevant prior art that supports the examiner's decision of either allowance or non-final rejection. The USPTO allowed 11.4% of the progenitor applications at first action and delivered a non-final rejection decision for 86.4% of the applications, with the remaining 2.3% abandoned prior to a first action decision. The Office allowed 36.1% of the progenitor applications after one or more rounds of amendments and negotiations with the examiner, while 14.5% were abandoned between non-final and final rejection. The remaining 38.7% of progenitor applications received a final rejection.

[Figure 1 on next page]

[10] The USPTO's official utility patent application filing guide provides a more comprehensive description of the rules and procedures. *See Nonprovisional (Utility) Patent Application Filing Guide*, U.S. PATENT & TRADEMARK OFFICE, http://www.uspto.gov/patents/resources/types/utility.jsp (last updated Jan., 2014).

Figure 1: The U.S. Patent Examination Process

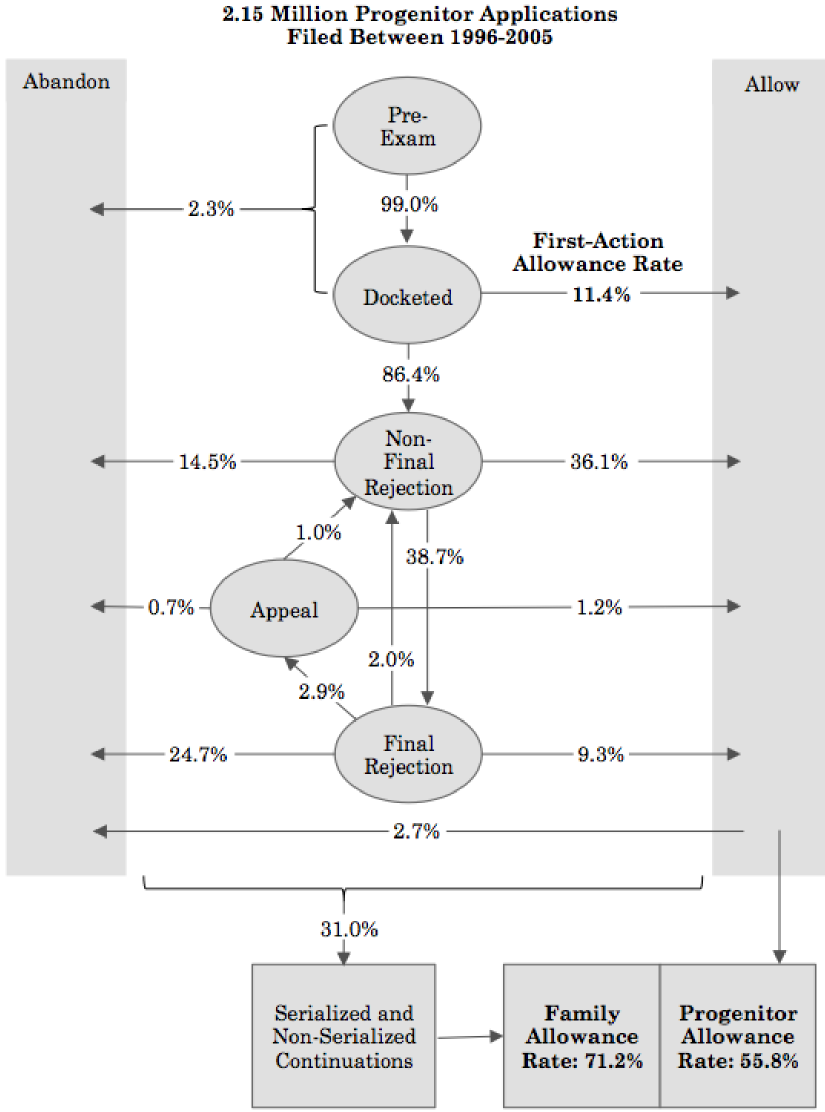

Figure 1 shows a simplified representation of the U.S. patent examination process. It also shows the key intermediate and final outcomes, as of June 30, 2013, for the 2.15 million applications filed for the first time ("progenitor" applications) between 1996 and 2005. The percentage indicated at each transition state reflects the percentage of the total progenitor applications that reached the state. *First-action allowance rate* refers to the proportion of progenitor applications that were allowed without amendment; *Progenitor allowance rate* refers to the proportion of progenitor applications that were eventually allowed and patented without continuation processes; *Family allowance rate* refers to the proportion of progenitor applications that produced at least one patent, including the allowances of continuation applications that emerged from the progenitors. Abandonments and allowances may not sum to 100% due to rounding.

For most applications, therefore, patent prosecution ends with patent issue or with abandonment. Applications are considered abandoned if the applicant does not respond to the examiner's decision by the stipulated deadlines or if the applicant expressly requests abandonment. Applicants can, however, continue to submit amended applications even after receiving a final rejection. Of applications that received a final rejection, 9.3% were subsequently allowed after further amendments. Applicants can also formally appeal a final rejection to the Board of Patent Appeals and Interferences. Accordingly, 7.5% of final rejections were subject to appeals, 41.4% of which resulted in allowances. Overall, 55.8% of progenitor applications filed between 1996 and 2005 and examined before mid-2013 emerged as patents without the use of continuation procedures.

B. *Continuation Procedures*

Applicants can continue prosecution after receiving a final rejection through various continuation procedures. Some scholars have blamed continuation procedures for abuses of the patent system such as submarine patents (patents that are intentionally delayed from publication and issue by the applicant for a long time), long pending patent applications, and low-quality patents;[11] others have pointed out that continuation procedures enable applicants to update pending applications.[12]

Thirty-one percent of progenitor applications utilized at least one continuation procedure. Continuation procedures fall into two broad categories: non-serialized and serialized.[13] Non-serialized continuations do not receive a new serial number and are immediately docketed to the same examiner that prosecuted the progenitor; the progenitor application is then considered abandoned. Requests for Continued Examination (RCEs) are by far the most common type of non-serialized continuations, and applicants may file an RCE multiple times during prosecution.[14] At least one RCE was filed by 19.5% of all applicants, and 38.7% of applicants that received a non-final rejection

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[11] *See* Mark A. Lemley & Kimberley A. Moore, *Ending Abuse of Patent Continuations*, 84 B.U. L. REV. 63, 74-76 (2004).

[12] *See* Deepak Hegde et al., *Pioneering Inventors or Thicket-Builders: Which Firms Use Continuations in Patenting?*, 55 MGMT. SCIENCE 1214, 1224-25 (2009).

[13] Serialized continuations can be exercised at any point during patent examination. Non-serialized continuations may only be used after particular events in prosecution, typically after final rejection.

[14] There have been several incarnations of non-serialized continuations, including Continued Prosecution Applications (CPAs), Rule 129 continuations (R129s), and File Wrapper Continuations (FWCs). The most recent incarnation (and by far the most prevalent) is the Request for Continued Examination (RCE). Throughout this section, we refer collectively to all of these non-serialized continuations as RCEs. Until November 2009, RCEs were put on the "amended docket," which meant that the examiner had to respond within two months. Since that time, RCEs have gone on the "special new docket," meaning that the examiner has more discretion as to when to respond (similar to newly docketed applications).

filed an RCE. If one includes allowances of non-serialized continuation applications, the allowance rate jumps from 55.8% to 69.2%.

In contrast to non-serialized continuations, serialized continuations are treated as new applications. They receive new serial numbers and are docketed to examiners based on the classification of the new application. There are three types of serialized continuations: continuation (CON), continuation-in-part (CIP), and divisional (DIV). A simple continuation of a parent application enables applicants to receive the benefit of the parent's priority date, so long as the CON is limited to the specification described in the parent application. Continuations-in-part allow applicants to introduce new subject matter to an existing application. Divisional applications allow applicants to separate claimed inventions when two or more distinct inventions are claimed in the same application. Serialized continuations, with the exception of new matter added in CIPs, receive the priority date of the progenitor application if the progenitor is pending when the serialized continuation is filed. The progenitor does not have to be abandoned, so both applications may proceed through the examination process in parallel. As a result, one progenitor application can produce a chain of serialized continuations resulting in multiple patents, which complicates the calculation of progenitor allowance rates. As of June 30, 2013, 15.8% of progenitor applications resulted in at least one serialized continuation. Overall, 71.2% of progenitor applications resulted in at least one patent after counting allowance of continuation applications.

Figure 2 plots the three allowance rates by progenitor cohort year. The figure shows that the probability of allowance is substantially lower for the more recent cohorts of applications. The striking decline in both first-action allowance rates and progenitor allowance rates is unlikely to be due to censoring, since the mean pendency between application date and first-action date was 21.1 months and mean pendency between application date and disposal date was 29.1 months. Although less than 1% of the progenitor applications in our study were pending as of June 30, 2013, a larger proportion of abandoned progenitors have pending continuation applications, which potentially biases our family allowance rates downward for later years. We account for this by calculating the maximum possible family allowance rate that would occur if all pending applications were to eventually issue. Dashed lines in Figure 2 represent maximum allowance rates. This correction demonstrates that the average family allowance rate for our cohorts could be at most 72.3% (as compared to the rate of 71.2% based on disposals observed to date), so the decline in allowance rates between 1996-2005 remains quite robust.[15]

[15] The effect of censoring is more pronounced for more recent cohorts and increased sharply after 2005, thus validating 2005 as the cut-off year for our study. Figure A1 of the Supplementary Appendix presents the lower and upper bounds for each of the three allowance rates for 1991 to 2010. As the window between filing and

Figure 2: Trends in Allowance Rates for Applications Filed from 1996-2005 and Examined Before Mid-2013

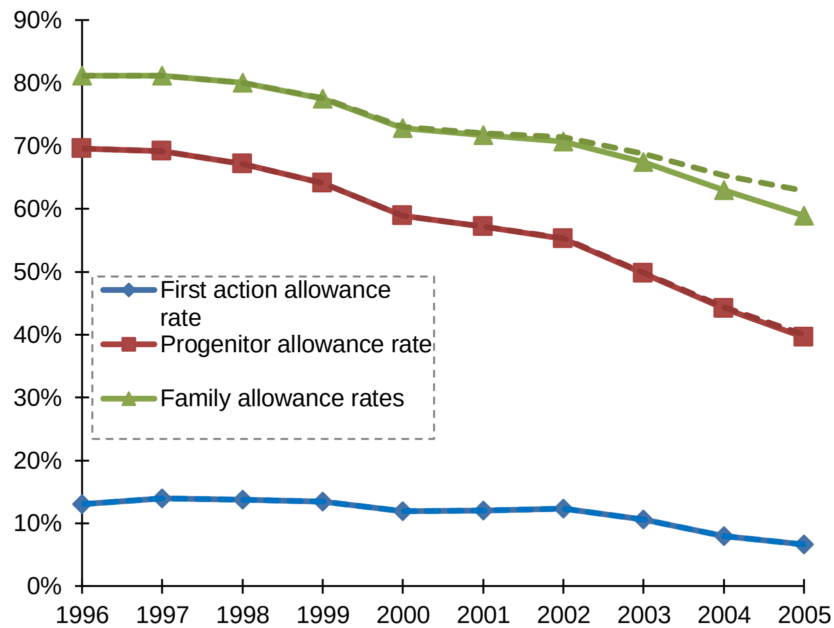

Figure 2 shows trends in the three types of allowance rates for applications filed at the USPTO for the first time between 1996 and 2005 and examined before June 30, 2013. Of the 2.15 million applications, 18,270 were pending as of June 30, 2013; the dotted lines (for the first-action allowance rate and the progenitor allowance rate) represent the corresponding rates if all pending applications are, in fact, allowed. These dotted lines represent the highest possible allowance rates. For progenitor applications that produced pending continuation applications, we assume that every pending continuation application will eventually be allowed. The dashed line represents the highest possible allowance rate.

Why did allowance rates decline between 1996 and 2005? Although proving causation is difficult, our interviews with patent experts at the USPTO suggested at least three plausible explanations for the decline. First, the financial market bust in March 2000 and the resulting financial constraints may have forced some inventors to abandon applications at a higher frequency than during "normal" times. Second, the USPTO introduced several procedures in 2000 that increased scrutiny of patent applications (for example, the "second pair of eyes" system, subjecting certain applications to mandatory assessment by more than one examiner before allowing them), which may have decreased the probability of patent allowance. Finally, the number of pending applications, as well as the lengths of first-action

observation shrinks, the observed allowance rates falls to 0% and the hypothetical maximum for each allowance rate approaches 100%.

and total pendency steadily increased during the period of our study. Longer pendency periods have been correlated with more abandonment,[16] thus lowering the observed allowance rates.[17] Of course, establishing causation or teasing out the relative contributions of the above three factors to changes in allowance rates is difficult, and future research should separate out the effects of changes in USPTO practices from changes in the frequency of abandonment.

III. ALLOWANCE RATES ACROSS TECHNOLOGY FIELDS

It is well known that patent value varies across industries. Inventors in discrete-product industries, such as the chemical and pharmaceutical industries, tend to use patents to preclude imitation by rivals, while those in complex product industries, such as the electronics and computers industries, amass patents to enhance bargaining power in cross-licensing negotiations.[18] As a result, inventors in different industries appear to pursue different strategies during the patent examination process. Additionally, judicial decisions affect the standards of patentability for some technological fields, while leaving the standards unchanged for others.[19]

Figure 3 displays the patent allowance rates for the patent-technology categories created by Bronwyn H. Hall, Adam B. Jaffe and Manuel Trajtenberg.[20] Applications in Drugs and Medical Instruments have the lowest average allowance rate of 42.8%, while applications in the Electrical and Electronics sectors enjoy the highest allowance rate of 66.6%. Applicants appear to use continuation procedures more in sectors with lower allowance rates; for example, 44.1% of the progenitor applications in the Drugs and Medical sector used at least one of the continuation procedures.[21] The decline in allowance rates is

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[16] *See* BENJAMIN MITRA-KAHN ET AL., UK INTELLECTUAL PROP. OFFICE & U.S. PATENT & TRADEMARK OFFICE, PATENT BACKLOGS, INVENTORIES, AND PENDENCY: AN INTERNATIONAL FRAMEWORK 70-90 (2013), http://www.ipo.gov.uk/ipresearch-uspatlog-201306.pdf.

[17] Table A1 of the Supplementary Appendix presents the correlation between our allowance rate measures and the percent change in GDP from the previous year, the number of applications pending in the year of filing, and the total pendency for applications disposed in the year of filing. All three allowance rates are strongly negatively correlated with pendency and the number of pending applications. They are moderately positively correlated with the percent change in GDP.

[18] *See, e.g.*, Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the US Semiconductor Industry, 1979–1995*, 32 RAND J. ECON. 101, 107 (2001).

[19] Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S.Ct. 1207 (2013); State Street Bank & Trust Co. v. Signature Fin. Group, 149 F.3d 1368 (Fed. Cir. 1998).

[20] *See generally* Hall et al., *supra* note 9. Hall, Jaffe, and Trajtenberg map U.S. Patent Classifications (USPC) to six technology categories for issued utility patent applications. *Id.* at 12-13, 41-42. We apply their mapping to all progenitor applications in our dataset to treat abandoned and issued applications similarly. Continuation applications are assigned to the same technology category as the progenitor application.

[21] *See* Table A3 of the Supplementary Appendix.

particularly striking for Drugs and Medical Instrument patents and Computers and Communication patents. In these sectors, both first-action allowance rate and progenitor allowance rates declined by more than 50%.[22]

Figure 3: Allowance Rates by Technology Field (for Patent Applications Filed 1996-2005 and Examined Before Mid-2013)

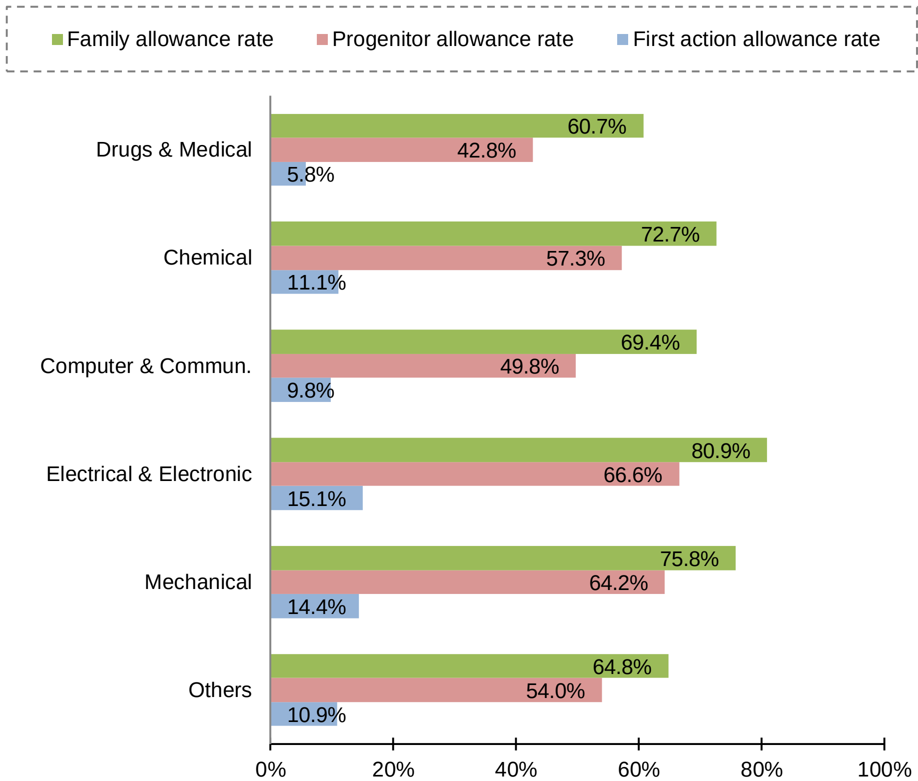

Figure 3 shows the three types of allowance rates across the six NBER patent-technology fields for applications filed at the USPTO for the first time between 1996 and 2005 and examined before mid-2013.

IV. ALLOWANCE RATES ACROSS INVENTOR TYPES

Does the patent allowance rate differ for different applicant types, such as small or foreign inventors? To answer this, we identified applications as originating from foreign inventors if the primary inventor on the application was located abroad, and defined small inventors as those that qualified for the USPTO's small-entity discounts on application fees. Large foreign inventors accounted for 39% of the progenitor applications, large U.S. inventors for 31.1%, small foreign inventors for 9.6%, and small U.S. inventors for 20.1%.

22 Figures A2-A4 of the Appendix compare sectorial trends for the three allowance rates.

Figure 4 reveals that large foreign inventors enjoy the highest progenitor and family allowance rates (60.5% and 77% respectively), followed by large U.S. inventors (57% and 75.2%). Small U.S. inventors have the lowest allowance rates, particularly with respect to family allowance rate. Foreign applicants and small inventors are less likely to use continuation applications.[23] The differences in allowance rates across applicant types appear more substantial in some fields (such as Computers and Communications) than others.[24] The decline in first-action allowance rates and progenitor allowance rates appears pronounced for U.S. inventors, both large and small.[25]

Figure 4: Allowance Rates by Inventor Type (for Patent Applications Filed from 1996-2005 and Examined Before Mid-2013)

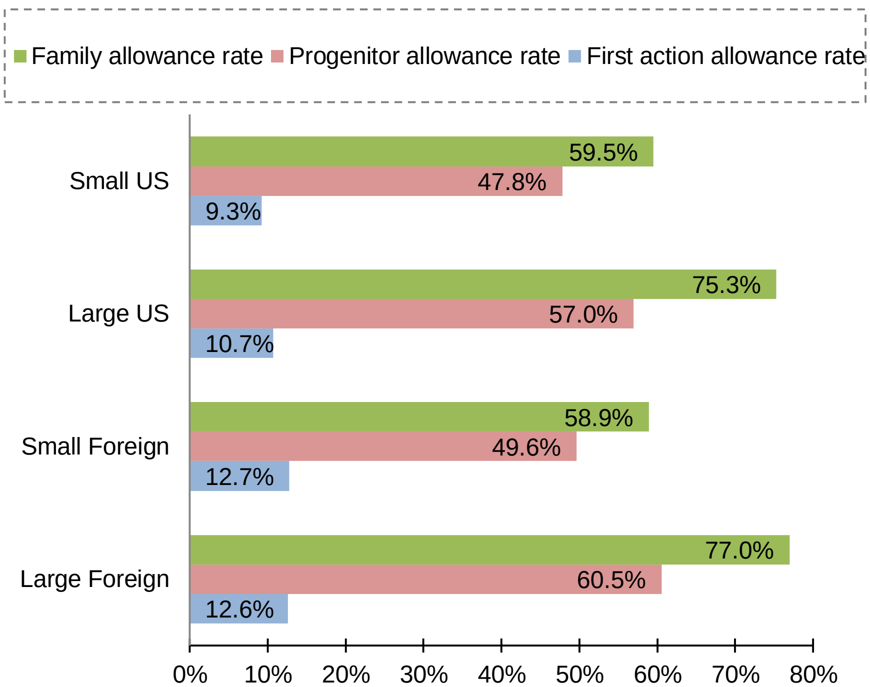

Figure 4 shows the three types of allowance rates across the four inventor types for applications filed at the USPTO for the first time between 1996 and 2005 and examined before mid-2013.

These numbers should be interpreted with caution. Lower allowance rates for small U.S. applicants could reflect higher propensity for abandonment or differences in the nature of subject

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23 Table A4 of the Supplementary Appendix reports the percentage of progenitor applications that used the different types of continuations by applicant type.

24 Table A5 of the Supplementary Appendix reports the allowance rates for the different applicant types across technology fields.

25 Figures A5-A7 of the Supplementary Appendix present trends for the three types of allowance rates by applicant type.

matter claimed in the applications. Similarly, large foreign inventors may enjoy higher allowance rates because they seek protection in the United States for only their most important inventions, or because they are more likely to have access to the necessary legal and financial resources.

V. CONCLUSION

Our analysis of U.S. patent applications filed between 1996 and 2005 and examined through mid-2013 counters the popular belief that the USPTO allows nearly all applications to emerge as patents. We find that the first-action allowance rate for patent applications is only 11.4%, and the progenitor allowance rate is similarly low at 55.8%. The family allowance rate, which accounts for continuations of progenitor applications, is 71.2%. Furthermore, we find that the probability that a patent will issue has declined over time, dropping from 70% for the 1996 cohort to 40% for the 2005 cohort (even accounting for censoring issues as shown in Figure A1). Applications in the "Drugs and Medical Instruments" field are least likely to be successful, with allowance rates declining sharply during the period of our study, while applications in the "Electrical and Electronics" field are most likely to be successful. Regardless of technology category, however, allowance rates are lower for small inventors.

What are the policy implications of these findings? Many scholars have interpreted allowance rates, typically incorrectly calculated, to reflect examination quality alone and have argued that high allowance rates indicate low examination quality.[26] Our findings challenge the popular belief that allowance rates are close to 100%, and based on our calculated allowance rates, we find no evidence that the USPTO is becoming more lenient in granting patents. To the extent that some inventors invest in patent applications based on likelihood of success, our findings help correct misperceptions and enable more informed decisions about investments.

Our finding that patent applications filed by small inventors and those seeking to protect biomedical technologies were systematically less likely to emerge as patents, particularly in more recent years, is quite striking. Are small inventors' applications less likely to emerge as patents because they are more likely to file frivolous applications, or because they are more constrained in accessing the legal and financial resources required to prosecute their applications? Similarly, are patents in the biomedical fields less likely to issue because applications in these fields increasingly seek protection for less novel subject matter? Or are the changes driven by changes in the strategies of either patent applicants or examination-related policies at the USPTO? Answering these questions will help pinpoint the causes behind the substantial variation in patent allowance rates, and is the

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26 *See*, *e.g.*, Quillen & Webster, *Continuing Patent Applications*, *supra* note 6; Quillen & Webster, *One More Time*, *supra* note 6.

next step towards developing policy responses to the variation. We leave this important investigation for future research.

Our study also suggests that policy makers should interpret patent allowance rates cautiously. Allowance rates are the product of an "opt out" system for applicants, driven not only by USPTO examination, but also by applicants' willingness to continue prosecution of their applications. Accordingly, allowance rates reflect the influence of several variables, including the patentability of the subject matter claimed, the rigor of the patent examination process, the length of application pendency, and the financial or legal costs of prosecution. As such, policymakers should recognize the difficulty of recommending changes to the examination system based on observed allowance rates. While a lenient patent examination process can impose costs on our innovation system, an overly rigorous examination process may deter inventors from seeking patents, or worse still, from investing in innovation. Achieving the right balance of encouragement and rigor will require further empirical analysis of the factors that influence fluctuations in allowance rates.

Appendix: Supplementary Statistics

Table A1: Correlations Between Allowance Rates and Environmental Covariates, 1996-2005

	(A)	(B)	(C)	(D)	(E)
(A) First-Action Allowance Rate					
(B) Progenitor Allowance Rate	0.949				
(C) Family Allowance Rate	0.950	0.998			
(D) Percent Change in Real GDP	0.352	0.482	0.515		
(E) Total Pending Applications	-0.925	-0.994	-0.992	-0.505	
(F) Total Pendency	-0.925	-0.967	-0.963	-0.349	0.971

Table A1 shows contemporaneous correlations between allowance rates and potential environmental determinants of allowance rates. All variables are measured annually. "Total Pending Applications" refers to the stock of patent applications filed and undergoing the examination process for the given year. "Total Pendency" refers to the average time, in months, between patent application date and patent disposal date during the entry year of the progenitor applications.

Table A2: Progenitor Applications and Related Continuation Applications, 1996-2005

Year	Applications	Serialized Continuations				Non-serialized Continuations (RCEs)	Either Continuation
		CON	CIP	DIV	Any		
1996	146,260	6.9%	5.6%	6.5%	17.7%	11.2%	24.9%
1997	166,232	5.8%	5.3%	6.7%	16.5%	12.1%	25.6%
1998	182,717	6.3%	5.0%	6.8%	16.9%	13.4%	26.9%
1999	197,704	6.9%	5.0%	6.9%	17.5%	14.5%	28.3%
2000	222,480	7.1%	4.8%	6.5%	17.2%	15.7%	29.0%
2001	232,668	7.1%	4.4%	6.5%	16.9%	17.4%	30.3%
2002	233,246	6.7%	4.4%	6.1%	16.1%	19.7%	31.5%
2003	235,861	6.3%	4.1%	5.1%	14.6%	24.1%	33.7%
2004	250,338	6.3%	3.4%	4.9%	13.7%	27.3%	35.6%
2005	278,160	6.5%	2.7%	4.7%	13.2%	29.2%	37.1%

Table A2 shows the number of progenitor applications filed per year and the percentage of progenitor applications from each cohort that resulted in continuations.

Table A3: The Use of Continuation Applications Across Technology Fields, 1996-2005

Technology Field	Applications	Serialized Continuations (%)				Non-serialized Contin-uations (RCEs)	Either Contin-uation
		CON	CIP	DIV	Any		
Chemical	245,150	6.0%	5.3%	9.2%	19.1%	18.2%	32.8%
Drugs & Medical	227,936	12.8%	8.2%	10.0%	28.2%	24.5%	44.1%
Computers & Comm.	611,046	8.3%	3.2%	3.6%	14.1%	26.7%	36.0%
Electrical & Electronic	402,401	4.7%	3.0%	7.7%	14.5%	16.4%	27.5%
Mechanical	311,040	3.9%	3.8%	4.9%	11.9%	13.2%	22.7%
Others	348,093	4.6%	5.2%	4.2%	13.2%	13.4%	23.7%

Table A3 shows the number of progenitor applications filed in each NBER patent-technology field and the percentage of progenitor applications that resulted in continuations.

Table A4: The Use of Continuation Applications Across Applicant Types, 1996-2005

Applicant Type	Applications	Serialized Continuations (%)				Non-serialized Contin-uations (RCEs)	Either Contin-uation
		CON	CIP	DIV	Any		
Large Foreign	838,210	4.4%	1.3%	5.9%	11.2%	21.1%	29.1%
Small Foreign	207,460	3.7%	3.7%	2.9%	9.7%	12.1%	19.3%
Large US	668,527	9.2%	5.2%	7.6%	20.4%	23.0%	37.6%
Small US	431,469	8.2%	9.2%	5.0%	20.5%	14.3%	30.0%

Table A4 shows the number of progenitor applications filed by applicant type and the percentage of progenitor applications that resulted in continuations.

Table A5: Allowance Rates Across Applicant Types and Technology Fields, 1996-2005

Technology Field	Applicant Type	Applications	First Action	Progenitor	Family
Chemical	Large Foreign	112,598	11.0%	59.6%	75.4%
	Large U.S.	76,595	11.3%	57.2%	74.1%
	Small Foreign	20,245	11.6%	52.9%	64.4%
	Small U.S.	35,712	9.7%	52.4%	65.8%
Computers & Comm.	Large Foreign	244,453	11.7%	54.5%	74.0%
	Large U.S.	251,253	8.9%	51.8%	74.1%
	Small Foreign	32,847	9.6%	37.7%	48.9%
	Small U.S.	82,493	6.4%	34.5%	49.6%
Drugs & Medical	Large Foreign	62,142	5.3%	45.0%	63.6%
	Large U.S.	69,632	6.0%	43.1%	62.7%
	Small Foreign	27,372	5.7%	39.9%	55.4%
	Small U.S.	68,790	5.6%	41.5%	58.3%
Electrical & Electronics	Large Foreign	204,125	15.5%	67.7%	83.3%
	Large U.S.	122,529	14.2%	69.3%	84.5%
	Small Foreign	30,489	17.0%	57.7%	65.2%
	Small U.S.	45,258	13.1%	60.0%	71.1%
Mechanical	Large Foreign	128,328	15.1%	68.8%	82.1%
	Large U.S.	74,681	14.1%	67.2%	80.5%
	Small Foreign	40,274	15.8%	56.2%	63.7%
	Small U.S.	67,757	12.0%	57.1%	65.9%
Others	Large Foreign	86,564	11.3%	60.7%	74.6%
	Large U.S.	73,837	9.9%	56.5%	71.9%
	Small Foreign	56,233	13.5%	51.1%	57.7%
	Small U.S.	131,459	9.5%	49.3%	57.4%

Table A5 shows the number of progenitor applications filed in each of the six NBER patent-technology fields by applicant type and the percentage of each type's applications that produced the different types of continuations.

Figure A1: Trends in Allowance Rates with Adjustments for Censoring, for Applications Filed Between 1991-2010

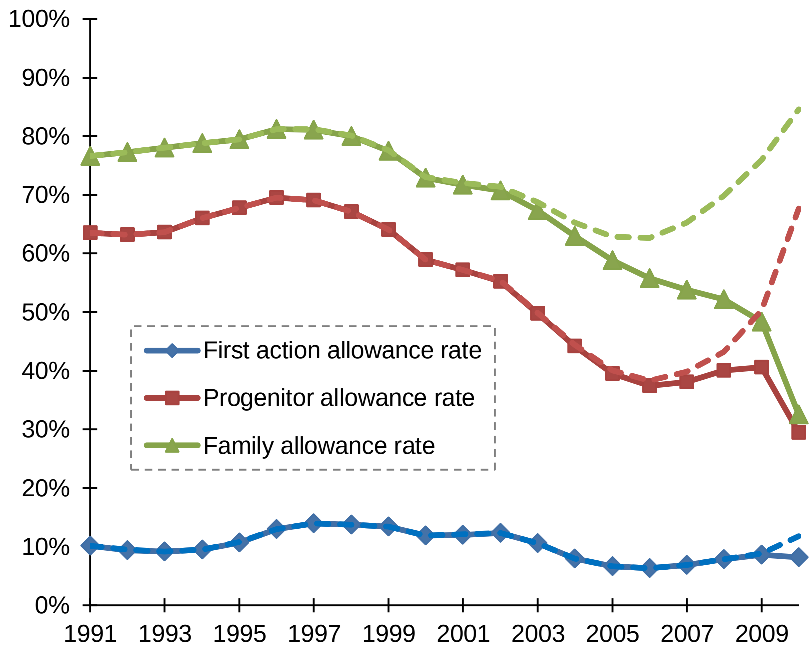


Figure A1 shows trends in the three types of allowance rates for the 4.2 million applications filed at the USPTO for the first time between 1991-2010. A significant number of applications filed after 2005 were pending as of June 30, 2013; the dotted lines (for the first-action allowance rate and the progenitor allowance rate) represent the corresponding rates if all pending applications are, in fact, allowed. These dotted lines represent the highest possible allowance rates. For progenitor applications that produced pending continuation applications, we assume that every pending continuation application will eventually be allowed. The dashed line therefore represents the highest possible family allowance rate.

Figure A2: Trends in First-Action Allowance Rate by Technology Field

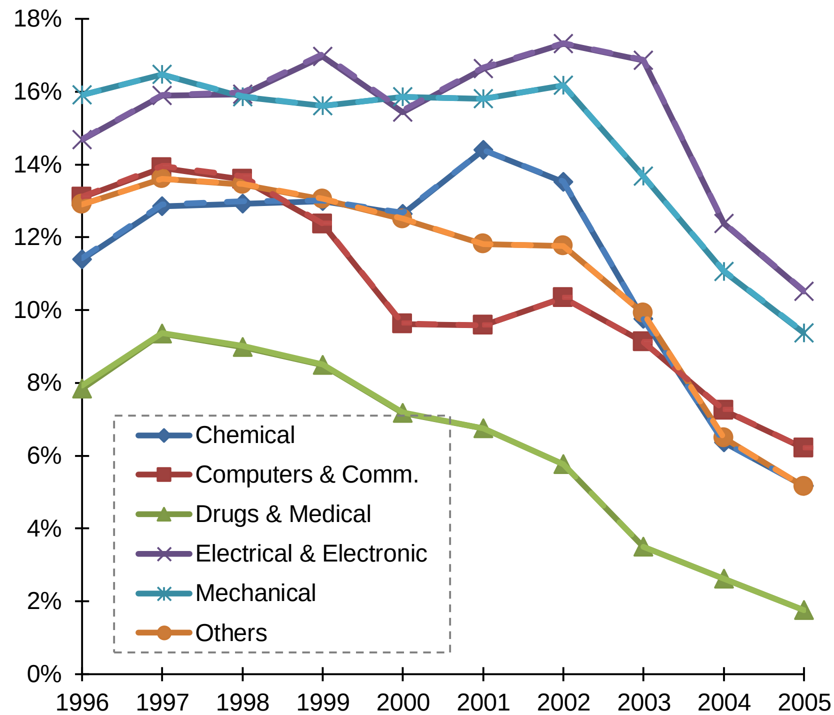


Figure A3: Trends in Progenitor Allowance Rate by Technology Field

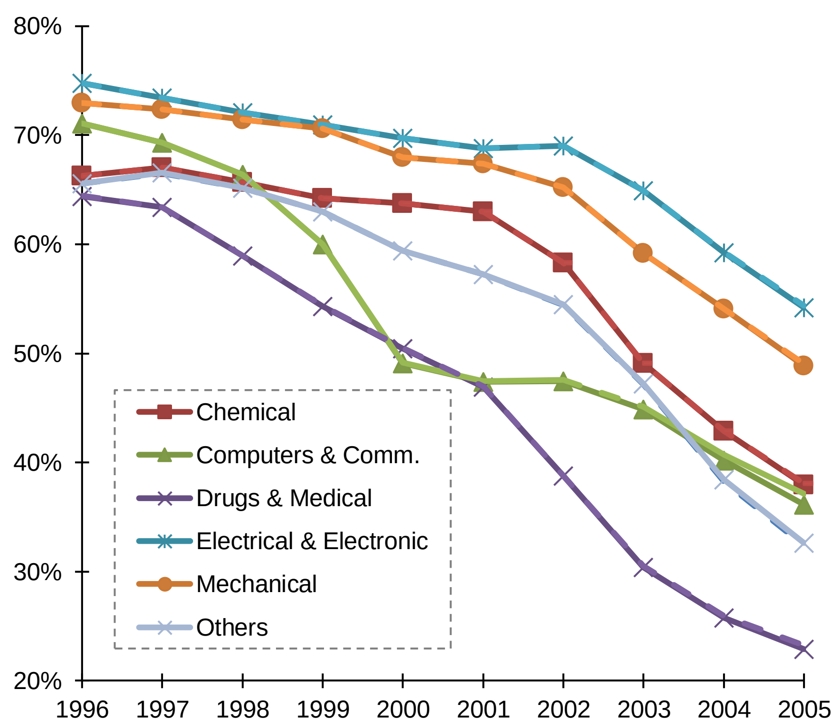


Figure A4: Trends in Family Allowance Rate by Technology Field

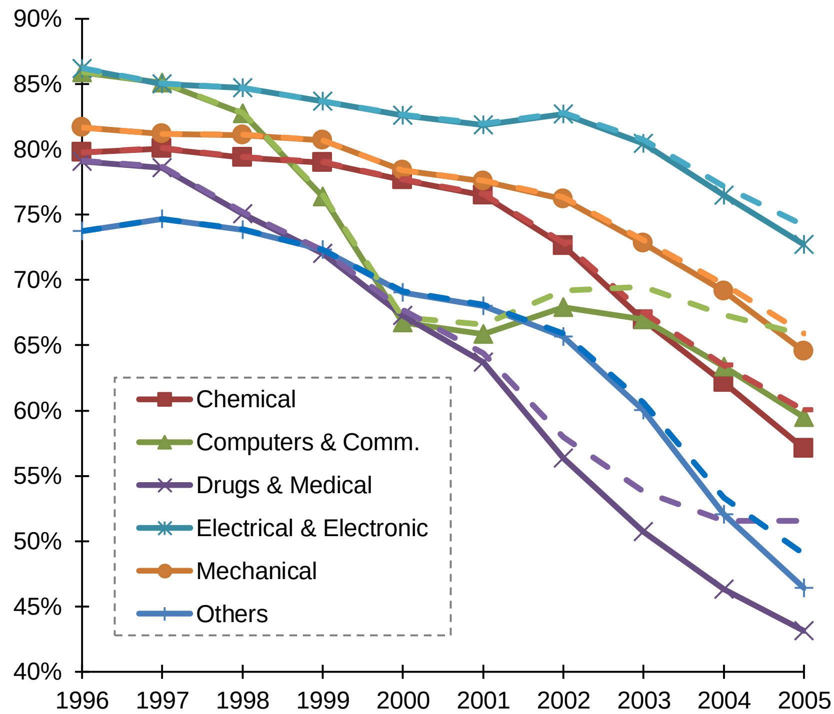


Figure A5: Trends in First-Action Allowance Rate by Applicant Type

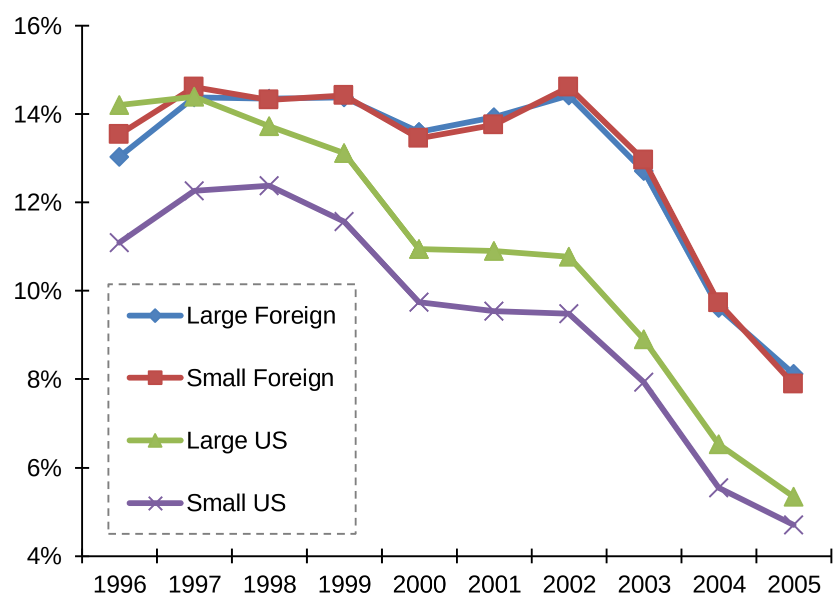


Figure A6: Trends in Progenitor Allowance Rate by Applicant Type

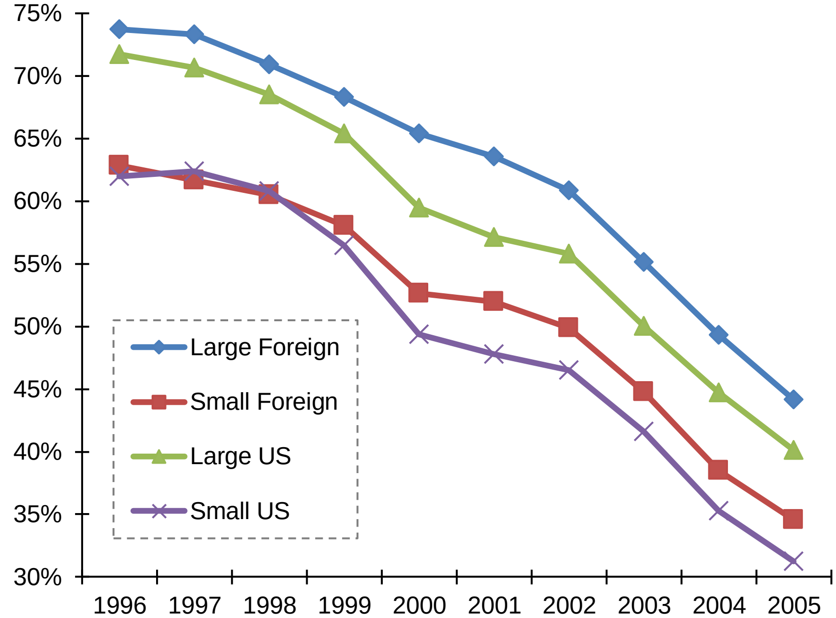
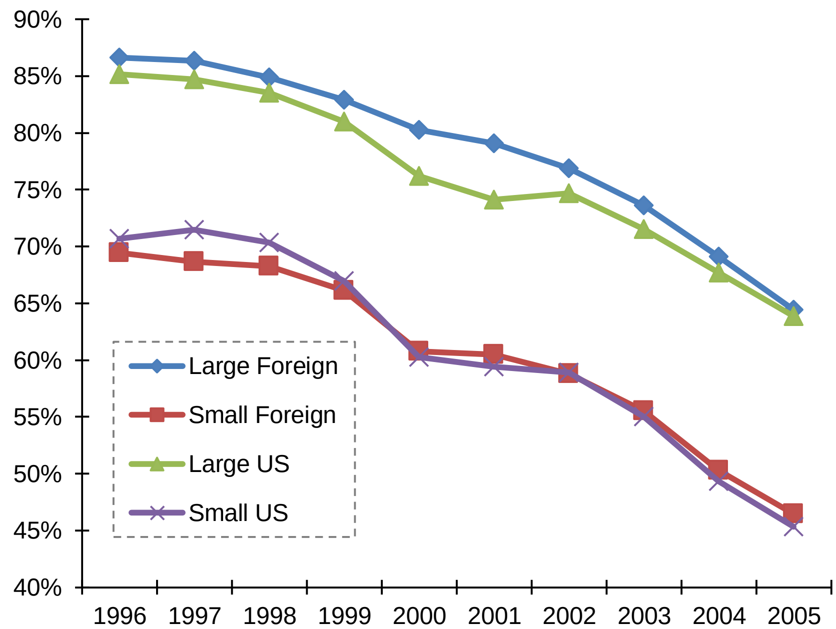


Figure A7: Trends in Family Allowance Rate by Applicant Type, 1996-2005



Session 4: Is SEP/FRAND Policy on the Right Track?

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Assistant Attorney General Makan Delrahim Delivers Remarks at the USC Gould School of Law's Center for Transnational Law and Business Conference

Los Angeles, CA ~ Friday, November 10, 2017

Good afternoon. Thank you for the opportunity to be with you today, and I especially want to thank Dean Scotten for the invitation, as well as the leaders of the USC Gould School of Law. Los Angeles has a special meaning to me. After my family moved to the United States from Iran, we settled in LA, and I've always considered California my home. It is good to be back.

Though we're thousands of miles from the center of federal government, we should take a moment to remember that today we observe a federal holiday, Veteran's Day, and pause on why we do so. The active armed forces, particularly those serving in areas of great danger overseas, do not get the day off. They struggle every day to protect our safety, liberty, and way of life, too often paying the ultimate price for their service. Indeed, my friend and Deputy Assistant Attorney General for litigation, Don Kempf, is a retired active duty marine. We thank him and all of our service members for their service. This conference is a venue for us to reflect on innovation and engage in lively debate about policy. But let's not forget what drives the hopes and dreams of so many innovators: the hope of making a technology that will improve the way people live. For wounded warriors returning home, innovations in medical technology have greatly assisted their adjustment. Many of these innovations would not be possible without the robust intellectual property system and free market liberties we enjoy today.

The field of innovation policy is an area about which I care deeply; and it drove me to public service. I am a registered patent lawyer—the first head of the Antitrust Division to be so, I am told. Given the growing importance of IP rights in the modern economy, I believe the stakes in this area are enormous. It has long been the view of the Antitrust Division that the intellectual property laws provide important incentives for innovation and commercialization, which ultimately benefit consumers. Relatedly, the Division has long viewed patent licensing as generally pro-competitive.

I'd like to focus my comments today on an important debate on antitrust enforcement and intellectual property—that is, the role of antitrust law in the context of standard setting organizations, or SSOs. Standard setting organizations arose with noble intentions, and play an important pro-competitive role. Once upon a time, and in their best mode, they were dominated by engineers aimed at the common goal of finding the most efficient technological solution to an industrywide problem. Over the years, the SSO process has worked best when participants endeavored to determine which technology, or combination of complementary technologies, would become the "winner" for a standard with limited concern over who the winner was, or how the winner would choose to license its IP rights.

Times have changed. Industry standards have exploded over the past several decades, and today they play a vital role in many sectors of the economy. By allowing products designed and manufactured by many different firms to function together, interoperability standards create enormous value for consumers and fuel the creation and utilization of new and innovative technologies to the benefit of consumers. As the global economy is increasingly characterized by information technology and accompanying intellectual property assets, the setting of industry standards has become more critical and more complicated. Because the stakes are so high, interest in the outcomes of SSOs is no longer merely that of engineers; they are now the subject of intense focus in the board room.

Competition policy and antitrust treatment of SSOs have also evolved. The goal of antitrust law is to protect free market competition and thereby consumers, but if mis-applied, it can cause great harm to innovation, the competitive process, and the consumer. As I have explained in the past, "Antitrust enforcers should . . . strive to eliminate as much as possible the unnecessary uncertainties for innovators and creators in their ability to exploit their intellectual property rights, as those uncertainties can also reduce the incentives for innovation." I submit that this is a good time to take a step back and think about the implications of SSOs and the proper role for antitrust law enforcement, to ensure our efforts maximize innovation incentives while protecting the competitive process.

In particular, I worry that we as enforcers have strayed too far in the direction of accommodating the concerns of technology implementers who participate in standard setting bodies, and perhaps risk undermining incentives for IP creators, who are entitled to an appropriate reward for developing break-through technologies. The dueling interests of innovators and implementers always are in tension, and the tension is resolved through the free market, typically in the form of freely negotiated licensing agreements for royalties or reciprocal licenses. Despite the benefits SSOs confer, the regulation of the interactions and licensing practices within an SSO through the misapplication of the antitrust laws threatens to disrupt the free-market bargain, which could undermine the process of dynamic innovation itself.

I credit my friend, Professor Carl Shapiro, the highly respected economist and former Deputy Assistant Attorney General in the Antitrust Division, for helping provide a framework in which to consider the interplay between technology innovation and implementation. Carl and other economics scholars highlighted a risk that can arise in the standard setting context, where a new standard implements a technology, after which the patent owner for that technology threatens to delay licensing until its royalty demands are met. This is the so-called "hold-up" problem. Much ink has been spilled on how standard setting organizations can remedy this risk, and in recent years the discussion has shifted to how antitrust law should assist in policing such private commitments to SSOs.

Too often lost in the debate over the hold-up problem is recognition of a more serious risk: the hold-out problem. Standard setting typically occurs against the backdrop of negotiations between innovators, who develop technologies through private investment and own IP rights, and implementers, who hope to market and use the technology through a license and pay the IP holder a royalty. The hold-out problem arises when implementers threaten to under-invest in the implementation of a standard, or threaten not to take a license at all, until their royalty demands are met.

I view the collective hold-out problem as a more serious impediment to innovation. Here is why: most importantly, the hold-up and hold-out problems are not symmetric. What do I mean by that? It is important to recognize that innovators make an investment before they know whether that investment will ever pay off. If the implementers hold out, the innovator has no recourse, even if the innovation is successful. In contrast, the implementer has some buffer against the risk of hold-up because at least some of its investments occur after royalty rates for new technology could have been determined. Because this asymmetry exists, under-investment by the innovator should be of greater concern than under-investment by the implementer.

More to the point, many of the proposed “solutions” to the hold-up problem are often anathema to the policies underlying the intellectual property system envisioned by our forefathers. These patent policies are constitutionally enshrined in Article 1, Section 8, which gives Congress the power “To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive right to their respective Writings and Discoveries.” These “exclusive rights” importantly and necessarily include the power to exclude. The misapplication of the antitrust laws to punish the legitimate exercise of these rights seems to undermine these policies when they require a patent holder to sacrifice these rights.

My priority as Assistant Attorney General is to help foster debate toward a more symmetric balance between the seemingly dueling policy concerns between intellectual property and antitrust law. Unfortunately, in recent years, competition policy has focused too heavily on the so-called unilateral hold-up problem, often ignoring what fuels dynamic innovation and efficiency. New inventions do not appear out of the ether, and excessive use of the antitrust laws rather than other remedies can overlook and undermine the magnitude of investment and risk inventors undertake for the chance at being included in a standard. Every incremental shift in bargaining leverage toward implementers of new technologies acting in concert can undermine incentives to innovate. I therefore view policy proposals with a one-sided focus on the hold-up issue with great skepticism because they can pose a serious threat to the innovative process.

Against this backdrop, I respectfully submit that enforcers and courts should be mindful of the proper application of antitrust law to standard setting. There is a growing trend supporting what I would view as a misuse of antitrust or competition law, purportedly motivated by the fear of so-called patent hold-up, to police private commitments that IP holders make in order to be considered for inclusion in a standard. This trend is troublesome. If a patent holder violates its commitments to an SSO, the first and best line of defense, I submit, is the SSO itself and its participants.

These commitments are typically contractual in nature. More specifically, SSOs often impose obligations on IP holders seeking to have their technology evaluated and, if selected, incorporated into a standard to engage in fair, reasonable, and nondiscriminatory licensing of their technology—what we call “FRAND” or “RAND” commitments. Disputes inevitably arise regarding what licensing fees or practices are “reasonable,” and “nondiscriminatory,” as you would expect with free-market negotiations. We should be most concerned, however, when this dispute involves concerted action, on either side—the implementers or the innovators.

If a patent holder is alleged to have violated a commitment to a standard setting organization, that action may have some impact on competition. But, I respectfully submit, that does not mean the heavy hand of antitrust necessarily is the appropriate remedy for the would-be licensee—or the enforcement agency. There are perfectly adequate and more appropriate common law and statutory remedies available to the SSO or its members.

Patent rights are conferred by statute and guaranteed by the U.S. Constitution. The enforcement of valid patent rights should not be a violation of antitrust law. A patent holder cannot violate the antitrust laws by properly exercising the rights patents confer, such as seeking an injunction or refusing to license such a patent. Set aside whether taking these actions might violate the common law. Under the antitrust laws, I humbly submit that a unilateral refusal to license a valid patent should be per se legal. Indeed, just this Monday, Chief Judge Diane Wood, a former Deputy Assistant Attorney General at the Antitrust Division, stated that “[e]ven monopolists are almost never required to assist their competitors.”

Under the existing statutory scheme, it is not the duty or the proper role of antitrust law to referee what unilateral behavior is reasonable for patent holders in this context. Patent holders make decisions every day about how to exploit their property rights, knowing that the consequence of those actions may be to subject themselves to contractual or other common law liability. The blunt application of antitrust law to such unilateral conduct throws those decisions into disarray, threatening to punish IP holders with onerous penalties that can deter other innovators from taking the necessary R&D investment risk to develop the next great technological leap forward.

More importantly, refraining from imposing antitrust penalties gives teeth to more appropriate common law remedies and allows SSOs to live up to their promise. In a breach of contract action, a party can litigate the facts regarding what constitutes a "reasonable" or "nondiscriminatory" rate or commitment. If there is a violation of a reasonableness standard, the factfinder can decide it, like they do in other instances of contract violations. Antitrust enforcers should exercise greater humility and enforce the antitrust laws in a manner that best promotes dynamic competition for the benefit of consumers.

In case anyone is inclined to misunderstand my comments, let me clearly state that there is an important role for antitrust scrutiny in the standard setting context. With respect to innovators, I agree with the D.C. Circuit's en banc statement in United States v. Microsoft that "[i]ntellectual property rights do not confer a privilege to violate the antitrust laws." Nor does membership in a standard setting organization confer immunity from serious antitrust scrutiny. Given the incentives participants in SSOs face to bend licensing negotiations to their benefit, there is a risk that members of standard setting bodies could engage in collusive, anticompetitive behavior.

Courts and antitrust law enforcers have long understood that SSOs "can be rife with opportunities for anticompetitive activity." When competitors come together, there is always a risk that they will engage in naked cartel-like behavior, such as fixing downstream prices or boycotting a new entrant. In cases like Radiant Burners, Allied Tube, and Hydrolevel, the Supreme Court has condemned efforts to use SSOs as a means of excluding particular competitors or products, emphasizing that such conduct can cause harm to competition. For that reason, enforcers should carefully examine and recognize the risk that SSO participants might engage in a form of buyer's cartel, what economists call a monopsony effect.

When implementers act together within a standard-setting organization as the gatekeeper to sales of products including a new technology, they have both the motive and means to impose anticompetitive licensing terms. At the extreme, they can shut down a potential new technology in favor of the status quo, all to the detriment of consumers. The risk of failing to implement a new technology does not fall equally on innovators and implementers. The prospect of hold-out offers implementers a crucial bargaining chip. Unlike the unilateral hold-up problem, implementers can impose this leverage before they make significant investments in new technology.

The Antitrust Division will therefore be skeptical of rules that SSOs impose that appear designed specifically to shift bargaining leverage from IP creators to implementers, or vice versa. SSO rules purporting to clarify the meaning of "reasonable and non-discriminatory" that skew the bargain in the direction of implementers warrant a close look to determine whether they are the product of collusive behavior within the SSO.

If an SSO pegs its definition of "reasonable" royalties to a single Georgia-Pacific factor that heavily favors either implementers or innovators, then the process that led to such a rule deserves close antitrust scrutiny. While the so-called "smallest salable component" rule may be a useful tool among many in determining patent infringement damages for multi-component products, its use as a requirement by a concerted agreement of implementers as the exclusive determinant of patent royalties may very well warrant antitrust scrutiny.

It is just as important to recognize that a violation by a patent holder of an SSO rule that restricts a patent-holder's right to seek injunctive relief should be appropriately the subject of a contract or fraud action, and rarely if ever should be an antitrust violation. Patents are a form of property, and the right to exclude is one of the most fundamental bargaining rights a property owner possesses. Rules that deprive a patent holder from exercising this right—whether imposed by an SSO or by a court—undermine the incentive to innovate and worsen the problem of hold-out. After all, without the threat of an injunction, the implementer can proceed to infringe without a license, knowing that it is only on the hook only for reasonable royalties.

In this regard, I believe Judge Posner was badly mistaken in the Apple v. Motorola case, in which he held that IP owners who make FRAND commitments somehow sacrifice their right even to seek an injunction. Though the Federal Circuit corrected that ill-conceived decision, its ruling did not improve matters much. The court of appeals held that making a FRAND commitment and entering into other licenses “strongly suggest” that damages for infringement should be adequate relief, meaning that injunctive relief should be denied except in rare cases. In my view, that is a distinction without much of a difference. We should not transform commitments to license on FRAND terms into a compulsory licensing scheme. Indeed, we have had strong policies against compulsory licensing, which effectively devalues intellectual property rights, including in most of our trade agreements, such as the TRIPS agreement of the WTO. If an SSO requires innovators to submit to such a scheme as a condition for inclusion in a standard, we should view the SSO’s rule and the process leading to it with suspicion, and certainly not condemn the use of such injunctive relief as an antitrust violation where a contract remedy is perfectly adequate.

The Antitrust Division will carefully scrutinize what appears to be cartel-like anticompetitive behavior among SSO participants, either on the innovator or implementer side. The old notion that “openness” alone is sufficient to guard against cartel-like behavior in SSOs may be outdated, given the evolution of SSOs beyond strictly objective technical endeavors. I therefore urge antitrust enforcers to take a more humble approach to the application of antitrust to unilateral violations of SSO commitments and to take a fresh look at concerted actions within SSOs that cause competitive harm to the dynamic innovation process. I likewise urge SSOs to be proactive in evaluating their own rules, both at the inception of the organization, and routinely thereafter. In fact, SSOs would be well advised to implement and maintain internal antitrust compliance programs and regularly assess whether their rules, or the application of those rules, are or may become anticompetitive.

My remarks here should not surprise anyone here who has followed my statements in the past. The views expressed here are consistent with the views I have held since my service in the mid-1990s at the U.S. Trade Representative’s Office, during my time working for the Senate Judiciary Committee with exclusive jurisdiction over the federal intellectual property and antitrust laws, and in my last tour of duty in the Antitrust Division in the early 2000s.

Fresh thinking about the implications of SSOs and the proper role of antitrust law is long overdue. Bargaining over new and innovative technologies is a high stakes game, and each side has an incentive to use every means necessary to improve its end of the bargain. In this game, the competitive market process should win. SSOs should not be a tool for IP licensors or licensees to obtain more favorable terms than they would otherwise achieve in an unconstrained market.

We don’t have the tools to know what the competitive royalty rate is—we’re not price regulators, after all—and if we inject antitrust law where it does not belong, it can actually subvert the competitive process and do serious harm to American consumers and to innovation itself. But we should guard against traditional forms of anticompetitive behavior to ensure that competitive rates prevail. That is why concerns over possible innovator hold-up should not override the dangerous prospect of implementer hold-out. It’s time to correct this asymmetry to ensure that there are maximum incentives to innovate, and equally proper incentives to implement.

Speaker:
Assistant Attorney General

Topic(s):
Antitrust

Attachment(s):
Download Remarks

Component(s):
Antitrust Division

Updated November 14, 2017

February 13, 2018

Assistant Attorney General Makan Delrahim
Department of Justice Antitrust Division
950 Pennsylvania Ave. NW
Washington, DC 20530-0001

Dear Assistant Attorney General Delrahim,

As judges, former judges and government officials, legal academics and economists who are experts in antitrust and intellectual property law, we write to express our support for your recent announcement that the Antitrust Division of the Department of Justice will adopt an evidence-based approach in applying antitrust law equally to both innovators who develop and implementers who use technological standards in the innovation industries.

We disagree with the letter recently submitted to you on January 24, 2018 by other parties who expressed their misgivings with your announcement of your plan to return to this sound antitrust policy. Unfortunately, their January 24 letter perpetuates the long-standing misunderstanding held by some academics, policy activists, and companies, who baldly assert that one-sided "patent holdup" is a real-world problem in the high-tech industries. This claim rests entirely on questionable models that predict that opportunistic behavior in patent licensing transactions will result in higher consumer prices. These predictions are inconsistent with actual market data in any high-tech industry.

It bears emphasizing that no empirical study has demonstrated that a patent-owner's request for injunctive relief after a finding of a defendant's infringement of its property rights has ever resulted either in consumer harm or in slowing down the pace of technological innovation. Given the well understood role that innovation plays in facilitating economic growth and well-being, a heavy burden of proof rests on those who insist on the centrality of "patent holdup" to offer some tangible support for that view, which they have ultimately failed to supply in the decade or more since that theory was first propounded. Given the contrary conclusions in economic studies of the past decade, there is no sound empirical basis for claims of a systematic problem of opportunistic "patent holdup" by owners of patents on technological standards.

Several empirical studies demonstrate that the observed pattern in high-tech industries, especially in the smartphone industry, is one of constant lower quality-adjusted prices, increased entry and competition, and higher performance standards. These robust findings all contradict the testable implications of "patent holdup" theory. The best explanation for this disconnect between the flawed "patent holdup" theory and overwhelming weight of the evidence lies in the institutional features that surround industry licensing practices. These practices include bilateral licensing negotiations, and the reputation effects in long-term standards activities. Both support a feed-back mechanism that creates a system of natural checks and balances in the setting of royalty rates. The simplistic models of "patent holdup" ignore all these moderating effects.

Of even greater concern are the likely negative social welfare consequences of prior antitrust policies implemented based upon nothing more than the purely theoretical concern about opportunistic "patent holdup" behavior by owners of patented innovations incorporated into technological standards. For example, those policies have resulted in demands to set royalty rates for technologies incorporated into standards in the smartphone industry according to particular components in a smartphone. This was a change to the longstanding industry practice of licensing at the end-user device level, which recognized that fundamental technologies incorporated into the cellular standards like 2G, 3G, etc., optimize the entire wireless system and network, and not just the specific chip or component of a chip inside a device.

In support, we attach an Appendix of articles identifying the numerous substantive and methodological flaws in the "patent holdup" models. We also point to rigorous empirical studies that all directly contradict the predictions of the "patent holdup" theory.

For these reasons, we welcome your announcement of a much-needed return to evidence-based policy making by antitrust authorities concerning the licensing and enforcement of patented innovations that have been committed to a technological standard. This sound program ensures balanced protection of all innovators, implementers, and consumers. We are confident that consistent application of this program will lead to a vibrant, dynamic smartphone market that depends on a complex web of standard essential patents which will continue to benefit everyone throughout the world.

Sincerely,

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Boston University School of Law
Former Vice-Chairman and Commissioner,
United States International Trade Commission

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Appendix

Richard A. Epstein & Kayvan Noroozi, *Why Incentives for Patent Hold Out Threaten to Dismantle FRAND and Why It Matters*, BERKELEY TECH. L. REV. (forthcoming), https://ssrn.com/abstract=2913105

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Jorge Padilla & Koren W. Wong-Ervin, *Portfolio Licensing to Makers of Downstream End-User Devices: Analyzing Refusals to License FRAND-Assured Standard-Essential Patents at the Component Level*, 62 THE ANTITRUST BULLETIN 494 (2017), https://doi.org/10.1177/0003603X17719762

Jonathan D. Putnam & Tim A. Williams, *The Smallest Salable Patent-Practicing Unit (SSPPU): Theory and Evidence* (Sept. 2016), https://ssrn.com/abstract=2835617

Gregory Sidak, *The Antitrust Division's Devaluation of Standard-Essential Patents*, 104 GEO. L.J. ONLINE 48 (2015), https://georgetownlawjournal.org/articles/161/antitrust-division-s-devaluation-of/pdf

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Joshua D. Wright, *SSOs, FRAND, and Antitrust: Lessons from the Economics of Incomplete Contracts*, 21 GEO. MASON L. REV. 791 (2014), http://www.georgemasonlawreview.org/wp-content/uploads/2014/06/Wright-Website-Version.pdf

May 17, 2018

BY OVERNIGHT MAIL AND E-MAIL
Assistant Attorney General Makan Delrahim
U.S. Department of Justice
Antitrust Division
950 Pennsylvania Ave., NW
Washington, DC 20530

Re: *Speeches on Patents and Holdup*

Dear Assistant Attorney General Delrahim:

We, 77 former government enforcement officials and professors of law, economics, and business, write to express concern with recent speeches[1] you have made that we do not believe are consistent with the broad bipartisan legal and economic consensus that has existed for over a decade regarding standard setting. We would like to raise eight issues in particular.

First, the anticompetitive harms from patent holdup have been consistently acknowledged by officials in Republican and Democratic administrations. The unanimously adopted 2007 joint agency Report, *Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition*, explained the difference between a patentee's power *ex ante* (when "multiple technologies may compete to be incorporated into the standard") and *ex post* (when "the chosen technology may lack effective substitutes precisely because the SSO chose it as the standard"). This disparity can allow the patentee to "extract higher royalties or other licensing terms that reflect the absence of competitive alternatives." *Id.* at 35-36. The FTC also unanimously endorsed the 2011 Report, *The Evolving IP Marketplace*, which highlighted how "an entire industry" could be "susceptible" to the "particularly acute" concern of holdup, which can result in "higher prices" and "discourage standard setting activities and collaboration, which can delay innovation." *Id.* at 234.[2] And the National Research Council of the National Academies concluded in its Report on *Patent Challenges for Standard-Setting in the Global Economy* that "a FRAND commitment limits a licensor's ability to seek injunctive relief." *Id.* at 9.

Second, the holdup problem has been recognized by courts and standard setting organizations themselves.[3] As one court stated, patent holdup is not a theoretical concern,

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[1] *The Long Run: Maximizing Innovation Incentives Through Advocacy and Enforcement*, Apr. 10, 2018; *The "New Madison" Approach to Antitrust and Intellectual Property Law*, Mar. 16, 2018; *Good Times, Bad Times, Trust Will Take Us Far: Competition Enforcement and the Relationship Between Washington and Brussels*, Feb. 21, 2018; *Assistant Attorney General Makan Delrahim Delivers Remarks at the USC Gould School of Law's Center for Transnational Law and Business Conference*, Nov. 10, 2017.

[2] As you recognized in your March 16, 2018 speech, the decision to include a patent in a standard "gives the patent holder some bargaining power" and "would require the patent holder to live up to commitments as they would have bargained for it."

[3] The studies cited to show the absence of holdup do not consider the counterfactual scenario: that prices could have fallen faster and output/diversity risen faster absent holdup. After all, few would argue that the Sherman Act was not necessary because, during the decade prior to enactment, "U.S.

but instead "is a substantial problem that [F]RAND [fair, reasonable, and nondiscriminatory licensing] is designed to prevent." *In re Innovatio IP Ventures*, 2013 WL 5593609, at *9 (N.D. Ill. Oct. 3, 2013).[4] As former FTC Commissioner Terrell McSweeney recently pointed out, courts in two cases awarded patentees only 1/150 and 1/500 of the royalties the patentholder sought. Commissioner Terrell McSweeny, *Holding the Line on Patent Holdup: Why Antitrust Enforcement Matters*, Mar. 21, 2018. The fact that SSOs—those with the most knowledge of the issues—adopt FRAND policies is itself telling proof that holdup is a problem; otherwise, why would they adopt contractual practices to prevent holdup?[5] In addition to higher royalties, expenditures can escalate as holdup increases the costs to SSOs and to those who oppose FRAND clarification. Timothy J. Muris, *Bipartisan Patent Reform and Competition Policy, American Enterprise Institute Report* 9 (2017).[6]

Third, we agree that "the hold-up and hold-out problems are not symmetric." *Nov. 10, 2017 speech*. But we believe that it is *holdup* that presents the more serious antitrust concern. As an initial matter, the risks faced by innovators are consistent with the "speculative investments" always made by technology and product developers; in contrast, implementers are vulnerable to paying supra-competitive royalties based on the entire value of the product, not on the value of the patented technology. A. Douglas Melamed & Carl Shapiro, *How Antitrust Law Can Make FRAND Commitments More Effective*, at 7-8, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3075970, 127 YALE L.J. __ (forthcoming 2018). While we agree that coordinated action can implicate antitrust, these concerns are not presented in licensing disputes at the core of holdout. The potential for holdout exists on both sides of contracts, occurring "when one side refuses to perform in good faith or negotiate reasonably." Muris, at 9. In contrast, the holdup problem and accompanying lock-in value exist only on one side of the exchange.

Fourth, patentees that obtain or maintain monopoly power *as a result of* breaching a FRAND commitment present a standard monopolization case. *E.g.*, *Broadcom v. Qualcomm*, 501 F.3d 297, 314 (3d Cir. 2007); *Microsoft Mobile v. Interdigital*, 2016 WL

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output of salt, petroleum, steel, and coal all increased significantly, and prices of steel, sugar, and lead all dropped significantly." Jorge L. Contreras, *Much Ado About Hold-Up*, at 22, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3123245.

[4] *See also Microsoft v. Motorola*, 2013 WL 5373179, at *7 (W.D. Wash. Sept. 24, 2013) (rejecting argument that "hold up does not exist in the real world" and finding that such an argument "does not trump the evidence presented by Microsoft that hold up took place in this case").

[5] As Richard Epstein has recognized, "[t]he intellectual history of rate regulation beg[an] with the writings of Sir Matthew Hale in the late seventeenth century," and the "[F]RAND formula" is "the best, indeed the only, approach" for "mimic[king] the performance of competitive markets" while not "undercutting their operation," which is needed since a "monopolist knows that he can extract at least some concessions from higher demanders precisely because they have nowhere else to go." Richard A. Epstein, *The History of Public Utility Rate Regulation in the United States Supreme Court: Of Reasonable and Nondiscriminatory Rates*, 38 J. SUP. CT. HIST. 345, 346, 348, 366 (2013).

[6] It also bears mention that one cannot conclude that the "winning technology" is inherently "better than its rivals" without considering the FRAND commitment that can be critical to the standard-selection decision and can avoid an industry being locked into a non-FRAND-restricted technology. MICHAEL A. CARRIER, INNOVATION FOR THE 21ST CENTURY: HARNESSING THE POWER OF INTELLECTUAL PROPERTY AND ANTITRUST LAW 328-29 (2009); Byeongwoo Kang & Rudi Bekkers, *Just-in-Time Inventions and the Development of Standards: How Firms Use Opportunistic Strategies to Obtain Standard-Essential Patents (SEPs)*, Aug. 28, 2013, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2284024.

1464545, at *2 (D. Del. Apr. 13, 2016).[7] FRAND breaches could satisfy the section 2 elements of exclusionary conduct by demonstrating an exclusion of competitors (the exclusion of rival competitive technologies not chosen by the SSO) that results in competitive injury (price increases and innovation harms from the breach) and acquisition or maintenance of monopoly power (obtained through the breach). Moreover, the conduct here is not protected under the "absolutist position" that *Noerr-Pennington* "immunizes every concerted effort that is genuinely intended to influence governmental action," as this would allow parties to violate the antitrust laws, for example by being "free to enter into horizontal price agreements." *Allied Tube & Conduit Corp. v. Indian Head, Inc.*, 486 U.S. 492, 503 (1988). Instead, a breach of a FRAND promise is "distinguish[able] from *Noerr* and its progeny" because it is "the type of commercial activity that has traditionally had its validity determined by the antitrust laws themselves." *Id.* at 505; *see also FTC v. Superior Court Trial Lawyers Ass'n*, 493 U.S. 411, 424-25 (1990).

Fifth, while we agree that patents are important for innovation and that injunctive relief often is appropriate, we do not agree that patents provide an unqualified "property right to exclude" that is accompanied by an injunction and a conclusion that "unilateral patent hold-up" is "per se legal." *Mar. 16 speech*. Hornbook law does not give property owners absolute rights to exclude. There are at least 50 doctrines (such as adverse possession, easements, eminent domain, nuisance, and zoning) that limit property owners' rights. Michael A. Carrier, *Cabining Intellectual Property Through a Property Paradigm*, 54 DUKE L.J. 1 (2004). Landowners, for example, cannot exclude others from entering their land to save lives or property or to avoid some other serious harm.[8] Relatedly, in upholding the inter partes review process for administratively reconsidering patents, the Supreme Court recently held that "[p]atents convey only a specific form of property right—a public franchise." *Oil States Energy Servs. v. Greene's Energy Group*, 2018 WL 1914662, at *8 (U.S. Apr. 24, 2018).

Sixth, the position that patent infringement necessarily results in an injunction is, for good reason, no longer the law. More than a decade ago, the Supreme Court ruled unequivocally that courts must decide whether to grant injunctions "consistent with traditional principles of equity, in patent disputes no less than in other cases." *eBay v. MercExchange*, 547 U.S. 388, 394 (2006); *see also* 35 U.S.C. § 283 (patent statute provides that courts "may grant injunctions in accordance with the principles of equity to prevent the violation of any right secured by patent, on such terms as the court deems reasonable"). In fact, the Federal Circuit, not historically associated with insufficient protection of patent rights, has made clear that the *eBay* framework "provides ample strength and flexibility for addressing the unique aspect of FRAND committed patents and industry standards in general." *Apple v. Motorola*, 757 F.3d 1286, 1332 (Fed. Cir. 2015). Because there could be thousands of patents in a product today, it is not appropriate uniformly to apply standards from the 18th century.

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[7] Relatedly, seeking an injunction against a licensee willing to pay a FRAND rate—such as where LSI sought an exclusion order in the U.S. International Trade Commission before proposing a FRAND license to Realtek, *Realtek Semiconductor v. LSI*, 946 F. Supp. 2d 998, 1007-08 (N.D. Cal. 2013)—can constitute monopolization. Challenging behavior like this is not "hubris" (*Mar. 16 speech*); it is an appropriate application of antitrust.

[8] Analogously, specific performance, which has the same effect in contract law as injunctions do in patent law, is only available in limited, extraordinary, circumstances. *See* 12 *Corbin on Contracts* §§ 63.1, 63.20 (rev. ed. 2012).

Seventh, pointing to exclusive rights granted to patentees as a type of natural property right ignores the uncontroversial utilitarian framework for the patent grant. The Supreme Court has long made clear the primacy of the utilitarian justification. *E.g.*, *Graham v. John Deere*, 383 U.S. 1, 9 (1966). Exclusive rights exist not to bestow upon patentees a moral right to a reward but to promote the best interests of society. That is why patents, like other forms of intellectual property, are subject to doctrines (like novelty, nonobviousness, the written-description and enablement disclosure requirements, and a limited 20-year term) that ensure that protections for market competition balance patents' incentive effects. Relatedly, it tells only half the story to focus on the incentives relevant to the initial invention while ignoring follow-on innovation, which is just as important and may be undermined significantly when patent owners abuse their FRAND obligations.[9] Suggesting (without offering evidence) that any diminished return to patent holders reduces innovation and welfare "is inconsistent with both sound economic analysis and patent law," as "FRAND commitments that reduce excessive royalties further the policies of both the antitrust laws and the patent laws." Melamed & Shapiro, at 9. And it is also inconsistent with the Supreme Court's recent clear reminder (in a 7-2 ruling written by Justice Thomas) that patents "involv[e] public rights." *Oil States*, 2018 WL 1914662, at *6.

Eighth, we do not believe that holding patentees to their promise to license on FRAND terms "amount[s] to a troubling de facto compulsory licensing scheme." *Mar. 16 speech*. Compulsory licensing occurs when the government forces a patentee to license against its wishes. In contrast, here the holder of a standard essential patent voluntarily chooses to license on a FRAND basis, receiving in exchange the SSO's "seal of approval" and the potential for significantly increased volume that comes with that seal, which is well worth the FRAND promise. Unlike other patents, holders of standard essential patents are protected from competition and guaranteed to collect royalties.

We applaud the energy of your leadership of the Division and support the regular reexamination of key antitrust issues. But we do not believe that the case has been made for departing from the bipartisan consensus set out in this letter. Thank you for your consideration of these views.

Sincerely,

Professor Michael A. Carrier*
Rutgers Law School

Professor Timothy J. Muris
Antonin Scalia Law School
Former Chairman, Federal Trade Commission

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[9] A standards organization's rule restricting the owner of a standard essential patent that makes a FRAND commitment from seeking injunctions against willing licensees is an appropriate attempt to enforce the FRAND commitment, not a return to the "DOJ's enforcement policies in the 1970s" (*Mar. 16 speech*) that have rightly been criticized for punishing numerous forms of procompetitive or competitively neutral licensing conduct.

* The letter presents the views of the individual signers. Institutions are listed for identification purposes only.

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Session 5: Report Card for the Patent Trial & Appeals Board

Remarks by Director Andrei Iancu at U.S. Chamber of Commerce Patent Policy Conference

April 11, 2018

U.S. Chamber of Commerce Patent Policy Conference

Director of the U.S. Patent and Trademark Office Andrei Iancu

Keynote Address

"Role of U.S. Patent Policy in Domestic Innovation and Potential Impacts on Investment."

April 11, 2018

As prepared for delivery

Thank you Neil (Bradley) for that generous introduction. Thank you also to the U.S. Chamber of Commerce and its Global Innovation Policy Center for hosting this impressive gathering and inviting me to speak here today.

Dr. Eli Harari, an electrical engineer, always tinkered and invented things. He tells, for example, that he invented a new type of fishing rod, although he never fished.

"Imagine how much more successful you'd be," his wife said, "if you'd invent in a field you knew something about."

And so he did. Dr. Harari is credited with inventing the Electrically Erasable Programmable Read-Only Memory, also known as EEPROM, or "E-squared PROM." This was in the 1970s, when Harari was working at a major corporation, where he was a star. But a few years later, he wanted to be on his own, to invent, to perfect, to commercialize. In his late 30s, he was also married and had a child. So in the prime of his career, with a family at home, Harari left his comfortable life with major corporations.

Seeding it in part with his own money, Harari started a company of his own. And he did not even draw a salary the first several months. He risked everything: his career, his finances, and his family. That first company actually did not work out well, but a few years later, Harari risked it all again and co-founded a new company, which he ultimately called SanDisk.

At SanDisk, Harari built upon his EEPROM technology, added critically important new inventions, and perfected flash memory data storage. And he obtained patents, including on how to turn memory chips into reliable systems. Harari's flash technology came to be used almost universally in devices like digital cameras and cell phones. In 2016, Western Digital acquired SanDisk for $19 billion.

But think about it: without patents, how could someone like Dr. Harari risk everything, put aside his secure career at an established company, and strike it on his own?

As Dr. Harari told me, "The only asset you have is your idea. If you have no way to protect your idea, you are at the mercy of the next bad guy. The U.S. patent system is genius, really the bedrock foundation of capitalism." Harari's sentiment was echoed by President Ronald Reagan, who said in 1982: "Throughout our nation's history, the patent system has played a critically important role in stimulating technological advances."

How true that is.

Yet today, our patent system is at a crossroads. For more than just a few years, our system has been pushed and pulled, poked and prodded. The cumulative result is a system in which the patent grant is less reliable today than it should be. This onslaught has come from all directions. There has been major reform legislation, and proposed legislation. There have been massive changes brought about by major court cases. And the USPTO itself has taken a variety of actions in an effort to implement these changes. Plus, importantly, the rhetoric surrounding the patent system has focused relentlessly on certain faults in, or abuses of, the system—instead of the incredible benefits the system brings to our nation. We see the result of this years-long onslaught in your own study, the U.S. Chamber's 6th Annual International IP Index.

I don't need to tell this audience that the American patent system, which in prior years was deservedly ranked as the number one system in the world, in 2017 fell to number 10. And this year it fell further, tied for number 12. But make no mistake: we are still an elite system, a mere ¼ point away from the systems ranked 2-11. And the United States remains the leader for overall IP rights.

Still, we are at an inflection point with respect to the patent system. As a nation, we cannot continue down the same path if we want to maintain our global economic leadership. And we will not continue down the same path. This administration has a mission to create sustained economic growth, and innovation and IP protection are key goals in support of that mission.

So, how do we reverse the trend? The good news is that reclaiming our patent leadership status is within reach.

For today, let me focus on two principal points:

1. Creating a new pro-innovation, pro-IP dialogue, and
2. Increasing the reliability of the patent grant.

First, we must change the dialogue surrounding patents. Words have meaning. Words impact perception and drive public policy. And for too long, the words surrounding our patent system have been overly-focused on its faults. A successful system cannot be defined by its faults. Rather, a successful system must be defined by its goals, aspirations, and successes. Obviously, errors in the system should be corrected. And no abuse should be tolerated. Errors and abuse should be identified and swiftly eliminated. However, the focus for discussion, and the focus for IP policy, must be on the positive. We must create a new narrative that defines the patent system by the brilliance of inventors, the excitement of invention, and the incredible benefits they bring to society. And it is these benefits that must drive our patent policies.

At my swearing-in, I remarked that through the doors of the U.S. Patent and Trademark Office comes our future. And indeed it does, and it always did. We must celebrate that. From Thomas Edison to the Wright Brothers, from Stanley Cohen and Herbert Boyer to Steve Jobs, American inventors have fueled the imagination of our people for generations. We are a pioneering people who overcome large obstacles in order to realize our dreams and create prosperity. Inventors help make dreams reality, and American invention changes the world. Indeed, with American patents, humans made light, began to fly, treated disease, and enabled instant communications across the globe from tiny devices in our pockets.

And those patents also enabled these inventors to start companies and grow our economy. Our dialogue and policies need to be focused on these amazing achievements, and how we can encourage more of them. Take Walter Hawkins as another example: Hawkins, who in 1942 became the first African American scientist on staff at AT&T's Bell Labs, developed the plastic coating that covers telephone wires, a more versatile, durable and eco-friendly alternative to the lead standard at the time. It was so durable, in fact, and so effective, that Hawkins' invention enabled huge investments to bring affordable phone service across America, including rural areas, and to millions of people in the 20th century.

Inventor stories like Hawkins' and Harari's are those we need to tell.

This is the American patent system. This is the dialogue we need to have. And this should be the focus of our patent policy. This is how we incentivize innovation and growth. But, how exactly do we translate this into a better patent system?

Here's a start: when we write, interpret, and administer patent laws, we must consistently ask ourselves "Are we helping these inventors?" Whether it's an individual tinkering in her garage, or a team at a large corporation, or a laboratory on a university campus, we must ask ourselves "Are we helping them? Are we incentivizing innovation?

And that brings me to my second principal point for today: increasing the reliability of the patent grant. Because that is key to incentivizing innovation. Without reliable patents, inventors like Dr. Eli Harari are less likely to risk it all in order to bring their new concepts to the market.

As I said at my Senate confirmation hearing: "When patent owners and the public have confidence in the patent grant, inventors are encouraged to invent, investments are made, companies grow, jobs are created, science and technology advance." This year's Chamber report explains why our patent system has dropped to number 12: "innovators and creators face a challenging environment for protecting their IP under current U.S. law [...] U.S. patentability standards and patent opposition procedures continue to create uncertainty for rightsholders."

So your report identifies two principal reasons for the increased uncertainty (or lower reliability) of our patents:

1. Patentability Standards, or more specifically, patent subject matter eligibility pursuant to 35 USC Section 101; and
2. Opposition procedures, namely, the post-grant procedures, such as IPR, that were established by the America Invents Act.

Let me address each of these in turn.

First, our current law surrounding patentable subject matter has created a more unpredictable patent landscape that is hurting innovation and, consequently, investment and job creation. Recent cases from the Supreme Court – Mayo, Myriad, and Alice – have inserted standards into our interpretation of the statute that are difficult to follow. Lower courts applying these cases are struggling to issue consistent results. Patent lawyers trying to advise their clients are, in turn, struggling to predict the outcome with respect to certain patents. And examiners at the USPTO must spend increased amounts of time addressing this challenging issue. The current standards are difficult for all: stakeholders, courts, examiners, practitioners, and investors alike.

System-wide, a significant amount of time is being spent trying to figure out where the lines should be drawn, and what's in and what's out. And multiple people looking at the same patent claims often have trouble agreeing on, and predicting, the outcome. Something must be done. To be sure, we must and will apply Supreme Court law faithfully. This does not mean, however, that more cannot be done to increase clarity and predictability. Of course, given our statutory mandate, there is only so much that the USPTO can do. But within that mandate, we will do everything we can. Currently, we're actively looking for ways to simplify the eligibility determination for our examiners through forward-looking guidance. Through our administration of the patent laws, which we are charged to execute, the USPTO can lead, not just react to, every new case the courts issue.

Second, your report also mentions our "patent opposition procedures" as a reason for the increased uncertainty of our patents. This refers primarily to our Inter Partes Review, or the IPR system. This was a creation of the America Invents Act, and since its introduction five and a half years ago, we have now conducted more than 8,000 such proceedings. It's been a very popular proceeding. Opinions on this new system diverge widely. Yet each opinion is passionately held by its supporters. Pointing to the high invalidation rates in IPR proceedings, some hate the new system with vigor, arguing that it's an unfair process that tilts too much in favor of the petitioner.

Others love the system, and think it's the best tool we have to correct errors, eliminate "bad patents," and improve patent quality. Who is right? Well, both arguments have legitimate elements. But I encourage people to reduce the hyperbole and look at the process with fresh eyes, in order to understand its true benefits and true challenges. This is what we are now doing at the USPTO.

Indeed, it's one of our highest priorities. We need to carefully balance rights-holder's and rights challenger's interests. On the one hand, for example, this proceeding can come years after issuance, when the patent owners and the public may both have relied on those rights and made investments accordingly. On the other hand, we do want to execute the statutory mandate and help maintain the quality of patent rights. And – assuming the Supreme Court does not declare it unconstitutional – we do want the IPR system to effectively address invalid claims, but at the same time, we don't want to throw out the baby with the bathwater. The filters need to be appropriately set.

And so, among various other things, we are now examining: how and when we institute proceedings, the standards we employ during the proceedings, and how we conduct the overall proceedings.The goal, with whatever action we take, is to increase predictability of appropriately-scoped claims.

Finally on the predictability front, let me mention something that was not addressed directly in your report. If we want truly reliable rights, we must ensure that we issue appropriately-scoped patent claims from the get-go. In other words, we must also focus on the front end. And since our examiners are first in line, we must ensure that they have the tools they need for a thorough search and examination.

Our examiners already do a fabulous job. And it is not easy, given the state of the law and all the information that needs to be processed and analyzed. To further improve the original examination, a next step would be to increase examiners' ability to find the best prior art during examination. At times, there is a gap between the prior art found during initial examination and the prior art found during litigation. There are many reasons for this, but the main culprits are the ever-accelerating publication and accessibility explosions. These are issues that face every patent office around the world. Indeed, we are ahead of most others on this front. But if we could further narrow this gap in prior art between examination and litigation, then the accuracy of the patent grant – and therefore, its reliability – would increase.

We are focusing on this as well, together with the other issues I've already mentioned.

Overall, addressing these various issues, especially as outlined in your report – from patentable subject matter to a carefully balanced post-grant process – we can return our patent system to a higher level of predictability and stability. Finding the right balance on these issues requires work and a holistic, collaborative approach.

As Neil mentioned in his introduction, I come from the private sector. I've seen our patent system at work from all sides, and I have represented clients from various sectors, of different sizes, and in different postures. I understand that there are a variety of legitimate points of view. We must work together to achieve a careful balance that is most beneficial to the American economy as a whole. In the end, the hallmarks of a well-functioning patent system are the reliability and predictability of quality patents. This is critical for both patent holders and the public. And the benefits of a well-functioning patent system are indeed unmistakable. It enabled inventors like Eli Harari and Walter Hawkins, who exemplify the brilliance of American innovation, to make significant technological advances while also generating remarkable job creation and progress for our nation.

Of his flash memory inventions, Dr. Harari told me, "We really changed the world." And as to how his patents helped him start his company? He said, "With a patent, at a minimum we were able to speak relatively freely under an NDA. And in a small startup, you need partners who can help you accelerate your development and invest in you."

"If you are not protected," he said, "God help you!"

Let me leave you with this: During his first address to Congress in February of last year, President Trump noted that, on our 100th anniversary in 1876, citizens from throughout the country came to Philadelphia to celebrate America's centennial. At that celebration, the country's inventors showed off their wonderful creations. Alexander Graham Bell presented his telephone for the first time. Remington revealed the first typewriter. And Thomas Edison showed an automatic telegraph and an electric pen.

President Trump then asked all of us to imagine the wonders our country could know in America's 250th year. He asked us to think about all the illnesses that could be cured, the distant worlds we could walk on, and the marvels we could achieve if only we could set free the dreams of Americans. That's how I think about intellectual property. As I see it, no dream is too big if we unleash the power of innovation and give our nation's inventors the protections they need to succeed. That's why it's so important that we find the right balance in the IP system. This is something I'm very passionate about, and fully committed to, as I lead the U.S. Patent and Trademark Office.

We have a remarkable patent system, born from our Constitution and steeped in our history. It is a crown jewel, a gold standard. We have a unique opportunity to ensure it meets its full Constitutional mandate to promote innovation and grow our economy.

I look forward to working with all of you in support of that great endeavor. Thank you again for the invitation to participate in this important discussion.

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DETERMINANTS OF PATENT QUALITY: EVIDENCE FROM INTER PARTES REVIEW PROCEEDINGS

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We study the determinants of patent "quality"—the likelihood that an issued patent can survive a post-grant validity challenge. We do so by taking advantage of two recent developments in the United States patent system. First, rather than relying on the relatively small and highly selected set of patents scrutinized by courts, we study the larger and broader set of patents that have been subjected to inter partes review, a recently established administrative procedure for challenging the validity of issued patents. Second, in addition to analyzing characteristics observable on the face of challenged patents, we utilize datasets recently made available by the United States Patent and Trademark Office (USPTO) to gather detailed information about the prosecution and examination of studied patents. We find a significant relationship between validity and a number of characteristics of a patent and its owner, prosecutor, examiner, and prosecution history. For example, patents prosecuted by large law firms, pharmaceutical patents, and patents with more words per claim are significantly more likely to survive inter partes review. On the other hand, patents obtained by small entities, patents assigned to examiners with higher allowance rates, patents with more US patent classes, and patents

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with higher backward citation counts are less likely to survive review. Our results reveal a number of strategies that may help applicants, patent prosecutors, and USPTO management increase the quality of issued patents. Our findings also suggest that inter partes review is, as Congress intended, eliminating patents that appear to be of relatively low quality.

INTRODUCTION

In theory, the patent system allows firms to treat their inventions as liquid assets that can be transferred to others better positioned to use them via a thick secondary market that indirectly matches inventors and implementers.[1] In this way, ideas (like capital) can flow to their highest and best use, guided by the invisible hand of the market. But reality falls short of this ideal. Unlike stocks, bonds, and other securities, there is to date no generally accepted methodology for evaluating patents. Consequently, rather than exhibiting robust liquidity, the market for patents is thin, opaque, and based largely on the value of ex post assertion against independent inventors, rather than ex ante licensing to eager commercializers.[2]

The result is a patent system all too often plagued by strategic behavior. For example, a lack of reliable methods for measuring patent scope and quality contributed to the rise of "patent assertion entities" (PAEs)—patent monetization specialists that are uniquely able to wield various forms of "holdup" power over the parties they sue in order to extract set-

1. *See* Edmund W. Kitch, *Elementary and Persistent Errors in the Economic Analysis of Intellectual Property*, 53 VAND. L. REV. 1727, 1740 (2000) ("[T]he ability of the owners of intellectual property rights to transfer these rights in whole or in part to others is an important feature of the systems . . . [because] rights can easily arise in the hands of persons or firms who are not in the best position to exploit them."); *see also* Amy L. Landers, *Liquid Patents*, 84 DENV. U. L. REV. 199, 211–14 (2006) (describing ways in which the patent system facilitates the transfer of patent rights); Michael Risch, *Patent Portfolios as Securities*, 63 DUKE L.J. 89, 93 (2013) (proposing that patent portfolios be regulated like securities).

2. *See* Brian J. Love et al., *An Empirical Look at the "Brokered" Market for Patents*, 83 MO. L. REV. 359 (2018) (collecting data on patents offered for sale by patent brokers between 2012 and 2016); Mark A. Lemley & Nathan Myhrvold, *How to Make a Patent Market*, 36 HOFSTRA L. REV. 257, 257–59 (2007) (describing problems created by the "blind market" for patents).

tlements that reflect more than the value of the asserted patent.[3] Conversely, the costs inherent in participating in an inefficient market contribute to the fact that many tech companies choose to turn a blind eye to the market entirely, a practice decried by many patentees as "holdout" behavior designed to raise the cost of patent enforcement.[4]

In an attempt to make the market more efficient and thereby reduce holdup and holdout, legal scholars, economists, and business professionals have experimented for years with methodologies for quickly assessing the scope and quality of a given patent or portfolio.[5] But so far, reliable solutions have proven elusive.[6] Indeed, even companies that prosecute large

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3. *See* Andrei Hagiu & David B. Yoffie, *The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-Aggregators*, 27 J. ECON. PERSP. 45, 51 (2013) ("In essence, nonpracticing entities act as arbitrageurs, first acquiring patents, typically from individual inventors or small companies, and then seeking licensing revenues from operating companies through litigation . . . ."). The term "patent assertion entity" is typically defined to encompass all non-practicing patent enforcers, except universities, early stage startups, and IP holding subsidiaries of operating technology companies. *See* Brian J. Love, Assistant Professor of Law, Santa Clara University, Testimony at the Informational Hearing on Patent Assertion Entities Before the California Assembly Select Committee on High Technology (Oct. 30, 2013), http://papers.ssrn.com/sol3/papers.cfm.?abstract_id=2347138 [https://perma.cc/2U4U-FM86]. Because PAEs do not compete with the companies that they sue, they are able to take advantage of several holdup opportunities that are generally not available to operating companies. For example, because PAEs do not sell products that compete with those produced by alleged infringers, they are able to avoid countersuit and thus can generally leverage asymmetric litigation costs against the parties they sue. *See id.* In addition, because PAEs sue to recover monetary damages rather than injunctions to protect market share, they can strategically delay suit until alleged infringers are "locked in" to using the allegedly infringing technology and, thus, cannot easily switch to a non-infringing alternative. *See* Colleen V. Chien, *Holding Up and Holding Out*, 21 MICH. TELECOMM. & TECH. L. REV. 1, 14 (2014) ("By pursuing a patent license ex post, after a product has been created, rather than ex ante, at the time the product is being designed, the patent owner can leverage not only the economic value of the invention, but also the cost of changing the product.").

4. *See* Chien, *supra* note 3, at 20 (defining patent holdout as "the practice of companies ignoring patents and patent demands because the high costs of enforcing patents makes prosecution unlikely").

5. *See, e.g.*, Anne Kelley, *Practicing in the Patent Marketplace*, 78 U. CHI. L. REV. 115, 116–17 (2011) ("[B]oth scholars and practitioners are seeking ways to improve how patents are valued, with scholars often calling for greater disclosure of sale terms to aid in setting market prices and practitioners focusing on refining methods for predicting a patent's value to their own clients.").

6. *See, e.g.*, Kevin G. Rivette et al., *Discovering New Value in Intellectual Property*, HARV. BUS. REV. 54, 66 (Jan.–Feb. 2000) ("[O]ne would be hard-pressed to find a major investment bank that employs even one individual with experience

patent portfolios covering their own technologies are often unable to reliably identify their best patents. Consider, for example, the fact that large tech companies routinely lose multimillion dollar patent suits—even when the patents they assert were previously deemed "essential" to important technology standards.[7] Overall, asserted patents are at least partially invalidated about 40 percent of the time when validity is litigated,[8] and overall patentees win only about one-quarter of patent cases litigated to a decision on the merits.[9]

In addition to vexing patent owners, there is reason to believe that the patent system's failure to reliably produce valid patents has broad implications for the economy and innovation generally. Uncertainty about patent quality generates transaction costs for companies attempting to navigate the patent landscape.[10] In addition to slowing the pace of research and development at existing firms, these costs can deter companies

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in evaluating patent portfolios. . . . [A]s matters stand now, 'due diligence' regarding patent assets is usually more myth than reality."); Markus Reitzig, *Improving Patent Valuations for Management Purposes: Validating New Indicators by Analyzing Application Rationales*, 33 RES. POL'Y 939, 939 (2004) ("[D]espite the diversity of articles from Industrial Organization (IO) or legal scholars on value related issues of intellectual property rights, there is a lack of scientific papers that restructure the knowledge on the evaluation of patent rights from a corporate perspective.").

7. *See* RPX CORP., STANDARD ESSENTIAL PATENTS: HOW DO THEY FARE? (2014), https://www.rpxcorp.com/wp-content/uploads/2014/01/Standard-Essential-Patents-How-Do-They-Fare.pdf [https://perma.cc/6Z8B-TRGM] (finding that plaintiffs like Nokia, Motorola, Samsung, and others successfully enforced standard-essential patents just 12 to 29 percent of the time between 2005 and June 2014).

8. *See* John R. Allison et al., *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1787 (2014) (collecting statistics for all patent cases filed in 2008 and 2009).

9. *Id*. at 1788. *See also* Shawn P. Miller, *Where's the Innovation: An Analysis of the Quantity and Qualities of Anticipated and Obvious Patents*, 18 VA. J.L. & TECH. 1, 6–7 (2013) (estimating that more than one quarter of all granted U.S. patents would be found at least partially anticipated or obvious if litigated).

10. *See* Bronwyn H. Hall & Dietmar Harhoff, *Post-Grant Reviews in the U.S. Patent System: Design Choices and Expected Impact*, 19 BERKELEY TECH. L.J. 989, 992 (2004) ("Low quality patents can create considerable uncertainty among inventors or would-be commercializers of inventions, which in turn can slow either the pace of innovation or investment in the commercialization of new technologies."); Joseph Farrell & Carl Shapiro, *How Strong Are Weak Patents?*, 98 AM. ECON. REV. 1347, 1361 (2008) (presenting an economic model predicting that weak patents can nonetheless command substantial royalty payments and concluding that "[t]here are large social benefits, ex post and, perhaps more importantly, ex ante, of better examining commercially significant patents").

from entering a market in the first place[11] and discourage them from combining complementary technologies to form new ones.[12]

As a result, patent policymakers have long sought guidance on how to design patent office procedures that produce high-quality patents. In 2015, the U.S. Patent and Trademark Office (USPTO) launched a "Patent Quality Initiative" overseen by a newly created "Deputy Commissioner for Patent Quality."[13] Similarly, the European Patent Office (EPO) formed a "Working Party on Patent Quality" in 2017,[14] and the Japanese Patent Office (JPO) released a new "Quality Policy on Patent Examination" in 2014 and published a "Quality Management Manual" for patent examiners in 2016.[15]

Despite intense interest, however, to date there have been relatively few formal studies of patent quality. Among other reasons, both public and private studies of patent quality have been hindered by two methodological obstacles. The first is a paucity of post-grant decisions on patent validity. While thousands of patent suits are filed each year, just a tiny fraction are litigated to a decision on the merits.[16] And, even

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11. *See* Josh Lerner, *Patenting in the Shadow of Competitors*, 38 J.L. & ECON. 463, 489–90 (1995) (finding in a study of 419 biotechnology companies that smaller firms with relatively high litigation costs are less likely to file for patents in technology areas where established competitors with relatively low litigation costs have already been granted patents).

12. *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698 (1998) (arguing that a proliferation of overlapping patent rights to technologies can create an "anticommons" that deters the commercialization of new products).

13. *Patent Quality*, U.S. PATENT & TRADEMARK OFFICE, https://www.uspto.gov/patent/patent-quality (last visited July 27, 2017) [https://perma.cc/8UBX-YL7Z].

14. *Engaging with Users on Patent Quality*, EUROPEAN PATENT OFFICE (Jan. 24, 2017), https://www.epo.org/news-issues/news/2017/20170124.html [https://perma.cc/9SSW-9ZU6].

15. *Quality Management on Patent Examination*, JAPAN PATENT OFFICE, https://www.jpo.go.jp/seido_e/quality_mgt/patent.htm (last visited July 27, 2017) [https://perma.cc/CK4J-ALFS].

16. According to Lex Machina, just 4 percent of patent cases filed between 2000 and 2015 were litigated to a jury verdict, grant of summary judgment, or judgment as a matter of law. Case Resolutions for District Court Patent Cases Filed 2000–2015, LEX MACHINA, INC., https://lexmachina.com/ (search conducted July 27, 2017) [https://perma.cc/ZS4A-JP66]. In a study of all patent cases filed in 2008 and 2009, Allison et al. found just 430 decisions on validity that represented an (at least partial) "win" for either the patentee or a defendant. Allison et al., *supra* note 8, at 1778. Moreover, these decisions likely involved fewer than 430 unique patents. *Id.* (noting that the 949 total decisions studied involved 777

when cases are litigated to a decision on validity, many such decisions address only a subset of the claims or arguments at issue in the case.[17] Many others are later reversed on appeal.[18] Moreover, those that are litigated are highly selected. Indeed, there is reason to believe that the most vulnerable litigated patents are those least likely to be challenged on the merits in court.[19] As a result, prior studies often analyzed relatively small, disparate samples of patents, making their findings hard to generalize.[20]

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unique patents).

17. According to Docket Navigator, only about 28 percent of decided motions for summary judgment of invalidity are granted in full. Document Search for "Motion for Summary Judgment – Patent Invalid," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 1, 2017) [https://perma.cc/YB3V-W23G]. Moreover, motions granted in full will themselves often only relate to a subset of claims at issue in a case.

18. Overall, the Court of Appeals for the Federal Circuit reverses in about 15 percent of appeals, and the rate has historically been much higher for appeals involving a review of claim construction. *See* Ted M. Sichelman, *Myths of (Un)Certainty at the Federal Circuit*, 43 LOY. L.A. L. REV. 1161 (2010); J. Jonas Anderson & Peter S. Menell, *Informal Deference: A Historical, Empirical, and Normative Analysis of Patent Claim Construction*, 108 NW. U. L. REV. 1 (2013); Shawn P. Miller, *"Fuzzy" Software Patent Boundaries and High Claim Construction Reversal Rates*, 17 STAN. TECH. L. REV. 809 (2014). Claim construction is an integral part of adjudicating patent quality as it is generally the first step to both infringement and validity analysis. *See* Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1456 (Fed. Cir. 1998) (en banc).

19. A substantial portion of patent suits filed by non-practicing entities settle quickly, often in a matter of months, for amounts that fall below defendants' expected cost of defense. *See* FED. TRADE COMM'N, PATENT ASSERTION ENTITY ACTIVITY: A FTC STUDY 4–5 (2016), https://www.ftc.gov/reports/patent-assertion-entity-activity-ftc-study [https://perma.cc/HJ66-H3H6] (finding that the majority of patent suits filed by "Litigation PAEs" settled within one year of filing and for less than $300,000, an amount that "approximates the lower bound of early-stage litigation costs of defending a patent infringement suit"). Few defendants would rationally choose to defend such cases on the merits, and thus many patents asserted in such cases are rarely, if ever, subjected to validity challenges in court. *See* Love, *supra* note 3, at 3 ("If . . . the costs of defense . . . are large relative to the value of the patented technology at issue, then the strength of their infringement allegations quickly becomes irrelevant. Tech companies accused of infringing a PAE's patent will be willing to—and, in fact, generally do—settle for amounts that primarily reflect the cost of fighting in court, and not the value of the patent that is allegedly infringed.").

20. *See* John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 194 (1998) (studying all 299 patents that were the subject of a final validity decision reported in the United States Patents Quarterly between 1989 and 1996); Ian M. Cockburn et al., *Are All Patent Examiners Equal? Examiners, Patent Characteristics, and Litigation Outcomes*, *in* PATENTS IN THE KNOWLEDGE-BASED ECONOMY 17, 19 (Wesley M. Cohen & Stephen A. Merrill eds., 2003) (studying "182 patents for which the

The second obstacle is difficulty obtaining detailed information about individual patents. Until recently, U.S. patent-level data were spread across numerous databases, each designed to prevent the automatic collection of information by members of the public.[21] As a result, many prior studies looked only at information that could be collected from the face of studied patents.[22] But doing so prevented researchers from including in their analyses detailed information about patents' prosecution histories, including characteristics of prosecution counsel and the examiners assigned to applications.

In this paper, we take advantage of two recent developments in the U.S. patent system that make it possible to study patent quality more comprehensively than ever before. First, rather than relying on the set of patents scrutinized by courts or juries in recent years, we study the larger set of patents that have been subjected to inter partes review, a recently established administrative procedure for challenging the validity of issued patents. Second, rather than relying solely on characteristics observable on the face of studied patents, we query datasets recently made available by the USPTO to gather detailed information about the prosecution and examination of studied patents.[23] Our study is, we believe, the largest and most comprehensive examination of patent quality conducted to

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Court of Appeals for the Federal Circuit (CAFC) ruled on validity between 1997 and 2000"); Ronald J. Mann & Marian Underweiser, *A New Look at Patent Quality: Relating Patent Prosecution to Validity*, 9 J. EMP. L. STUD. 1, 7 (2012) (studying all 366 patents that were the subject of Federal Circuit invalidity decisions made from 2003 through 2009); Ronald J. Mann, *The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition*, 92 TEX. L. REV. 2149, 2158 (2014) (studying "a data set of 366 patents, which constitute the universe of patents for which the Federal Circuit issued a final decision on validity during the period 2003–2009"); Yutaka Niidome, *The Relation of Patent Description and Examination with Validity: An Empirical Study*, 111 SCIENTOMETRICS 159, 168, 171 (2017) (studying all 267 patents that (1) had an application date between October 2001 and December 2004, (2) were granted before April 2014, and (3) were the subject of a completed validity challenge decided by the JPO's Board of Appeals). *But see* Miller, *supra* note 9, at 16 (studying the population of 980 patents with final validity decisions on the grounds of anticipation and obviousness—the only bases for review in inter partes review—among all lawsuits filed in the eleven years from 2000 through 2010).

21. For example, the USPTO's "Patent Application Information Retrieval" (PAIR) database, https://portal.uspto.gov/pair/PublicPair, periodically requires users to complete a "captcha" to prevent the automatic collection of data about the prosecution of patent applications.

22. *See, e.g.*, studies cited *infra* notes 27–33.

23. *See infra* notes 195–196.

date.

Our multivariate analysis, which controls for almost two-dozen attributes of challenged patents, suggests that among other things:

- Patents owned by patent assertion entities (PAEs) and non-practicing entities (NPEs) are significantly more likely (by about 7 and 5 percent, respectively) to be "instituted" (i.e., found "reasonabl[y] likel[y]" to have at least one invalid claim[24]) when challenged in inter partes review;
- High-tech patents are neither more nor less likely to be instituted, whereas pharmaceutical patents are between 6 and 11 percent less likely to be instituted;
- Patents applied for by "small entities" and patents prosecuted by solo practitioners are each 5 percent more likely to be instituted, whereas patents prosecuted by large law firms are 6 percent less likely to be instituted;
- Patents assigned to more U.S. patent classes (USPCs) are more likely to be instituted, with each additional class associated with a 0.6 percent increase in the chance of institution;
- Patents with more total words per claim and patents with more unique words in claim 1 are both less likely to be instituted, with an increase of one thousand total words per claim or an increase of ten additional words in claim 1 each associated with a 1 percent decrease in the chance of institution;
- Patents with more backward citations (i.e., citations to relevant prior art) and patents with more backward citations added by the examiner are both *more* likely to be instituted, with an additional 10 backward citations associated with a 0.15 percent increase in the chance of institution, and an additional 10 backward citations added by the examiner associated with a 1.8 percent increase in the chance of institution; and
- Patents reviewed by more experienced examiners, patents

24. 35 U.S.C. § 314(a) (2012) ("The Director may not authorize an inter partes review to be instituted unless the Director determines that . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.").

reviewed by examiners with higher allowance rates, and patents reviewed by examiners in art units with higher allowance rates are all more likely to be instituted, with a roughly 2.5 percent increase in the likelihood of institution associated with each additional 1,000 applications assigned to an examiner in his or her career, with each 10 percent increase in an examiner's allowance rate, and with each 10 percent increase in an art unit's allowance rate.

In addition to advancing the literature on patent quality, our findings have importance for ongoing policy debates. As described in detail *infra* in Section II.D.3, the continued existence of administrative patent challenges in the United States is uncertain. In both Congress and the courts, opponents of post-grant administrative review have sought to weaken or altogether eliminate existing procedures. At the core of this policy debate is a dispute about whether, on balance, administrative review of issued patents helps or harms innovation. Our results suggest that inter partes review is, on average, eliminating patents with characteristics traditionally associated with "weakness" and, thus, are consistent with arguments that the procedure is functioning as originally intended.

The paper proceeds as follows: Part I provides a brief review of the existing academic literature on patent value and quality. Part II briefly describes ex ante patent examination and post-grant patent challenges. Part III describes our data collection methodology, and Parts IV and V report our findings and discuss their implications.

I. PATENT "VALUE" AND PATENT "QUALITY"

Patents (unlike the technologies that they cover) have no inherent worth; rather, they entitle their owner to seek redress against an alleged infringer by filing a lawsuit.[25] To successfully litigate a patent infringement claim, a patent owner must

25. *See* Jonathan S. Masur, *The Use and Misuse of Patent Licenses*, 110 NW. U. L. REV. 115, 127 (2015) ("No one would ever license a patent absent the threat of litigation. If a patent holder could not threaten to enforce its patent against a putative licensee in court, the licensee would have no reason to negotiate a license in the first place. Patent licenses are best understood as civil settlements in anticipation of possible litigation.").

prove that the allegedly infringing products or actions fall within the scope of a patent claim and must successfully defend against the accused infringer's inevitable defense that the asserted patent claim fails to satisfy the requirements for patent protection (and, thus, should never have been issued in the first place).[26] In this Part, we summarize existing research regarding the relationship between the observable characteristics of a patent and its value or quality.

A. *Patent Value*

For decades, scholars have studied the relationship between a patent's importance and its observable characteristics. The earliest, and most developed, of these lines of research examines patent citations. This literature focuses on the extent to which a given patent has been cited by subsequent patents, primarily as a metric for the fundamental importance of the disclosed invention to future innovators and innovations.[27] Tallies, types, and patterns of these so-called "forward citations" have been used by academics to measure the relative importance of various kinds of patents (such as those covering software[28] or those filed by universities[29] or lone inventors[30]),

26. The defense of invalidity is raised in virtually every patent suit litigated in the United States. *See* Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1502 (2001) ("Virtually every patent infringement lawsuit includes a claim that the patent is either invalid or unenforceable due to inequitable conduct (or commonly both)."). In other countries, this is not always so. *See* Brian J. Love et al., *Patent Litigation in China: Protecting Rights or the Local Economy?*, 18 VAND. J. ENT. & TECH. L. 713, 736 (2016) (finding that less than 14 percent of invention patents enforced in China between 2006 and 2011 were challenged on validity grounds); Brian J. Love et al., *Patent Assertion Entities in Europe*, *in* PATENT ASSERTION ENTITIES AND COMPETITION POLICY 104, 112 (D. Daniel Sokol ed., 2017) (finding that "fewer than half of German and U.K. patent suits . . . included a validity challenge").

27. *See generally* Bronwyn H. Hall et al., *Market Value and Patent Citations*, 36 RAND J. ECON. 16, 16 (2005) (studying "the usefulness of patent citations as a measure of the 'importance' of a firm's patents, as indicated by the stock market valuation of the firm's intangible stock of knowledge"); ADAM B. JAFFE & MANUEL TRAJTENBERG, PATENTS, CITATIONS, AND INNOVATIONS: A WINDOW ON THE KNOWLEDGE ECONOMY (2002); Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. ECON. 172 (1990).

28. *See* John R. Allison & Ronald J. Mann, *The Disputed Quality of Software Patents*, 85 WASH. U. L. REV. 297, 321 (2007); Josh Lerner et al., *Financial Patent Quality: Finance Patents After* State Street 16 (Harv. Bus. Sch., Working Paper No. 16-068, 2015).

29. *See* Bhaven N. Sampat et al., *Changes in University Patent Quality After*

to identify firms undervalued by the stock market,[31] to track the geographic or institutional flow of knowledge,[32] and even to predict the emergence of new technologies.[33] They have also given rise to numerous analytics firms that mine patent citation data in an attempt to rank or value patents.[34]

That said, citation-based patent rankings have been criticized as well. Commentators have noted many ways in which citation counts are biased and thus difficult to compare over time and across technologies.[35] In fact, there is reason to doubt that citation counts reliably measure what scholars have traditionally assumed that they do. Prior work suggests that technology users and researchers rarely read patents for their technical content.[36] And anecdotes abound of citation-related

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the Bayh–Dole Act: A Re-examination, 21 INT'L J. INDUS. ORG. 1371 (2003).

30. *See* Jasjit Singh & Lee Fleming, *Lone Inventors as Sources of Breakthroughs: Myth or Reality?*, 56 MGMT. SCI. 41 (2010).

31. *See* Mark Hirschey & Vernon J. Richardson, *Are Scientific Indicators of Patent Quality Useful to Investors?*, 11 J. EMP. FIN. 91 (2004); Anthony Breitzman & Patrick Thomas, *Using Patent Citation Analysis to Target/Value M&A Candidates*, 45 RES. TECH. MGMT. 28 (2002).

32. *See* Peter Thompson & Melanie Fox-Kean, *Patent Citations and the Geography of Knowledge Spillovers: A Reassessment*, 95 AM. ECON. REV. 450 (2005); Adam B. Jaffe & Manuel Trajtenberg, *Flows of Knowledge from Universities and Federal Laboratories: Modeling the Flow of Patent Citations over Time and Across Institutional and Geographic Boundaries*, 93 PROC. NAT'L ACAD. SCI. 12671 (1996); Adam B. Jaffe et al., *Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations*, 108 Q.J. ECON. 577 (1993).

33. *See* Peter Erdi et al., *Prediction of Emerging Technologies Based on Analysis of the US Patent Citation Network*, 95 SCIENTOMETRICS 225 (2013); Tugrul U. Daim et al., *Forecasting Emerging Technologies: Use of Bibliometrics and Patent Analysis*, 73 TECH. FORECASTING & SOC. CHANGE 981 (2006).

34. *See, e.g.*, *Quantitative Patent Scoring*, ACCLAIMIP, http://www.acclaimip.com/articles/quantitative-patent-scoring/ (last visited Aug. 10, 2017) [https://perma.cc/LC9K-3C2M]; *Models of Patent Valuation: White Paper*, CPA GLOBAL, https://www.cpaglobal.com/resources/wp_models-of-patent-valuation (last visited Aug. 8, 2018) [https://perma.cc/2PUV-8W5W]; *About PatentVector*, PATENTVECTOR, http://www.patentvector.com/about.php [https://perma.cc/VHR9-4SSV]; *Analytics Tools*, UNIFIED PATENTS, https://www.unifiedpatents.com (last visited Aug. 8, 2018) [https://perma.cc/NXC7-RXXY] ("Compare patent quality using APIX, CITX and BRIX ratings.").

35. *See* Jeffrey M. Kuhn et al., *Patent Citations Reexamined* (June 1, 2018) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2714954 [https://perma.cc/EJ8E-ESD4]; Nicolas van Zeebroeck, *The Puzzle of Patent Value Indicators*, 20 ECON. INNOVATION & NEW TECH. 33, 41 (2011) ("[C]itation counts are difficult to interpret by nature, due to their lack of natural scale . . . [which] makes citation counts difficult to compare across time and industries, where different scales in citation intensity have been observed.").

36. *See* Mark A. Lemley, *Ignoring Patents*, 2008 MICH. ST. L. REV. 19, 21 ("[R]esearchers and companies in component industries simply ignore patents.

gamesmanship by patentees, including to artificially inflate citations of their own patents.[37]

Another, related literature examines the characteristics of patents that their owners' actions reveal to be of relatively high or relatively low private value. Because direct evidence of the value parties place on patent rights is rarely made public,[38] scholars have traditionally studied proxies for value. For example, in one seminal study, Allison et al. compared the characteristics of patents selected for assertion in court to those not chosen.[39] Other scholars have studied instead, or in addition, the characteristics of patents that were and were not renewed by their owners in exchange for payment of periodic

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Virtually everyone does it. They do it at all stages of endeavor."). *But see* Lisa Larrimore Ouellette, *Who Reads Patents?*, 35 NATURE BIOTECH. 421, 421 (2017) (finding in a survey of scientific researchers that "[t]he vast majority of respondents had at least some experience reading patents, and just over half of the patent readers had read more than five patents in the past year").

37. Some companies, for example, frequently cite large numbers of their own prior patents in new applications. In addition, applicants may strategically decide to cite relatively few or many patents for a variety of reasons unrelated to the importance of the patented invention. *See* James H. Richardson, *Are Prior Art Citations Determinative of Patent Approval?: An Empirical Analysis of the Strategy behind Citing Prior Art*, 7 HASTINGS SCI. & TECH. L.J. 25 (2015).

38. *See* Lemley & Mhyrvold, *supra* note 2, at 257 (noting that "[e]ven if [a] patent or ones like it have been licensed dozens of times before, the terms of those licenses, including the price itself, will almost invariably be confidential"); Kelley, *supra* note 5, at 130 n.82 (noting that "[t]he vast majority of IP licenses and technology sales occur on confidential bases" and that "confidentiality is often highly negotiated between the parties"). Nonetheless, some licenses and sales become public when, for example, securities regulations require their disclosure. *See* SEC FORM 8-K, CURRENT REPORT PURSUANT TO SECTION 13 OR 15(D) OF THE SECURITIES EXCHANGE ACT OF 1934, at 4, Item 1.01, http://www.sec.gov/about/forms/form8-k.pdf [https://perma.cc/M7G9-U4L4] (requiring the disclosure of "material definitive agreement[s] not made in the ordinary course of business"); Thomas R. Varner, *An Economic Perspective on Patent Licensing Structure and Provisions*, 46 BUS. ECON. 229, 231 (2011) (studying 1,458 patent licenses and transfers disclosed to the SEC). Others are occasionally admitted into evidence in patent suits. *See* Tejas N. Narechania & Jackson Taylor Kirkland, *An Unsettling Development: The Use of Settlement-Related Evidence for Damages Determinations in Patent Litigation*, 2012 ILL. J.L. TECH. & POL'Y 1, 19–25 (collecting court orders discussing the discoverability and admissibility of licenses).

39. John R. Allison et al., *Valuable Patents*, 92 GEO. L.J. 435 (2004); *see also* Colleen V. Chien, *Predicting Patent Litigation*, 90 TEX. L. REV. 283 (2011); Alan Marco, *The Option Value of Patent Litigation: Theory and Evidence*, 14 REV. FIN. ECON. 323 (2005); Alan C. Marco & Richard D. Miller, *Patent Examination Quality and Litigation: Is There a Link?* (USPTO Econ., Working Paper No. 2017-09, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2995698 [https://perma.cc/SD33-WPN4].

maintenance fees.[40] And, more recently, a small number of studies have been conducted using actual pricing information gleaned from the secondary market for patents.[41]

Though nomenclature is not standardized in these lines of scholarship, we refer herein to the studies described above as studies of patent "value" because they most directly measure the correlation between patent characteristics and a patent's private and/or social value. While this link is rather obvious for maintenance fee payments and market prices, we believe it is also true for citation-based studies. Forward citations have long been viewed in the literature as a metric for measuring a patent's effectiveness at carrying out the patent system's fundamental social goal of publicizing important technical information,[42] and numerous studies have additionally suggested a strong, positive relationship between forward citations and a patent's realized or revealed private value.[43]

B. Patent Quality

In this paper, we study a different metric: the likelihood that a patent will survive a post-grant challenge to its validity. We refer to this as patent "quality."[44] While value and quality

40. *See, e.g.*, James Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, 37 RES. POL'Y 932 (2008); Yi Deng, *Renewal Study of European Patents: A Three-Country Comparison* (S. Methodist Univ., Dep't of Econ., Working Paper No. 0514, 2005), https://ideas.repec.org/p/smu/ecowpa/0514.html [https://perma.cc/3MPR-MFQL]; Dietmar Harhoff et al., *Citation Frequency and the Value of Patented Inventions*, 81 REV. ECON. STAT. 511 (1999); 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).

41. *See* Erik Oliver et al., *Finding the Best Patents—Forward Citation Analysis Still Wins*, IPWATCHDOG (Mar. 24, 2016), http://www.ipwatchdog.com/2016/03/24/finding-best-patents-forward-citation-analysis-still-wins/id=67192/ [https://perma.cc/86JY-L383]; Christina Odasso et al., *Selling Patents at Auction: An Empirical Analysis of Patent Value*, 24 INDUS. & CORP. CHANGE 417 (2014) (studying 535 lots auctioned by Ocean Tomo between 2006 and 2008); K. A. Sneed & D. K. N. Johnson, *Selling Ideas: The Determinants of Patent Value in an Auction Environment*, 39 R&D MGMT. 87, 89 (2008) (studying 121 Ocean Tomo lots resulting in 51 sales).

42. *See, e.g.*, Mann & Underweiser, *supra* note 20, at 3 ("The most advanced literature about patent quality . . . has analyzed the extent to which patents reflect and facilitate the diffusion of knowledge, as evidenced by citations to and in patents.").

43. *See* sources cited *supra* notes 39–41.

44. Here, we follow the lead of Mann and Underweiser. Mann & Underweiser, *supra* note 20, at 4 ("[T]his article conceives of quality as legal

are related, they are nonetheless distinct.

1. Quality vs. Value

The distinction is perhaps easiest to see in the context of social value. A patent's ability to disseminate detailed, groundbreaking, technical information to the public is conceptually unrelated to the validity of its claims. For example, an important disclosure may be accompanied by claims that are overbroad or even irrelevant. Few would doubt that Samuel Morse's patent on the telegraph was highly cited despite the fact that he famously claimed patent rights to "electromagnetism, however developed" for communicating "at any distances"[45]—a scope so broad that it would seemingly cover preexisting forms of communication using fires or lanterns,[46] as well as virtually every after-arising telecommunications technology. In fact, studies of patent citations have revealed that many highly cited patent applications are never issued at all.[47]

The distinction between quality and private value—i.e., value derived from the ability to enforce a patent—is a bit more

validity."); *see also* R. Polk Wagner, *Understanding Patent-Quality Mechanisms*, 157 U. PA. L. REV. 2135, 2138 (2009) ("Patent quality is the capacity of a granted patent to meet (or exceed) the statutory standards of patentability . . . ."); Bronwyn Hall et al., *Prospects for Improving U.S. Patent Quality via Postgrant Opposition*, 4 INNOVATION POL'Y & ECON. 115, 118 (2004) ("Both the economic and legal views suggest that high-quality patents describe an invention that is truly new, rather than an invention that is already in widespread use but not yet patented."). We caution, however, that others have used the term in a variety of contexts. *See* Mann & Underweiser, *supra* note 20, at 2 ("Because the term 'quality' is itself so general, it should not be surprising that different groups of scholars have used the term to examine distinct concepts relevant to their own interests.");. *see also Quality Metrics*, USPTO, https://www.uspto.gov/patent/initiatives/quality-metrics-1#step1 (last visited Dec. 8, 2017) [https://perma.cc/VBM9-MFV9] (including, among other things, metrics related to examination efficiency, grant rate consistency, and "stakeholder" perceptions); Christi J. Guerrini, *Defining Patent Quality*, 82 FORDHAM L. REV. 3091, 3091 (2014) (proposing that "patent quality" be examined "using a methodology applied in the business literature of quality management").

45. *See* O'Reilly v. Morse, 56 U.S. 62 (1854) (invalidating claim 8 of Morse's patent).

46. Light is, after all, part of the electromagnetic spectrum. *Electromagnetic Spectrum*, MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY 401 (11th ed. 2003) (defining the term as "the entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light").

47. *See* van Zeebroeck, *supra* note 35, at 49 (reporting that "one fifth of the most cited applications have never been granted").

nuanced. Because a patentee generally must prove infringement *and* overcome an invalidity defense to win a patent suit, it stands to reason that patent quality is typically an integral component of patent value. But, while it is true that value and quality are theoretically related in this manner, it is less clear how well the two correlate in practice. For one, the "value" of a patent is a function of the value of the technology that it covers.[48] Thus, a low-quality patent that covers high-value technology may well have more "value" than a high-quality patent that covers low-value technology. At best, then, patent value is a noisy proxy for measuring the performance of the patent system.

Further, there is good reason to believe that in recent history, success in patent litigation (and thus patent value) has been influenced more by the breadth of a patent's claims than by the likelihood that those claims could withstand a full-throated validity challenge. For one, patents asserted in court are presumed to be valid,[49] and the validity of their claims must be disproved by the accused infringer with "clear and convincing" evidence.[50] What's more, a significant share of patent suits brought in the last two decades—perhaps even a majority—were filed by patentees with no intention of litigating to a decision on the merits. Each year since 2008, non-practicing entities (NPEs) have filed more than half of all U.S. patent infringement claims.[51] Because NPEs cannot be countersued for infringement and because U.S. courts rarely

48. Mann & Underweiser, *supra* note 20, at 4 ("[A] poorly drafted patent of dubious validity might be worth tens (or hundreds) of millions of dollars if it purports to claim rights to a valuable product (like the Blackberry or Microsoft Word). Conversely, a patent drafted with sterling clarity and undoubted novelty might be worth little or nothing if the product that it describes is unmarketable."); Marco, *supra* note 39, at 324 ("Thus, the value of a patent is a function of the enforceability of the property right, the underlying technology, and the distribution of beliefs about those parameters.").

49. 35 U.S.C. § 282(a) (2012) ("A patent shall be presumed valid. . . . The burden of establishing in-validity of a patent or any claim thereof shall rest on the party asserting such invalidity.").

50. Microsoft Corp. v. i4i Ltd. P'ship, 564 U.S. 91, 95 (2011) ("We consider whether [35 U.S.C.] § 282 requires an invalidity defense to be proved by clear and convincing evidence. We hold that it does.").

51. *See* Shawn P. Miller et al., *Introduction to the Stanford NPE Litigation Dataset*, STAN. L. SCH. (Oct. 23, 2017), https://law.stanford.edu/publications/introduction-to-the-stanford-npe-litigation-dataset/ (last visited Jan. 25, 2018) [https://perma.cc/7DPM-J4NX].

award fees to prevailing parties,[52] nonpracticing patentees are often able to leverage the high cost of patent litigation defense[53] to extract large settlements even in suits asserting patents that are likely invalid. Indeed, the Federal Trade Commission observed in a recent study of the licensing behavior of twenty-two PAEs (with 327 patent-asserting affiliates) that the majority of PAE suits settled quickly, generally within one year, and most often for amounts below the cost of defending the case to even a preliminary ruling on the merits.[54]

The primacy of claim breadth over validity is borne out by the secondary market as well. It has been reported that patent sales and prices are primarily driven by the scope of patent claims, not their validity.[55] For example, patents offered for sale are virtually never circulated to potential buyers along with prior art search reports but *are* frequently accompanied by "evidence of use" documentation suggesting that the patent may be infringed by one or more large tech companies.[56]

If it is true that a credible threat to sue has been, in recent memory, more important than a credible threat of winning, then it is likewise true that metrics of patent value and quality will often point in different directions. After all, broad claims are both more likely to cover an accused product and more likely to cover the prior art.

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52. *See* Thomas F. Cotter & John M. Golden, *Empirical Studies Relating to Patents—Remedies*, *in* RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW (forthcoming 2018) (manuscript at 15–16 & n.71), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2665680 [https://perma.cc/6HT7-QRBS].

53. *See* AIPLA, 2017 REPORT OF THE ECONOMIC SURVEY I-142 (2017) (reporting that the median cost of defending a relatively small patent suit filed by an NPE (i.e., one with less than $1 million at stake) is $500,000).

54. *See* FED. TRADE COMM'N, PATENT ASSERTION ENTITY ACTIVITY 49 (Oct. 2016), https://www.ftc.gov/system/files/documents/reports/patent-assertion-entity-activity-ftc-study/p131203_patent_assertion_entity_activty_an_ftc_study_0.pdf [https://perma.cc/Q5QM-CFXZ] (reporting that lawsuits filed by "Litigation PAEs" generally "settled within a year of filing and . . . for less than $300,000").

55. It is our anecdotal experience that many large, sophisticated patent buyers select patents for purchase almost exclusively on the basis of the technology that they cover and the breadth of their claims.

56. *See* Love et al., *supra* note 2, at 380 (finding that "[p]ackages listed with EOUs were disproportionately likely to sell and, in addition, appear to have sold at a premium").

2. The Importance of Quality

In addition to theoretical and practical distinctions between patent value and quality, there are at least two more reasons why patent quality deserves additional attention from scholars of the patent system. First, studies of patent quality are more likely than studies of patent value to lead to actionable recommendations for improving the patent system. Factors that the literature tells us influence patent value are often outside the control of patent applicants and patent examiners. There is little a patent applicant can do at the time of filing to influence the value of the covered technology or the citation patterns of future inventors. The path of future innovation is notoriously difficult to predict.[57] As a result, studies of patent value are generally unable to make recommendations that patent system stakeholders can operationalize.

On the other hand, many suspected determinants of patent quality are very much within the ex ante control of applicants and examiners.[58] For example, patent prosecutors and examiners have long assumed a link between claim length and validity. This conventional wisdom is embodied in the so-called "pencil" and "hand" tests, which predict that patent claims that either can be covered by a pencil, or cannot be covered by one's hand, are unlikely to be both valid and infringed.[59] If studies like this one can identify where improvements can be made, patent applicants and examiners can likely adjust their procedures or habits to improve the quality of granted patents.

Second, the winds of change are blowing in U.S. patent law. Increasingly, validity is king when it comes to successful patent enforcement. Since the passage of the America Invents

57. *See, e.g.*, THOMAS KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (4th ed. 2012) (conceptualizing the progress of science as one marked by occasional, sudden "paradigm shifts," rather than a linear progression driven by the gradual accumulation of information).

58. For a discussion of ways in which modifications to applicant behavior might be able to improve patent quality, see Stephen Yelderman, *Improving Patent Quality with Applicant Incentives*, 28 HARV. J.L. & TECH. 77 (2014). For a discussion of prior studies documenting variations in the behavior of patent examiners, see Ronald J. Mann, *The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition*, 92 TEX. L. REV. 2149 (2014).

59. *See, e.g.*, *The Hand Test Revisited*, IPCOPY (Nov. 15, 2012), https://ipcopy.wordpress.com/2012/11/15/the-hand-test-revisited/ [https://perma.cc/94CB-6FCH].

Act (AIA),[60] it has become more and more common for asserted patents' validity to be quickly challenged in administrative proceedings before the USPTO's Patent Trial and Appeal Board (PTAB).[61] Today, parties to a patent suit regularly receive at least a preliminary decision on claim validity from the PTAB before incurring the high cost of discovery, not to mention before the court conducts claim construction, rules on summary judgment motions, or holds a trial.[62] Increasingly, this is also true even for patents asserted by PAEs that are willing to settle for relatively small nuisance-value amounts. For example, in 2016, Unified Patents, Inc., (for which one of the authors of this Article works) challenged patents owned by Shipping and Transit, LLC, and Sportbrain Technologies, LLC,[63] that collectively had been asserted in well over two hundred lawsuits that settled on average within one hundred days of filing,[64] likely for relatively small amounts.[65] As a result, validity is more important than ever to the evaluation of patents, and we expect

60. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (codified in various sections of Title 35).

61. *See, e.g.*, Erin Coe, *PTAB's Skyrocketing Petition Rate Starts to Stabilize*, LAW360 (Feb. 11, 2016), https://www.law360.com/articles/756867/ptab-s-skyrocketing-petition-rate-starts-to-stabilize [https://perma.cc/NTP9-6NKR] ("The Patent Trial and Appeal Board took in nearly 1,800 total petitions in 2015 for another record year as defendants in litigation continue to turn to the popular venue to wage validity fights over patents they are accused of infringing . . . .").

62. According to LexMachina.com, the median time to institution decision in an inter partes review is 187 days, Institution Decision Timing for PTAB Trials, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66], while the median time to summary judgment in patent litigation is 663 days, Summary Judgment Timing for District Court Patent Cases, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

63. *See Unified Challenges the Three Most Prolific Patent Trolls of 2016*, UNIFIED PATENTS (July 27, 2016), https://www.unifiedpatents.com/news/2016/7/27/unified-challenges-the-three-most-prolific-patent-trolls-of-2016 [https://perma.cc/83WR-N3CT].

64. Termination Timing for District Court Patent Cases for Party Group Shipping & Transit LLC and Sportbrain Technologies, LLC, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

65. Shipping & Transit, LLC v. Hall Enters., Inc., No. CV 16-06535-AG-AFM, 27 WL 3485782, at *8 (C.D. Cal., July 5, 2017) ("Plaintiff's business model involves filing hundreds of patent infringement lawsuits, mostly against small companies, and leveraging the high cost of litigation to extract settlements for amounts less than $50,000."); Shipping & Transit, LLC v. Lensdiscounters.com, No. 16-80980-CIV, 2017 WL 5300068, at *5 (S.D. Fla., July 11, 2017) (noting in support of a fee award that plaintiff's "demand letter seeks payment of a $45,000 discounted 'license fee'" which is "indicative of a 'nuisance value settlement'").

this importance to increase as an ever-higher percentage of asserted patents are challenged before the PTAB.

3. Existing Studies of Quality

Despite the benefits that can be realized from studying the characteristics of high- and low-quality patents, scholars have paid the topic relatively little attention. Just a handful of existing studies attempt to measure the determinants of patent quality (defined as validity).

In what is probably the most important study of patent quality conducted to date, Mann and Underweiser studied the characteristics of 366 patents that were the subject of validity-related opinions issued by the U.S. Court of Appeals for the Federal Circuit between 2003 and 2009.[66] In a more recent contribution to the literature, Niidome performed a similar analysis for 267 patents challenged in post-grant proceedings conducted by the Japanese Patent Office.[67]

While both studies find a number of statistically significant differences between patents deemed valid and invalid, their small sample sizes cast doubt on their ability to adequately control for confounding factors like technology area and patent age. Perhaps as a result, the two studies' findings are somewhat at odds. For example, while Mann and Underweiser find significance in the number of office actions in a patent's prosecution history, as well as the number of citations that were added by the examiner during that process, Niidome finds no statistical significance in either characteristic.[68] Moreover, while both find significance in the number of technology classifications assigned by the patent office to an application, the effects they observe point in opposite directions.[69] Conflicts like these underscore the need for further research in this area.

In a second quality-related line of investigation, scholars—including Harhoff and Reitzig[70] and Graham et al.[71]—have

66. Mann & Underweiser, *supra* note 20, at 7.

67. Niidome, *supra* note 20, at 168–71.

68. *Compare* Mann & Underweiser, *supra* note 20, at 17, *with* Niidome, *supra* note 20, at 173.

69. *Compare* Mann & Underweiser, *supra* note 20, at 18 (finding that tech class count is a significant positive predictor of validity), *with* Niidome, *supra* note 20, at 175–76 (finding that IPC count is a significant negative predictor of validity).

70. Dietmar Harhoff & Markus Reitzig, *Determinants of Opposition Against*

studied the characteristics of patents challenged in EPO opposition proceedings and U.S. reexaminations. Though such studies benefit from much larger datasets, their relationship to "quality" is tangential at best because they do not incorporate data on actual validity determinations, only decisions to seek such determinations. As both studies readily admit, their findings suggest that challengers (quite rationally) select relatively "valuable" patents to challenge, but offer little in the way of predicting which valuable patents are valid or invalid.[72]

Finally, a third line of relevant scholarship analyzes the prosecution of patent families across multiple patent offices. Both Chien[73] and Lei and Wright[74] have examined the concurrent prosecution of related applications at the USPTO and EPO, with a particular focus on applications granted by the former but denied by the latter. These studies play an important role in benchmarking patent office procedures, but they are not without limitations. Perhaps most importantly, both studies measure quality by reference to ex parte examination rather than inter partes adjudication. Chien, for example, relies on the EPO's reputation as the "gold standard" for high-quality patent examination.[75] Though there is good reason to believe that the EPO does, in fact, provide higher-quality pros-

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EPO Patent Grants: The Case of Biotechnology and Pharmaceuticals, 22 INT'L J. INDUS. ORG. 443 (2004).

71. Stuart J.H. Graham et al., *Patent Quality Control: A Comparison of U.S. Patent Reexaminations and European Patent Oppositions*, *in* PATENTS IN THE KNOWLEDGE-BASED ECONOMY 74 (Wesley M. Cohen & Stephen A. Merrill eds., 2003).

72. Harhoff & Reitzig, *supra* note 70, at 443 ("We show empirically that the likelihood of opposition increases with patent value . . . ."); Graham et al., *supra* note 71, at 108 ("In general, the results from the regressions in columns (1) and (2) confirm the findings by Harhoff and Reitzig (2001) that variables positively correlated with the value of a patent increase the probability that the patent will be subject to opposition.").

73. Colleen V. Chien, *Comparative Patent Quality*, 50 ARIZ. ST. L.J. 71, 85 (2018) (comparing "USPTO and EPO patent application 'twins' filed in both jurisdictions in 2002").

74. Zhen Lei & Brian D. Wright, *Why Weak Patents? Testing the Examiner Ignorance Hypothesis*, 148 J. PUB. ECON. 43, 44 (2017) (studying "a set of US patents with a USPTO filing date between 1990 and 1995, for which applications were also filed in the Europe Patent Office (EPO) . . . [and] us[ing] outcomes from the EPO application process, reflecting not only European laws but also procedures and traditions distinct from those at the USPTO, as indirect indicators of the strength of the related US patents").

75. Chien, *supra* note 73, at 74 ("The . . . EPO . . . has come to be viewed by many as the 'gold standard' in patent quality.").

ecution than the USPTO, there is also good reason to believe that the EPO still routinely issues a large number of patents that would be invalidated if tested by litigants in court. For example, Henkel and Zischka estimate that a whopping 80 percent of German patents would be at least partially invalidated if challenged post grant.[76]

Overall, whether viewed individually or in the aggregate, these studies leave much to be desired. Studies that measure quality most directly and thoroughly suffer from small sample sizes. Conversely, studies with large samples rely on noisy quality metrics and compare only a handful of variables drawn from either the patent or its prosecution history (but not both). In this Article, we aim to assemble all the pieces of this puzzle: a large sample of patents, a reliable measure of quality, and a wide array of variables drawn from the patentee, the patent, and its prosecution history.

II. PATENT EXAMINATION AND POST-GRANT REVIEW

In order to analyze the determinants of patent quality, we must first understand how patents come to be, as well as the mechanisms available for testing their validity after issuance. In this Part we briefly summarize the procedures and policies that govern patent examination and post-grant validity challenges.

A. *Patent Examination*

Unlike most other forms of intellectual property, patent rights do not automatically vest at the moment of invention.[77] Rather, U.S. patent rights exist only when they are granted by the U.S. Patent and Trademark Office.[78] To obtain a patent, an

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76. Joachim Henkel & Hans Zischka, *Why Most Patents are Invalid: Extent, Reasons, and Potential Remedies of Patent Invalidity* 3 (TUM Sch. Mgmt. & Ctr. for Econ. Pol'y Res., Working Paper, June 12, 2015), https://www.tim.wi.tum.de/fileadmin/w00bcy/www/Research/Publications/Henkel/Henkel_Zischka_Patent_Validity.pdf [https://perma.cc/82VE-HQ7T] ("We conclude that around 80% or more of all active German patents are latently invalid, either fully or partially.").

77. *See, e.g.*, MARK A. LEMLEY ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE I-38 to I-41 (2016) (briefly describing each major type of intellectual property right).

78. *Id.* at I-38 ("To obtain a utility patent, an inventor must submit an application to the Patent and Trademark Office . . . .").

inventor must submit an application to the USPTO that includes a "specification" describing the invention and one or more "claims" that define the scope of protection sought.[79] Typically, these materials are prepared by a patent attorney or "agent" representing the applicant.[80] The application is then assigned to a patent "examiner" employed by the USPTO who is tasked with determining whether the application complies with all statutory requirements of patentability,[81] especially the requirement that all claims be novel and non-obvious.[82] If the examiner determines that the claims are overbroad relative to the body of pre-existing research—the "prior art"[83]—or relative to the information disclosed in the specification,[84] the examiner will "reject" the claims. Following a rejection, the applicant may amend the claims or replace them with entirely new versions and return them for a second look.[85] This back-and-forth process of rejections and responses generally plays out multiple times over the course of several years before any claims are issued in the form of an enforceable patent.[86] That

79. *See, e.g.*, ROBERT P. MERGES & JOHN F. DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 28–32 (7th ed. 2017) (listing and describing the parts of a patent document).

80. *See, e.g.*, LEMLEY ET AL., *supra* note 77, at III-13.

81. *See, e.g.*, MERGES & DUFFY, *supra* note 79, at 60–62 (briefly summarizing the patent prosecution process).

82. *See* Quiang Lu et al., *USPTO Patent Prosecution Research Data: Unlocking Office Action Traits* 33 (USPTO Econ. Working Paper No. 2017-10, Nov. 2017), https://patentlyo.com/media/2017/11/USPTO-Patent-Prosecution-Research-Data_Unlocking-Office-Action-Traits-1.pdf [https://perma.cc/CE47-4NEM] (showing that obviousness and lack of novelty are the most frequent grounds for rejection in a sample of more than 4 million USPTO office actions issued between 2008 and 2017).

83. *See* 35 U.S.C. § 102(a)(1) (2012) (denying patent rights for inventions that were "patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention"); 35 U.S.C. § 103 (2012) (denying patent rights "if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains").

84. *See* 35 U.S.C. § 112(a) (2012) (denying patent rights for inventions that lack "a written description of the invention . . . in such full, clear, concise, and exact terms as to enable any person skilled in the art . . . to make and use the same").

85. *See, e.g.*, MERGES & DUFFY, *supra* note 79, at 60–62.

86. On average in recent years, patents have issued about three years after filing. *See* USPTO, TRADITIONAL TOTAL PENDENCY INCLUDING RCES, https://www.uspto.gov/corda/dashboards/patents/kpis/kpiWithRCE.kpixml [https://perma.cc/TGV0

said, applications that are pursued long enough overwhelmingly result in the issuance of at least one patent.[87]

As litigation outcomes attest,[88] examination of patent applications is an imperfect process.[89] To at least some extent, this is a rational choice on the part of patent policymakers.[90] As a practical matter, it is all but impossible for patent examiners to conclusively determine the novelty of the inventions that they examine. For example, doing so would require them to locate and review every relevant pre-existing discovery, no matter where in the world it was made or in what language it was documented.[91] And even if exhaustive examination were possible, it would rarely be cost-effective. About one-half of all issued U.S. patents expire prematurely because their owners fail to pay relatively modest maintenance fees that are due periodically after issue.[92] And whatever the case, history suggests that less than 2 percent of issued patents will ever be enforced

-3E9A] (displaying monthly average pendency for patents issued between October 2015 and December 2017); USPTO, PENDENCY OF PATENT APPLICATIONS, https://developer.uspto.gov/visualization/pendency-patent-applications-2-visuals [https://perma.cc/U8C3-FUR7] (displaying monthly average pendency for patents issued between October 2008 and December 2015).

87. On average, about three-quarters of original U.S. patent applications result in at least one issued patent. Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 101, 102 (2008) (finding in a study of almost ten thousand U.S. patent applications filed in the month of January 2001 that "approximately 75% of all applications result in at least one patent").

88. *See,* Allison et al., *supra* note 8, at 1787.

89. *See*, *e.g.*, Henkel & Zischka, *supra* note 76, at 3.

90. *See* Lemley, *supra* note 26, at 1497 ("Because so few patents are ever asserted against a competitor, it is much cheaper for society to make detailed validity determinations in those few cases than to invest additional resources examining patents that will never be heard from again. In short, the PTO doesn't do a very detailed job of examining patents, but we probably don't want it to.").

91. Under U.S. law, a patent claim lacks novelty if, among other things, the invention it claims was disclosed in any prior art "publication" made anywhere else in the world. *See* 35 U.S.C. § 102 (2012). Courts have also broadly defined the concept of "publication" to include documents available in public libraries and even presentations made at conferences. *In re* Klopfenstein, 380 F.3d 1345, 1350–52 (Fed. Cir. 2004) (holding that a slide presentation on a poster presented at a conference may constitute an invalidating "printed publication"). Thus, for example, a U.S. patent claim can be invalidated by a single copy of a doctoral thesis that was written in German and is available only in a German library. *In re* Hall, 781 F.2d 897 (Fed. Cir. 1986).

92. *See, e.g.*, Dennis Crouch, *Maintenance Fees 2015*, PATENTLY-O (July 21, 2015), http://patentlyo.com/patent/2015/07/maintenance-fees-2015.html [https://perma.cc/5SNJ-2TAS] (showing that only 40 to 50 percent of patentees elect to take advantage of the full patent term by making all three maintenance fee payments required by the USPTO).

in court.[93]

B. High Costs from Low-Quality Patents

Since any given patent is likely to languish in obscurity until expiration, the USPTO's decision not to conduct scorched-earth examination is a rational one. That said, there is good reason to believe that patent examination is presently conducted in a manner that is too cost conscious.[94] U.S. patent examiners, for example, work under a quota system that requires them to review applications quickly,[95] devoting on average less than twenty hours total per application.[96] Moreover, studies find that examiners largely limit their search for prior art to indexed databases of published patents, often thereby ignoring the academic literature, books, and other sources published exclusively online.[97]

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93. *See, e.g.*, Lemley, *supra* note 26, at 1502 ("[I]t is reasonable to estimate that at most only about two percent of all patents are ever litigated, and less than two-tenths of one percent of all issued patents actually go to court.").

94. *See, e.g.*, Lei & Wright, *supra* note 74, at 43 ("Among lawyers, economists, policy makers and businessmen there is a widespread belief that patent examiners at the United States Patent Office (USPTO) have allowed the grant of too many patents that do not satisfy the statutory criteria for allowance. Such 'weak patents' impose social costs associated with increased uncertainty and abusive litigation without commensurate social benefits associated with increased innovation incentives.").

95. *See, e.g.*, Michael D. Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents? Evidence from Micro-Level Application Data*, 99 REV. ECON. & STATS. 550, 552 (2016) (explaining that the USPTO's time-per-application expectation "depends on both the technological field in which the examiner is working and her position in the general schedule (GS) pay scale").

96. *See id.* ("On average, a U.S. patent examiner spends only nineteen hours reviewing an application: reading the application, searching for prior art, comparing the prior art with the application, writing a rejection, responding to the patent applicant's arguments, and often conducting an interview with the applicant's attorney." (internal citation omitted)); *see also* Lemley, *supra* note 26, at 1500 (estimating eighteen hours of examiner time per application); FED. TRADE COMM'N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY, Ch. 5, at 5 (Oct. 2003), https://www.ftc.gov/reports/promote-innovation-proper-balance-competition-patent-law-policy [https://perma.cc/PAZ3-JR4Q] (collecting estimates, including "24.9 hours at the outside, but often half that; 21 hours; 20 to 25 hours; 18 hours; 8-18 hours; and more than 11-12, but 'not a lot of hours' to read and understand the application, search for prior art, evaluate patentability, communicate with the applicant, work out necessary revisions, and reach and write up conclusions").

97. *See* Christopher A. Cotropia et al., *Do Applicant Patent Citations Matter?*, 42 RES. POL'Y 844, 844 (2013) (finding "patent examiners rarely use applicant-

The result, many contend, is a proliferation of low-quality patents that impose large costs on innovators and, on balance, act to slow rather than spur the overall pace of innovation.[98] One reason for this concern is the possibility that the issuance of low-quality patents will beget even more low-quality patents, and so on in a vicious cycle.[99] This may happen for at least two reasons: First, patenting firms may feel compelled to seek more patent protection in response to a perceived decline in patent quality in order to raise the odds that their inventions are adequately protected.[100] Second, an increase in patent filing rates may, in turn, increase strain on already-overburdened examiners, inducing them to spread limited examination resources thinner still and, as a consequence, issue patents of even lower quality.[101]

Regardless of their *raison d'etre*, patents of questionable validity can impose significant costs on actors in the world of innovation who, in the absence of relatively inexpensive methods for testing patent validity, may often find it rational to license patents that, if challenged, would be invalidated with high probability.[102] Other times, researchers may decide not to use the patented technology at all.[103] In addition to slowing the pace of research and development for existing incumbents,

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submitted art in their rejections to narrow patents, relying almost exclusively on prior art they find themselves").

98. *See* sources cited *supra* notes 10–12.

99. *See* Hall & Harhoff, *supra* note 10, at 993–94 ("The issuance of low quality patents is also likely to spur significant increases in patent applications, further straining the already overburdened examination processes of the USPTO. A vicious circle may result, in which cursory examinations of patent applications result in the issue of low quality patents, which triggers rapid growth in applications, further taxing the limited resources of the USPTO, further limiting the examination of individual applications, and further degrading the quality of patents.").

100. *See id.* at 993 ("[T]he issue of a large number of low quality patents will increase uncertainty among inventors concerning the level of protection enjoyed by these related inventions . . . .").

101. *See id.* at 993–94.

102. *See id.* at 993 ("[R]esolution of the non-producer's claims is clearly more costly when the validity and breadth of the asserted patent can only be determined via expensive litigation. In that instance, paying licensing fees may be cheaper than going to court, even if the patent in question is viewed as low quality by the accused infringer.").

103. *See id.* ("If . . . previous technical advances are covered by patents of dubious validity or uncertain breadth, the costs to inventors of pursuing the inventions that rely on them may be so high as to discourage such cumulative invention.").

inefficiencies like these can quash entirely new endeavors. A bulwark of accumulated low-quality patents can both deter entrepreneurs from entering a market in the first place[104] and discourage the combination of complementary technologies to produce new goods or services.[105]

C. *Post-Grant Validity Challenges*

To mitigate the costs of imperfect examination, patent systems generally allow the public to challenge the validity of granted patent claims. Most often, these post-grant challenges are made by companies that have been sued for patent infringement because accused infringers can, and generally do, argue that the asserted patent is "invalid" and, thus, never should have been granted. In the United States, the defense of invalidity is pled in virtually every patent suit, and defendants are successful in at least partially invalidating an asserted patent about 40 percent of the time when validity is litigated to a decision on the merits.[106]

However, despite the relatively high rate of success, validity decisions are rare in court cases. In a study of more than five thousand patent suits filed in 2008 and 2009, Allison et al. found just 430 decisions concerning the validity of asserted patents.[107] One reason for the dearth of rulings is the simple fact that litigation is expensive, and defending patent suits is among its most expensive forms. According to a recent survey conducted by the American Intellectual Property Law Association, the cost of defending a U.S. patent suit to the point where a ruling on the merits might be possible generally exceeds $250,000, even for cases with less than $1 million in potential damages at stake.[108] Accordingly, many accused infringers rationally choose to settle cases enforcing likely invalid patents simply to avoid the high cost of defense, particularly in countries like the United States where attorney's fee

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104. *See* Lerner, *supra* note 11, at 489–90.
105. *See* Heller & Eisenberg, *supra* note 12.
106. Allison et al., *supra* note 8, at 1787.
107. *Id.*
108. *See* AIPLA, *supra* note 53, at I-118 (reporting a median cost of $250,000 (and an average of $306,000) for litigating a patent case with less than $1 million at stake through discovery and claim construction).

awards are rare.[109] This fact makes it possible for unscrupulous patentees to enforce weak patents in order to extract nuisance-value settlements from companies active in the product market,[110] a practice sometimes referred to as patent "trolling."

In addition, even in the context of good-faith patent assertion, an individual defendant has suboptimal incentives to challenge the validity of the asserted patent because it will bear the full cost of defense but share the benefit of invalidation with all its competitors.[111] In fact, there is good reason to believe that defendants sometimes tacitly collude with patent enforcers to buttress the subsequent assertion of the same patent against the defendants' competitors.[112]

One way to increase the likelihood that invalid patents will be eliminated post-grant is to establish alternative mechanisms for testing the validity of issued patents that are less expensive and more broadly available than judicial challenges. One alternative available today in many nations is some form of administrative patent review undertaken by the country's patent office. In the United States, issued patents can be challenged in court or in one of a variety of "post-grant proceedings," and in some countries like China and Germany, administrative review is the exclusive means for challenging the validity of issued patents.[113]

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109. *See* Colleen V. Chien et al., *Enhanced Damages, Litigation Cost Recovery, & Interest*, *in* PATENTS REMEDIES AND COMPLEX PRODUCTS: TOWARD A GLOBAL CONSENSUS 158, 185–91 (Brad Biddle, Jorge L. Contreras, Brian J. Love, & Norman V. Siebrasse, eds., forthcoming) (describing regimes for attorney fee and litigation cost recovery in Europe, Asia, and the United States).

110. *See* FED. TRADE COMM'N, *supra* note 19, at 4–5.

111. *See* Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won't Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L.J. 943, 952 (2004) ("[F]or instance, if there are five infringers of equal size, each gets only a fifth of the gains from a successful challenge because each is paying only a fifth of the patentee's total royalties. Therefore, the patentee has five times more incentive to prevail in litigation than any one challenger has.").

112. It is common for repeat patent enforcers to begin assertion campaigns against relatively small, weak defendants in hopes of obtaining favorable settlements or court victories that will set an initial "market price" for a license moving forward. *See* Brian J. Love & James C. Yoon, *Expanding Patent Law's Customer Suit Exception*, 93 B.U. L. REV. 1605, 1635 (2013). Initial defendants are often complicit in this process and, for example, may willingly settle for an artificially high royalty rate applied to an artificially small quantity of sales in hopes that their competitors will later pay the same rate on all their revenue. *See id*.

113. For a summary of the procedures for post-grant challenges available in

In one form or another, post-grant administrative review has been available in the United States since 1981, when a procedure called "ex parte reexamination" was established to allow the public to "petition" the USPTO to cancel one or more claims of an issued patent and re-open the examination process between the USPTO and patentee.[114] A second procedure, dubbed "inter partes reexamination," was added in 1999 to give petitioners the option of participating in the subsequent examination process.[115]

In the years that followed, however, petitions for inter partes reexamination were filed relatively rarely and ex parte reexamination was seldom used successfully to eliminate problematic claims,[116] leading to a widespread perception that neither procedure provided an efficient alternative to defending an infringement suit in court.[117] In 2011, Congress responded by

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Germany and China, see Katrin Cremers et al., *Invalid but Infringed? An Analysis of the Bifurcated Patent Litigation System*, 131 J. ECON. BEHAV. & ORG. 218, 221–22 (2016) (describing Germany's bifurcation of decisions regarding infringement, which are heard by regional courts, and challenges to validity, which are heard by the German Federal Patent Court); Brian J. Love et al., *Patent Litigation in China: Protecting Rights or the Local Economy?*, 18 VAND. J. ENT. & TECH. L. 713, 721–22 (2016) (describing China's bifurcation of decisions regarding infringement, which are typically heard by Intermediate People's Courts, and validity challenges, which are heard by SIPO's Patent Review and Adjudication Board).

114. *See* MPEP § 2209 (9th ed. Rev. Aug. 2017) ("Procedures for reexamination of issued patents began on July 1, 1981, the date when the reexamination provisions of Public Law 96-517 came into effect.").

115. *Id.* § 2609 ("The inter partes reexamination statute and rules permit any third party requester to request . . . inter partes reexamination of a patent which issued from an original application filed on or after November 29, 1999 . . . .").

116. Overall, about 87 percent of patents challenged in ex parte reexamination survived, and two-thirds were re-issued with new claims. USPTO, EX PARTE REEXAMINATION FILING DATA 2 (Sept. 30, 2017) [hereinafter USPTO, EXPARTE REEXAMINATION FILING DATA], https://www.uspto.gov/sites/default/files/documents/ex_parte_historical_stats_roll_up.pdf [https://perma.cc/463H-FKL8]. As a result, ex parte reexamination was often used strategically by patentees to re-write their own issued claims before asserting them. *Id.* (reporting that 29 percent of ex parte reexaminations were filed by the challenged patent's owner).

117. *See* Brian J. Love & Shawn Ambwani, *Inter Partes Review: An Early Look at the Numbers*, 81 U. CHI. L. REV. DIALOGUE 93, 95 (2014) ("Though originally developed to serve as a cost-effective alternative to full-blown litigation, reexaminations rarely realized that goal. Rather, reexamination developed a well-deserved reputation for lengthy delays, a lack of decisive results, and a permissiveness for claim amendments that led some in the patent bar to view reexamination more as a vehicle for patentees to strengthen their patent rights post hoc than as a tool for possible infringers to quickly and cheaply eliminate invalid claims without resorting to litigation.").

passing legislation overhauling the USPTO's system for post-grant review. While ex parte reexamination was left unchanged, the America Invents Act (AIA) replaced inter partes reexamination with a suite of three new procedures for the administrative review of issued patent claims.[118]

D. Inter Partes Review

Principal among the new procedures is inter partes review (IPR), which has proven to be far more popular than both its predecessors and contemporaries. Since it became available in September 2012, parties have filed almost 6,500 petitions for IPR, a figure that exceeds the total number of patent cases filed in all but one district court during the same period of time,[119] as well as the total number of petitions for inter partes reexamination that were filed during the thirteen years that the process was available.[120] Relatively speaking, the two other new forms of administrative challenge created by the AIA—"post-grant review" (PGR) and "covered business method patent" (CBM) review—have been used infrequently, due in large measure to greater restrictions on their availability. Post-grant reviews must be filed within nine months of a patents' issuance[121] and are applicable only to patents with priority dates

118. Pub. L. No. 112-29, 125 Stat. 284 (2011) (codified at 28 U.S.C. § 1454; 35 U.S.C. §§ 123, 257, 298–99, 321–29 (2012)).

119. According to LexMachina.com, 8,414 patent suits were filed in the U.S. District Court for the Eastern District of Texas between September 16, 2012 and the end of 2017. Courts Summary for District Court Patent Cases Filed Sept. 16, 2012–Dec. 31, 2017, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66]. The next most popular district, the District of Delaware, saw just 4,506 patent suits during the same period. *Id.*

120. A total of 1,919 petitions for inter partes reexamination were filed between 1999 and 2012, an average of fewer than 13 per month. USPTO, INTER PARTES REEXAMINATION FILING DATA (Sept. 30, 2017) [hereinafter USPTO, INTER PARTES REEXAMINATION FILING DATA], https://www.uspto.gov/sites/default/files/documents/inter_parte_historical_stats_roll_up.pdf [https://perma.cc/L827-PUTC]. Less than 14,000 petitions for ex parte reexamination have been filed since 1981, an average of about 32 per month. USPTO, EXPARTE REEXAMINATION FILING DATA, *supra* note 116. In recent years, petitions for review by the PTAB have been filed at a rate of approximately 150 per month. *See, e.g.*, *2017 Patent Dispute Report: Year in Review*, UNIFIED PATENTS, INC. (Dec. 30, 2017), https://www.unifiedpatents.com/news/2017/12/26/2017-patent-dispute-report-year-in-review [https://perma.cc/EC3M-XPKW] (reporting that an average of 449 petitions per quarter were filed in 2017).

121. 35 U.S.C. § 321(c) (2012) ("A petition for a post-grant review may only be

on or after March 16, 2013. To date, fewer than one hundred PGRs have been filed.[122] Covered business method patent reviews, as their name suggests, apply only to patents that claim a "business method"—that is, "a method or corresponding apparatus for performing data processing or other operations used in the practice, administration, or management of a financial product or service"[123]—and must be filed by a party with standing to challenge the patent in court.[124] About five hundred petitions for CBM review have been filed to date, and the pace of filings is falling.[125] IPRs, by contrast, may be filed against any patent that is more than nine months old and may be filed by any party, whether or not they have been sued or threatened with suit.[126]

Compared to its predecessors, IPR proceeds much more quickly and ends with greater finality. Unlike reexaminations, which merely initiated yet another opened-ended examination of the challenged claims by USPTO examiners, IPRs take place on a tight schedule and are decided by Administrative Patent Judges (APJs) sitting on the Patent Trial and Appeal Board (PTAB). The AIA mandates that the PTAB must decide whether to grant—or "institute"—a petition within six months of filing,[127] and if a petition is instituted the PTAB must issue a final decision on the patentability of the challenged claims within one year of the institution decision.[128] The result is a decision that is not only much faster than inter partes

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filed not later than the date that is 9 months after the date of the grant of the patent . . . .").

122. Case Search for Type of Pleading "Petition for Post Grant Review," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 1, 2017) [https://perma.cc/YB3V-W23G].

123. 37 C.F.R. § 42.301(a) (2017).

124. *Id.* § 42.302(a) (2017) ("A petitioner may not file with the Office a petition to institute a covered business method patent review of the patent unless the petitioner . . . has been sued for infringement of the patent or . . . . a real and substantial controversy regarding infringement of a covered business method patent exists such that the petitioner would have standing to bring a declaratory judgment action in Federal court.").

125. Case Search for Type of Pleading "Petition for Covered Business Method," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 1, 2017) [https://perma.cc/YB3V-W23G].

126. *See, e.g.*, USPTO, MAJOR DIFFERENCES BETWEEN IPR, PGR, AND CBM, https://www.uspto.gov/sites/default/files/ip/boards/bpai/aia_trial_comparison_chart.pptx [https://perma.cc/QK37-RJ63].

127. 35 U.S.C. § 314(b) (2012).

128. *Id.* § 316(a)(11) (2012).

reexamination, which had a median time to termination of about three years,[129] but also far faster than is typically possible in court, where trials take place on average well over two years after the filing of an infringement complaint.[130]

Compared to reexamination, IPRs also offer petitioners a higher likelihood of finality. Patentees facing reexamination were permitted to amend their claims as a matter of course, and as a result, the most common outcome of a reexamination was the issuance of a new set of amended claims that could be asserted against the petitioner.[131] Though claim amendments are technically permitted in IPRs, to date the PTAB has denied all but a handful of motions to amend.[132] Moreover, when petitions for IPR are litigated to a decision on the merits, the PTAB has frequently elected to review and cancel all challenged claims, leaving nothing behind for the patentee to subsequently assert.[133] On the flip side, when claims are upheld, patentees also benefit from a broad estoppel provision that prevents challengers from raising the same invalidity arguments again in court.[134] As a result, IPR often operates as a one-time "up or down" vote on the validity of challenged claims.

1. Procedural Overview

IPR includes a first round of briefing and a decision from the Board on whether to institute the petition, followed by a second round of briefing, a hearing, and finally a decision from the Board on the patentability of challenged claims. First, a

129. USPTO, INTER PARTES REEXAMINATION FILING DATA, *supra* note 120.

130. According to LexMachina.com, the median time-to-trial for patent cases filed between 2000 and 2016 is 821 days. Trial Timing for District Court Patent Cases Filed 2000-2016, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

131. USPTO, INTER PARTES REEXAMINATION FILING DATA, *supra* note 120; USPTO, EX PARTE REEXAMINATION FILING DATA, *supra* note 116.

132. Trial Resolutions for PTAB Trials, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

133. *See Analytics: Cases by Status and Phase*, UNIFIED PATENTS, INC., https://portal.unifiedpatents.com/ptab/analytics/case-level/by-status-and-phase (last visited Jan. 13, 2018) [https://perma.cc/HDG2-PRW5].

134. 35 U.S.C. § 315(e)(2) (2012) ("The petitioner in an inter partes review of a claim in a patent . . . that results in a final written decision . . . may not assert either in a civil action . . . that the claim is invalid on any ground that the petitioner raised or reasonably could have raised during that inter partes review.").

party wishing to challenge a patent must file a petition that establishes a "reasonable likelihood" of invalidating at least one of the patent's claims.[135] As with reexamination, petitions are limited to arguments that the patent is invalid for lack of novelty, or as obvious in light of prior patents or other "printed publications."[136] Once a petition is filed, the owner of the challenged patent is given three months to prepare and file a "preliminary response," but the patentee is not required to do so.[137]

The patent owner is free to end the review at any time by unilaterally canceling its challenged (or, later, instituted) claims. Likewise, the parties are also free to settle on confidential terms at any time,[138] and to date about one-third of IPRs have concluded with a settlement.[139] The PTAB has discretion to proceed with its determination of validity despite a settlement, but in practice, it has done so very rarely.[140]

By statute, the PTAB must issue a decision within six months of the petition's filing as to whether the petitioner has shown a reasonable likelihood of success.[141] If the petitioner has met that burden for at least one challenged claim, the review is considered instituted and continues.[142] Institution decisions are final and nonappealable.[143]

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135. 35 U.S.C. § 314(a) (2012) ("The Director may not authorize an inter partes review to be instituted unless the Director determines that . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition."); 37 C.F.R. § 42.108(c) (2017).

136. 35 U.S.C. § 311(b) (2012) ("A petitioner in an inter partes review may request to cancel as unpatentable 1 or more claims of a patent only on a ground that could be raised under section 102 or 103 and only on the basis of prior art consisting of patents or printed publications.").

137. 35 U.S.C. § 313 (2012); 37 C.F.R. § 42.107 (2017).

138. 35 U.S.C. § 317 (2012); 37 C.F.R. § 42.74 (2017).

139. *Analytics: Cases by Status and Phase*, *supra* note 133.

140. *See* Stephen Kenney, *When Joint Settlement Agreements Do Not Settle*, PTAB BLOG (Oct. 20, 2015), http://www.ptab-blog.com/2015/10/20/when-joint-settlement-agreements-do-not-settle/ [https://perma.cc/C4K7-KLBM] ("Under 37 CFR 42.74, parties to a trial before the Patent Trial and Appeal Board (PTAB) may mutually agree to terminate the proceeding. However, the PTAB is not a party to the settlement and . . . in select instances the PTAB has elected to continue the proceeding despite a joint motion to terminate by the Parties.").

141. 35 U.S.C. § 314(b) (2012); 37 C.F.R. §42.107(b) (2017).

142. *See infra* note 146. Prior to *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), the PTAB would proceed to a final written decision only with respect to those claims that it deemed likely invalid at the institution stage. Today, the PTAB must issue "a final written decision addressing all of the claims . . . challenged" in the petition. *Id.* at 1359.

143. *See* 35 U.S.C. § 314(d) (2012) ("The determination by the Director [of the

At this point, if the challenged patent has been asserted in court, it is common for the petitioner to request that litigation be stayed pending the review's final outcome.[144] District courts have broad discretion to stay the cases before them in the interests of efficiency, including to await the resolution of independent proceedings, like IPRs.[145] Post-institution, courts are generally receptive to such motions and grant them roughly 80 percent of the time, though grant rates vary significantly from district to district.[146] Some courts are additionally receptive to motions to stay suits filed against other accused infringers in addition to the suit filed against the successful petitioner.[147] To similar effect, in situations where an instituted patent has been asserted against numerous parties, it is also common for other defendants to file copy-cat petitions that substantially crib from the one that was just instituted.[148]

Patent Office] whether to institute an inter partes review under this section shall be final and non-appealable."); Cuozzo Speed Techs., LLC v. Lee, 136 S. Ct. 2131, 2136 (2016) (holding that section 314 "may not bar consideration of a constitutional question" but nonetheless "does bar judicial review of the kind of mine-run claim at issue here, involving the Patent Office's decision to institute inter partes review").

144. According to Docket Navigator, to date, courts have decided over 1,650 motions to stay pending inter partes review. Document Search for "Motion to Stay Pending Inter Partes Review," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 28, 2018) [https://perma.cc/YB3V-W23G].

145. *See, e.g.*, Landis v. N. Am. Co., 299 U.S. 248, 254–55 (1936) ("[T]he power to stay proceedings is incidental to the power inherent in every court to control the disposition of the causes on its docket with economy of time and effort for itself, for counsel, and for litigants. How this can best be done calls for the exercise of judgment, which must weigh competing interests and maintain an even balance.").

146. In cases between the same parties to the IPR, grant rates are especially high when motions are filed after the IPR is instituted. *See* Love & Ambwani, *supra* note 117, at 103 ("Of patent suits proceeding in parallel with an instituted IPR between the same parties, a motion to stay was filed in over 76 percent. Overall, these cases were stayed (at least in part) 82 percent of the time, though rates varied considerably across districts."). Overall, including motions filed by other parties in other cases, as well as motions filed by the petitioner pre-institution, the grant rate is a bit more modest. DocketNavigator.com reports an overall grant rate of about 69 percent for motions to stay pending inter partes review.

147. *See* Brian J. Love, *Inter Partes Review as a Shield for Technology Purchasers: A Response to Gaia Bernstein's* The Rise of the End-User in Patent Litigation, 56 B.C. L. REV. 1075, 1089–90 (2015) (explaining that "manufacturers [have been] relatively successful in leveraging the IPR process to halt litigation filed against their customers" and providing examples).

148. *See, e.g.*, *IPRs: Balancing Effectiveness vs. Cost*, RPX (June 17, 2016), https://www.rpxcorp.com/2016/06/17/iprs-balancing-effectiveness-vs-cost/ [https://

Overwhelmingly, these "me too" petitions are quickly instituted and joined to the original.[149]

Again by statute, the PTAB must issue a final written decision within one year of the institution decision and, thus, within a total of eighteen months from the date of petition.[150] By contrast, a litigant is unlikely to get a substantive ruling on validity from a court for several additional months,[151] and often not until much, much later. Immediately following institution, the patent owner is allotted three months to conduct discovery and file a post-institution response to the petition and a motion to amend.[152] Afterwards, the petitioner is given three months to conduct its own discovery and file a reply.[153] Finally, the patent owner may conduct one more month of discovery and file a sur-reply of its own.[154]

The petitioner may also file a motion to amend the challenged claims at the time of its response.[155] However, unlike in reexamination where amendments were permitted as a matter of course, motions to amend in inter partes reviews have been granted only a handful of times[156] and, for all practical purposes, are de facto prohibited.

IPRs culminate in oral hearings held before a panel of

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perma.cc/8UEE-X7G2] (noting that "some petitioners use a 'copycat' strategy, filing a petition that lifts the arguments from an existing IPR that the new petitioner then seeks to join").

149. According to DocketNavigator.com, the PTAB has granted over 80 percent of motions for joinder or consolidation of challenges. Document Search for "PTAB Motion to Consolidate, OR PTAB Motion for Joinder," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 28, 2018) [https://perma.cc/YB3V-W23G].

150. *See* sources cited *supra* notes 127–128.

151. According to LexMachina.com, the median time to summary judgement in patent cases filed since 2000 is about 660 days. Summary Judgment Timing for District Court Patent Cases, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

152. 37 C.F.R. § 42.120 (2017).

153. *See, e.g.*, USPTO, TRIALS, https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials (last visited Jan. 22, 2018) [https://perma.cc/FGX5-YWWR] (showing a timeline of PTAB trial deadlines).

154. *Id.*

155. 37 C.F.R. § 42.121 (2017).

156. *See* USPTO, PATENT TRIAL AND APPEAL BOARD MOTION TO AMEND STUDY 4–6 (2017), https://www.uspto.gov/sites/default/files/documents/PTAB%20MTA%20Study%20%203%20%20update%20through%2020170930.pdf [https://perma.cc/WM7W-NUVB] (reporting that as of September 30, 2017 motions to amend were filed in just 8 percent of all PTAB challenges and that only fourteen total motions to amended have been granted in whole or in part).

three APJs. Though often called "trials," these hearings do not include live testimony and share much more in common with appellate arguments than trials. Sometime after the hearing—typically just before the statutory deadline—the panel will issue a final written decision on the validity of the instituted claims.[157] Final written decisions may be appealed to the U.S. Court of Appeals for the Federal Circuit,[158] but appeals from the PTAB are reviewed with deference to the Board's decisions and are affirmed across the board at very high rates (about three-quarters of the time to date).[159]

If any instituted claims survive review, the petitioner is thereafter estopped from challenging them again in court on grounds that the petitioner raised "or reasonably could have raised" in the IPR.[160] Though written in broad terms, the IPR estoppel provision does not completely prohibit unsuccessful petitioners from challenging the validity of surviving claims in subsequent litigation. For one, estoppel applies only to arguments based on evidence that is admissible in an IPR—that is, prior art publications.[161] Thus, a petitioner may still argue in court that surviving patent claims lack novelty or are obvious in light of prior public sales or uses rather than publications. In addition, an unsuccessful petitioner may raise in court a number of other bases for invalidity, including failure to satisfy the "utility," "written description," or "enablement" requirements.[162] Nonetheless, due to the effect of estoppel, petitioners that fear (or are currently facing) assertion of the challenged patent in court have a strong incentive to take their best shot

157. According to LexMachina.com, the median time to final written decision is 545 days. Final Decision Timing for PTAB Trials, LEX MACHINA, INC., https://lexmachina.com/ (search conducted Aug. 28, 2018) [https://perma.cc/ZS4A-JP66].

158. 35 U.S.C. § 319 (2012).

159. According to DocketNavigator.com, appeals of PTAB decisions have been affirmed about 86 percent of the time. Document Search for "CAFC Opinion and Judgment on IPR/CBM Decision," DOCKET NAVIGATOR, INC., https://www.docketnavigator.com/ (search conducted Aug. 28, 2018) [https://perma.cc/YB3V-W23G].

160. 35 U.S.C. § 315(e)(2) (2012) ("The petitioner in an inter partes review . . . that results in a final written decision . . . may not assert either in a civil . . . or in a proceeding before the International Trade Commission . . . that the claim is invalid on any ground that the petitioner raised or reasonably could have raised during that inter partes review.").

161. *Id.* § 311(b) (2012) (limiting petitions to "grounds that could be raised under section 102 or 103 and only on the basis of prior art consisting of patents or printed publications").

162. *Id.*

at invalidating the patent on novelty and non-obviousness grounds before the PTAB.[163]

2. PTAB Proceedings vs. Court Proceedings

Challenging a patent's validity in an IPR has a number of advantages for the challenger relative to a validity challenge heard in court. For one, patent claims can be cancelled in an IPR upon a showing by a mere "preponderance of the evidence" that they lack novelty or are obvious,[164] while patents are presumed to be valid in court proceedings and, thus, must be proven invalid by "clear and convincing evidence."[165] In addition, while patent claims asserted in court are interpreted according to their "ordinary and customary meaning" to a person of ordinary skill in the art,[166] patent claims challenged in IPRs are given their "broadest reasonable construction" when compared to the prior art cited by petitioners.[167] Finally, as discussed above, IPRs in most instances promise faster and cheaper resolution. That said, IPRs are far from cheap in absolute terms. USPTO filing fees alone for an instituted IPR are

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163. Estoppel applies not only to the named petitioner, but also to the "real party in interest" (RPI) behind the petitioner if another entity is actually in control. However, the PTAB has ruled that third parties can file IPRs without estopping their members as long as members do not control which IPRs are filed and how those IPRs are litigated. Unified Patents, Inc. v. Am. Vehicular Scies., LLC, No. IPR2016-00364 (P.T.A.B. June 27, 2016).

164. 35 U.S.C. § 316(e) (2012).

165. *See supra* note 50.

166. *See* Phillips v. AWH Corp., 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) ("[T]he words of a claim are generally given their ordinary and customary meaning. We have made clear, moreover, that the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." (internal quotation marks and citations omitted)).

167. 37 C.F.R. § 42.100(b) (2017) ("A claim in an unexpired patent that will not expire before a final written decision is issued shall be given its broadest reasonable construction in light of the specification of the patent in which it appears."). This advantage may soon go away. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 21221, 21221 (May 9, 2018) (to be codified at 37 C.F.R. pt. 42) [hereinafter Changes to the Claim Construction Standard] ("[T]he Office proposes to replace the broadest reasonable interpretation ('BRI') standard for construing unexpired patent claims and proposed claims in these trial proceedings with a standard that is the same as the standard applied in federal district courts . . . .").

$30,500,[168] and median legal fees required to pursue an IPR to a final written decision are estimated to be about $250,000.[169]

3. Controversy Surrounding PTAB Proceedings

To date, commentary on IPR has primarily focused on the procedure's high claim "kill rate." Numerous studies have documented the relatively high (though declining) rate of institution (79 percent of decisions on the merits),[170] as well as the fact that most IPRs that reach a final determination conclude with the cancellation of all instituted claims (70 percent of final written decisions).[171]

The high rate of claim cancellation in particular has attracted an enormous amount of attention, including fierce criticism from lobbies for patent owners, especially those representing the interests of biotech and pharmaceutical companies. Randall Rader, former Chief Judge of the U.S. Court of Appeals for the Federal Circuit, went as far as describing APJs as "acting as death squads, killing property rights,"[172] and some observers have voiced concerns that IPR may be detrimental to the proper functioning of the patent system and innovation more broadly.[173] Indeed, a bipartisan group of Senators has twice introduced legislation that, if enacted, would make dras-

168. USPTO, FEE SCHEDULE, https://www.uspto.gov/learning-and-resources/fees-and-payment/uspto-fee-schedule#PTAB (last visited Jan. 14, 2018) [https://perma.cc/U7PS-4UKE] (showing a $15,500 "[i]nter partes review request fee" and a $15,000 "[i]nter partes review post-institution fee").

169. AIPLA, *supra* note 53, at I-162.

170. *Analytics: Cases by Status and Phase*, *supra* note 133.

171. *Id.* Overall, about 68 percent of claims that were the subject of an institution decision (on the merits of the petition) have been instituted, and about 82 percent of instituted claims that were the subject of a final written decision were cancelled. *Id.*

172. Tony Dutra, *Rader Regrets CLS Bank Impasse, Comments on Latest Patent Reform Bill*, BLOOMBERG BNA (Oct. 29, 2013), https://www.bna.com/rader-regrets-cls-b17179879919/ [https://perma.cc/458T-DREE].

173. *See, e.g.*, Peter J. Pitts, *'Patent Death Squads' vs. Innovation*, WALL ST. J. (June 10, 2015), https://www.wsj.com/articles/patent-death-squads-vs-innovation-1433978591 [https://perma.cc/S9KT-WGL8] ("The PTAB could devastate innovation-intensive industries."); Alden Abbott et al., *Crippling the Innovation Economy: Regulatory Overreach at the Patent Office*, REG. TRANSPARENCY PROJECT, https://regproject.org/paper/crippling-innovation-economy-regulatory-overreach-patent-office/ (last visited July 21, 2018) [https://perma.cc/QVG2-H3WV] ("The PTAB administrative tribunal is creating unnecessary costs for inventors and companies, and thus it is harming the innovation economy far beyond the harm of the bad patents it was created to remedy.").

tic changes to PTAB practice designed to benefit patent owners.[174] Yet another recently introduced bill would eliminate inter partes review and post-grant review entirely.[175] PTAB procedures have been attacked in the courts as well, where patent owners have argued that various aspects of PTAB practice either exceed congressional authority or are altogether unconstitutional.[176] While these arguments have thus far been largely unsuccessful, additional challenges are sure to follow.[177]

III. DATA COLLECTION AND METHODOLOGY

Rather than focus directly on this long-running debate, however, we take a step back and ask what more than four years' of PTAB decisions can teach us about the determinants of patent validity. As described in greater detail below, we take advantage of IPR's popularity and relatively low settlement rate to compare the characteristics of over 2,500 patents that were the subject of at least one "institution" decision issued by the PTAB between its founding in September 2012 and the end of January 2017. Here, we identify the sources of our data and explain our methodology.

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174. *See* Support Technology and Research for Our Nation's Growth (STRONG) Patents Act, S. 632, 114th Cong. (2015); Support Technology and Research for Our Nation's Growth and Economic Resilience (STRONGER) Patents Act of 2017, S. 1390, 115th Cong. (2017). For a summary of the bills' provisions, see Sen. Chris Coons, *The STRONGER Patents Act of 2017: Section by Section*, U.S. SENATE, https://www.coons.senate.gov/imo/media/doc/STRONGER%20Patents%20Act%20of%202017%20Section-By-Section.pdf [https://perma.cc/K62R-JDHA].

175. Restoring America's Leadership in Innovation Act of 2018, H.R. 6264, 115th Cong. (2018).

176. The Supreme Court of the United States recently decided two cases argued in October Term 2017. Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC, 138 S.Ct. 1365, 1370 (2018) (holding that inter partes review violates neither Article III nor the Seventh Amendment of the U.S. Constitution); SAS Inst. Inc. v. Iancu, 138 S. Ct. 1348, 1352–53 (2018) (holding that when the PTAB "institutes" an IPR, its final written decision must address the patentability of *all* challenged claims).

177. Indeed, in *Oil States*, the Court expressly left open the possibility that IPR might violate the Constitution's Due Process or Takings Clauses. *See* 138 S. Ct. at 1379 ("[W]e address only the precise constitutional challenges that Oil States raised here. Oil States does not challenge the retroactive application of inter partes review, even though that procedure was not in place when its patent issued. Nor has Oil States raised a due process challenge. Finally, our decision should not be misconstrued as suggesting that patents are not property for purposes of the Due Process Clause or the Takings Clause.").

A. *Inter Partes Review Petition-Level Data*

To learn what PTAB outcomes can tell us about patent quality, we set out to gather as much data as we could on individual petitions. We began by obtaining data on PTAB proceedings from Unified Patents, Inc., which maintains a commercial database of PTAB statistics and filings.[178] Unified Patents provided us with petition-level data that allowed us to identify the patent challenged in each proceeding, as well as the proceeding's filing date, the date and outcome of all PTAB decisions, and the date and reason for each petition's termination. Our data includes all petitions filed through January 31, 2017.

As shown below in Table 1, our data includes 5,829 petitions, 4,903 of which were litigated to (at least) an institution decision. A small but noteworthy share of institution denials was based not on the merits of the validity arguments raised in the petition, but instead on a procedural defect.[179] Excluding these, we are left with 4,567 petitions challenging a total of 2,532 unique patents that were reviewed on their merits by the PTAB.

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178. *Id.* A coauthor of this study, Shawn Ambwani, is the COO of Unified Patents.

179. A party seeking IPR of a patent asserted against it in court must, by statute, file a petition within one year of being sued. 35 U.S.C. § 315(b) (2012). If a party fails to seek IPR within that one-year window, its petition will be denied as untimely. The PTAB also may deny a petition without reaching its merits on the grounds that it is substantially duplicative of an earlier-filed petition. 35 U.S.C. § 325(d) (2012).

TABLE 1. PTAB data overview (Sept. 16, 2012 through Jan. 31, 2017)

	Number	Percent
Petitions	5,829	100
Pending, pre-institution	39	0.67
Settled, pre-institution	823	14.1
Adv. judgment, pre-institution	24	0.41
Other, pre-institution	43	0.74
Institution decisions	4,903	84.1
Granted	3,403	69
Denied – merits	1,164	24
Denied – procedural	336	7
Unique (Utility[a]) patents petitioned	3,920	100
Subject of inst. decision(s) on merits	2,532	65
Always granted	1,680	66
Always denied	671	27
Both granted and denied	181	7

[a] We excluded from our analysis a small number of petitions challenging design patents.

As of January 2017, only about 40 percent of these patents were the subject of a final written decision. The large drop in the number of decisions is a result of two factors. The first is a pipeline effect caused by the fact that final written decisions are typically not issued until very close to one year after their corresponding institution decision. The second reason is settlement. Overall, about one-third of PTAB petitions settle, and about half of settlements take place after an institution decision has been issued.[180]

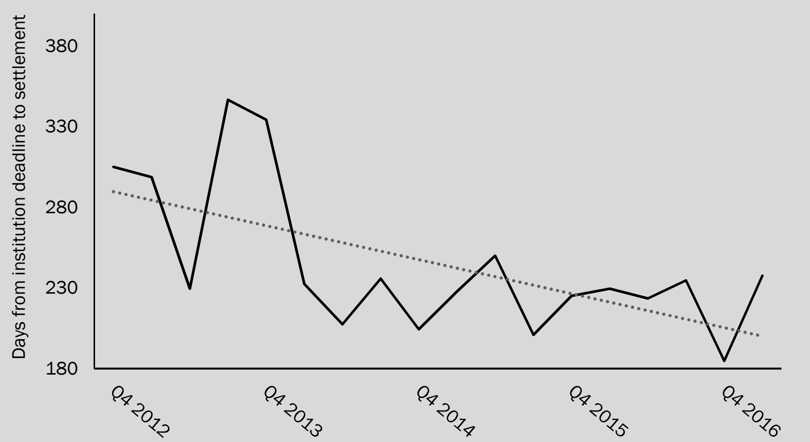
In those petitions litigated to a final written decision, the PTAB overwhelmingly decided to cancel at least one instituted claim. Overall, final written decisions have cancelled about 82 percent of the instituted claims they reviewed, and about 73 percent of final written decisions issued to date cancelled *all* instituted claims.[181] Indeed, it is our experience that parties to

180. *Analytics: Cases by Status and Phase*, *supra* note 133.

181. *Id.* While this rate is high, it is hardly surprising. Final written decisions are decided by the same panel of APJs that voted less than a year prior to institute the petition on the grounds that the very same claims were shown to be unpatentable to a "reasonable likelihood."

PTAB proceedings generally view the institution decision as the most consequential decision in a PTAB proceeding. Instituted claims, it is generally assumed, will be cancelled if competently litigated to a conclusion. Thus, an institution decision alone is often sufficient to destroy the majority of a claim's licensing value. Indeed, as depicted in Figure 1, it is increasingly likely for PTAB proceedings to settle shortly before or shortly after the institution decision, which must be made within six months of the date of petition.[182]

FIGURE 1: Monthly average days from IPR petition to settlement.



Note: Monthly averages calculated from population of IPR proceedings that ended in settlement. Linear trend included with a slope of 5.7 fewer days from petition to settlement each month. Chi-square test rejected the null that the time from petition to settlement is not declining (p = 0.000).

B. PTAB Institution as a Quality Filter

Because of the pivotal role that institution plays in PTAB practice, we use merits-based institution decisions in this study as our primary indicator of patent quality. That is, we assume that challenged patents that were flagged by a panel as having at least one likely invalid claim are of relatively "low quality" while patents that were challenged but never instituted on any

182. 35 U.S.C. § 314(b) (2012); 37 C.F.R. § 42.107(b) (2017).

claims are of relatively "high quality." While we explain our precise classification methodology in greater detail immediately below, we pause here to explain why we believe that institution decisions are a valid quality filter.

For one, as explained above, we believe that a focus on institution decisions accurately reflects the current state of patent practice. Overwhelmingly, instituted claims are cancelled in final written decisions, and IPRs frequently settle just before or after an institution decision is issued. We believe that employing institution decisions as a quality filter is advantageous for a number of additional reasons. First, we believe that institution decisions reflect with a high degree of accuracy whether the challenged patent claims should have originally been granted. An instituted petition has demonstrated to the satisfaction of a panel of Administrative Patent Judges that the challenged patent includes at least one claim that likely should not have been issued.[183] Unlike decisions made in court, PTAB decisions employ the same interpretive rules, legal standard, and burden of proof applicable in ex ante examination.[184] Moreover, all APJs have a technical degree in science or engineering as well as experience working as a patent examiner or patent lawyer (if not both),[185] and thus may be better positioned than judges or juries to understand both patentees' inventions and the prior art raised by petitioners.[186]

183. Moreover, almost all decisions issued by panels are unanimous. *See* Scott McKeown, *Judicial Independence & The PTAB: The Tension Between Judicial Independence & Agency Consistency*, ROPES & GRAY: PATENTS POST-GRANT (Dec. 12, 2017), https://www.patentspostgrant.com/judicial-independence-ptab/#more-12559 [https://perma.cc/F9Z7-KPSA] (reporting that 98 percent of all PTAB institution decisions and final written decisions are unanimous).

184. *See* MPEP § 2111 (9th ed. Rev. Aug. 2017) ("Patented claims are not given the broadest reasonable interpretation during court proceedings involving infringement and validity, and can be interpreted based on a fully developed prosecution record."). However, as mentioned above, this may soon change. *See* Changes to the Claim Construction Standard, *supra* note 167.

185. *See* David Ruschke, Chief Judge, U.S.P.T.O., Powerpoint Presentation at Santa Clara Fireside Chat: State of the Board After 5 Years (Nov. 16, 2017) (copy on file with the authors) (noting that APJs have technical degrees in addition to law degrees, with more than 10 percent of APJs holding a PhD, about 27 percent holding a master's degree in a technical field, and about 32 percent having prior experience working as a USPTO patent examiner).

186. *See, e.g.*, Michael Goodman, *What's So Special About Patent Law?*, 26 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 797 (2016) (arguing that the PTAB should become the exclusive forum for validity challenges because "the difficult portion of a patent case is the technology" and APJs have "the necessary expertise to deal with that technology"); *see also* Gen. Tire & Rubber Co. v. Jefferson Chem.

Second, we believe that institution decisions likely suffer from fewer selection effects than validity decisions rendered by courts. While we acknowledge that patents challenged in PTAB proceedings are highly selected, there is good reason to believe that challenged patents are *less* selected than patents litigated to a decision by a judge or jury.[187] For one, a PTAB challenge is much more likely than a lawsuit to lead to a decision on the merits. In an analysis of the more than 5,100 patent suits filed in U.S. courts in 2008 and 2009, Allison et al. found just 430 validity decisions.[188] By contrast, the more than 5,800 PTAB IPR petitions in our data set generated institution decisions for 2,532 unique patents, and many of these petitions are still pending.

In addition, there is good reason to believe that the set of patent disputes worth litigating to a decision on the merits is a subset of the patent disputes worth challenging before the PTAB. Though it is true that just 15 percent of patents asserted in court are challenged at the PTAB,[189] an even smaller percentage of patent suits are litigated to a motion for summary judgment.[190] We believe that cases traditionally falling in the latter category are likely today to fall in the first as well. Simply put, disputes worth litigating for two to three years at a cost well north of $1 million[191] are, with high probability, also worth challenging at the PTAB for eighteen

Co., 497 F.2d 1283, 1284 (2d Cir. 1974) ("This patent appeal is another illustration of the absurdity of requiring the decision of such cases to be made by judges whose knowledge of the relevant technology derives primarily, or even solely, from explanations of counsel and who, unlike the judges of the Court of Customs and Patent Appeals, do not have access to a scientifically knowledgeable staff.").

187. To be clear, though we believe that the population of petitioned patents suffers from less selection bias than the population of litigated patents, we also acknowledge that petitioned patents are nonetheless still a highly selected group and, thus, different from the population of granted patents. Consistent with the literature showing a connection between litigation and private value, we suspect that the principal difference between petitioned patents as a group and the population of all U.S. patents is that the former have greater private value.

188. Allison et al., *supra* note 8, at 1778.

189. *Analytics: Cases by Status and Phase*, *supra* note 133.

190. Case Resolutions for District Court Patent Cases, LEX MACHINA, INC., https://lexmachina.com/ (search conducted July 27, 2017) [https://perma.cc/ZS4A-JP66].

191. See AIPLA, *supra* note 53, at I-121 (reporting a median cost of $1 million to litigate a patent case with between $10 million and $25 million at stake through claim construction).

months and closer to $250,000.

Finally, at least some patent disputes that are *not* worth litigating to a decision nonetheless still *are* worth challenging at PTAB. In addition to the fact that PTAB proceedings are simply less expensive than litigation, because IPR has no standing requirement, potential infringers can pool resources in third-party organizations—like defensive aggregators and industry associations—that can challenge especially weak patents previously asserted en masse for nuisance value.[192] For example, in 2016 Unified Patents instituted a challenge against a patent owned by Shipping & Transit, LLC (formerly known as ArrivalStar, LLC), which had previously filed hundreds of patent suits with an average time to termination of just 114 days.[193] Though few parties would elect to defend a lawsuit that could be settled for a five-figure sum, third party organizations that serve the interests of dozens or hundreds of potential lawsuit targets often will have the incentive to launch a PTAB challenge. In addition, roughly fifteen percent of PTAB proceedings challenge a patent that has never been asserted in court.[194] Such challenges may happen for a variety of reasons and, thus, allow us to observe the validity of patents that otherwise may never have been selected for litigation.

C. *Classifying High- and Low-Quality Patents*

Accordingly, we chose merits-based institution decisions to classify patents as either "high" or "low" quality. While we could have instead categorized patents using only the outcomes of PTAB final written decisions, we chose not to because doing so would have substantially reduced the size of our sample,

192. *See* Love, *supra* note 147, at 1094 n.59 ("A small but growing number of IPRs have been filed by industry groups (like the Printing Industries of America), public interest organizations (like the Electronic Frontier Foundation), and membership-based patent risk management firms (like RPX and Unified Patents). By pooling resources ex ante, these groups also help mitigate the collective action problem that arises when multiple purchasers, rather than one manufacturer, is faced with infringement allegations."). To date, Unified Patents and RPX have collectively filed 175 petitions for inter partes review. PTAB Trials for Party Group RPX Corp. and Unified Patents, Inc., LEX MACHINA, INC., https://lexmachina.com/ (search conducted Jan. 23, 2018) [https://perma.cc/ZS4A-JP66].

193. Termination Timing for Party Group Shipping & Transit, LLC and ArrivalStar S.A., LEX MACHINA, INC., https://lexmachina.com/ (search conducted July 27, 2017) [https://perma.cc/ZS4A-JP66].

194. *Analytics: Cases by Status and Phase*, *supra* note 133.

while at the same time increasing selection effects. Though we feel confident in this choice given the high rate of claim cancellation observed in final written decisions, it is nonetheless possible for a final written decision to confirm the patentability of all instituted claims and, in effect, "reverse" the institution decision. While this is rare, it does happen from time to time. To correct for these "reversals," we re-classified petitions as "not instituted" if all instituted claims were upheld in a final written decision.

With that correction made, as shown above in Table 1, the population of patents that were the subject of at least one merits-based institution decision can be divided into three sets: (1) 1,680 patents that were instituted every time they were the subject of an institution decision, i.e., patents that were "always instituted"; (2) 671 patents that were *not* instituted every time they were the subject of an institution decision, i.e., patents that were "never instituted"; and (3) 181 patents that were both instituted at least once on the merits *and* were not instituted at least once on the merits.

In the analyses described below, we consolidate these three sets in two ways to compare patents that are of relatively "high" and relatively "low" quality. First, we create a dichotomous variable that compares the set of 671 patents that were "never instituted" (and thus of relatively high quality) to the set of 1,861 patents that were instituted at least once (and thus of relatively low quality). This compares patents that passed PTAB scrutiny with flying colors against patents with at least one challenged claim that appears to have been issued erroneously.

While such a comparison is useful from a policy perspective—after all, in an ideal world, the USPTO would only issue valid claims—it is arguably the wrong comparison to make from a practical perspective. Victory in a patent enforcement action requires a finding of infringement of just a single valid claim. Thus, a patent with one rock-solid claim can remain a significant hurdle to competitors despite containing numerous additional claims that are likely invalid. With this consideration in mind, we created a second dichotomous variable that compares the set of patents that were not instituted on the merits at least once (and thus of relatively high quality) with the set of patents that were "always instituted" (and thus of relatively low quality). This comparison is marginally more practical in that it compares patents that withstood at least one well-funded validity challenge against those that fell at least in part each time they were scrutinized.

That said, one limitation to our study is that we lack data on patent claim-level outcomes. For practical reasons related to the difficulty inherent in collecting such data from court filings, we did not track the fate of each individual patent claim that was challenged. Thus, we lack the ability to identify patents that were instituted at least once on each and every challenged claim despite surviving at least one petition among many. Similarly, we are unable to identify patents that survived IPR with at least one challenged claim intact despite being instituted each time a petition was filed. We hope in future iterations of this study to expand our analysis to include claim-level comparisons.

D. Patent-Level Data Collection Methodology

With our patents classified by quality, we next collected as much patent-level data as possible that might predict in some way a patent's quality. The data that we collected falls into five broad categories: (1) characteristics of the patent's applicant, prosecution counsel, and examiner; (2) the type of technology that the patent relates to; (3) the complexity of the patent document itself; (4) the intensity of the patent's prosecution and examination; and (5) attributes that the patent acquired over time post-grant. Unless otherwise indicated, we queried the data described below from the USPTO's recently released "PatentsView"[195] and "PatEx"[196] databases.

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195. PatentsView is a relational database that links individual U.S. patent numbers ("patent_id") to, among other things, data on patent assignees, claims, inventors, lawyers, reverse citations, and technology classifications. *See* USPTO, FAQs, http://www.patentsview.org/api/faqs.html [https://perma.cc/H5LK-Q3WB] (last visited Aug. 9, 2018). We downloaded a copy of the database, USPTO, DATA DOWNLOAD TABLES, http://www.patentsview.org/download/ [https://perma.cc/HTL7-E9F2] (last visited Aug. 9, 2018), and queried it using SQL scripts. PatentsView can now be queried directly via Google's BigQuery platform. *See* Ian Wetherbee, *Google Patents Public Datasets: Connecting Public, Paid, and Private Patent Data*, GOOGLE CLOUD BLOG (Oct. 31, 2017), https://cloud.google.com/blog/big-data/2017/10/google-patents-public-datasets-connecting-public-paid-and-private-patent-data [https://perma.cc/3HNC-9HUP].

196. PatEx is a relational database that links individual U.S. patent application numbers ("application_number") to, among other things, data on patent examiners, parent applications, child applications, and "events" that

1. Applicant, Prosecutor, and Examiner

The first category of data that we collected pertains to the people and entities that controlled each patent's filing and examination. In addition to identifying each patent's applicant, we noted whether the applicant claimed "small entity" status at the time of filing in order to receive fee discounts available to businesses with fewer than five hundred employees.[197] We also hand-classified each applicant as: one or more individuals (typically the patent's inventor(s)), a for-profit business entity (typically the employer of inventors working in a corporate research setting), a university or university-affiliated entity (typically the employer of inventors working in an academic research setting),[198] or, finally, a government department or government-run research lab (typically the employer of inventors working in a non-academic research setting).[199]

We next identified the people or entities selected by each applicant to prosecute the application from which each patent issued. Then we categorized each application as prosecuted by one or more of the patent's inventors (i.e., prosecuted "pro se"), by lawyers employed by the applicant (i.e., by the applicant's "in-house" legal team), or by lawyers employed by an outside law firm. For each application prosecuted by a law firm, we additionally categorized the firm by size, measured by the number of attorneys employed by the firm.[200] For this purpose, we

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occurred during prosecution. Stuart J.H. Graham et al., *The USPTO Patent Examination Research Dataset: A Window on the Process of Patent Examination* (USPTO, Econ. Working Paper No. 2015-4, Nov. 2015), https://www.uspto.gov/sites/default/files/documents/PatEx%20Working%20Paper.pdf [https://perma.cc/7MF9-45NH]. We downloaded a copy of the database, *See* USPTO, PATENT EXAMINATION RESEARCH DATASET (Public PAIR), https://www.uspto.gov/learning-and-resources/electronic-data-products/patent-examination-research-dataset-public-pair [https://perma.cc/EG4U-E8JK], and queried it using SQL scripts. This data can now be queried directly via Google's BigQuery platform. *See* Wetherbee, *supra* note 195.

197. 13 C.F.R. § 121.802(a) (2018) ("A concern eligible for reduced patent fees is one . . . [w]hose number of employees, including affiliates, does not exceed 500 persons . . . .").

198. In addition to universities, we included in this category about two-dozen affiliated nonprofit entities. These were primarily university-affiliated hospitals.

199. Because we found just five government patents, we do not discuss them separately.

200. We primarily collected this information by visiting each firm's website. In some instances, firms had merged with others since the time of prosecution. In those circumstances, we attempted to the best of our ability to determine the size

adopted the size classifications used by the AIPLA in its biannual *Report of the Economic Survey*, which groups firms into the following categories: "large" firms, which employ 60 or more attorneys; "medium" firms, which employ 16 to 59 attorneys; "small" firms, which employ 4 to 15 attorneys; and "solo" practices, which employ 3 or fewer attorneys.[201]

Finally, we identified the USPTO examiner who was assigned to examine the application from which each patent issued.[202] For each examiner, we identified his or her level of "experience," measured by the total number of applications that he or she had examined in his or her career. Building on this data point, we next calculated the examiner's overall "allowance rate," measured by the percentage of each examiner's applications that were granted. We then identified the "art unit" in which each examiner worked,[203] and calculated each art unit's overall allowance rate. Finally, using both examiner and art unit allowance rates, we calculated each examiner's relative allowance rate—that is, the differential between each examiner's individual allowance rate and the average allowance rate across all other examiners working in his or her respective art unit.

2. Technology Area

Next, we collected data about the technological focus and scope of each challenged patent. First, we collected data on the number and type(s) of technology "classifications" assigned to the patent, including those classes and subclasses assigned under the USPTO's "U.S. Patent Classification System" (USPC), the USPTO and EPO's joint "Cooperative Classification System" (CPC), and the WIPO's "International Patent Classifi-

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of the firm before the merger. Often this was possible by locating press releases announcing the merger.

201. *See, e.g.*, AIPLA, *supra* note 53, at I-93.

202. The examiners assigned to five patents were missing from the PatEx database. We exclude those patents from the examiner-related analyses reported infra in Tables 4, 18, and 19.

203. U.S. patent examiners are divided into nine "technology centers," each of which is subdivided into a number of "work units" that, in turn, are further subdivided into "art units." *See* USPTO, PATENT TECHNOLOGY CENTERS MANAGEMENT, https://www.uspto.gov/patent/contact-patents/patent-technology-centers-management (last visited Aug. 30, 2018) [https://perma.cc/SH3Y-PCEM].

cation System" (IPC).[204] Using these classifications, we further defined a set of "pharmaceutical" patents,[205] a set of "business method" patents,[206] and a set of "software" patents.[207] Finally, to supplement these class-based categories, we hand-classified each patent as broadly related to "high tech" (i.e., computing and telecommunications), "medical" technology (i.e., pharmaceuticals, biotechnology, and medical devices), or some "other" technology.[208]

3. Specification and Claims

We next collected data related to the length and complexity of various parts of the patent document itself. For each patent, we identified its total number of claims as well as the number of independent and dependent claims. We also determined the length (measured by word count) of various parts of each patent document, including each patent's abstract, specification, and claims. Finally, to correct for the common repetition of words or phrases in claim language, we took the additional step of noting the number of unique words that appear in each patent's first (and typically principal) claim.

4. Prosecution History and Family

Turning from patent documents to prosecution histories, we next collected data about each patent's examination. First, we took the simple step of noting the date on which each patent's application was filed, the filing date of the earliest prior application to which it claimed priority, and the date on which the application was granted. From this data, we calculated each patent's "pendency," that is, the duration of the patent's

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204. *See* USPTO, CLASSIFICATION STANDARDS AND DEVELOPMENT, https://www.uspto.gov/patents-application-process/patent-search/classification-standards-and-development (last visited Aug. 9, 2018) [http://perma.cc/PG42-B5U4].

205. We define "pharmaceutical" patents as those assigned to USPC 514 or 424.

206. We define "business method" patents as those assigned to USPC 705 or any USPC in the range 718 to 726.

207. Following Bessen, we define "software" patents as those assigned to any of the following USPCs: 341, 345, 370, 375, 380, 381, 382, 700–07, 715–17, 726, and 902. James Bessen, *A Generation of Software Patents*, 18 B.U. J. SCI. & TECH. 241, 253 (2012).

208. Such as manufacturing, industrial, and oil and gas related technologies.

prosecution history.

We next identified all prior art references that were cited during the patent's prosecution (often referred to as "backward" or "reverse" citations). In addition to determining the overall count of such citations, we determined the number of backward citations to foreign patents, as well as the number and type of backward citations to "non-patent literature" (NPL) such as academic articles, books, and websites. Finally, for all patents issued in 2001 or thereafter, we determined whether backward citations to patents and applications were disclosed by the applicant or, instead, were identified and cited by the examiner in an office action.[209]

In addition to the documents cited during prosecution, we searched USPTO records to identify whether (and if so how often) certain actions were taken by the applicant or examiner during prosecution. For example, we identified whether the applicant disclosed prior art references to the examiner in an "information disclosure statement" (IDS), and if so how many times. Similarly, we identified whether, and if so how many times, the examiner "rejected" the application in an office action. In addition, in response to a "final" rejection (if any) we noted whether the applicant filed a "request for continued examination" or, alternatively, filed a notice of appeal to the Board of Patent Appeals and Interferences.

We also noted whether each patent's application was published prior to issuance.[210] If so, we noted the number of claims and total word count of those claims at the time of publication, and compared those figures to the total number of claims and

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209. Our ability to distinguish between applicant- and examiner-cited prior art is limited in two important respects. First, PatentsView only distinguishes between applicant- and examiner-cited prior art *patents or applications*; it does not distinguish between applicant- and examiner-cited NPL. Second, PatentsView only includes this (partial) data for patents issued after 2000.

210. U.S. patent applications filed on or after November 29, 2000, are generally published eighteen months after their filing date. *See, e.g.*, USPTO, USPTO WILL BEGIN PUBLISHING PATENT APPLICATIONS (Nov. 27, 2000), https://www.uspto.gov/about-us/news-updates/uspto-will-begin-publishing-patent-applications [https://perma.cc/5GY9-RB8M] (noting that the publication mandate "stems from a statutory mandate contained in the American Inventors Protection Act of 1999 (AIPA)" and that "[t]here are exclusions from the publication requirement, the most significant of which is for applicants who attest upon filing that they have not and will not file an application for the same invention in a foreign country or under a multilateral international agreement, that requires publication of applications 18 months after filing").

word count at the time of the application's issuance as a granted patent.[211] Lastly, we identified whether each applicant sought patent protection solely in the United States or, instead, prosecuted a "family" of similar applications in various patent offices across the globe. For each patent with foreign family members, we additionally noted the total number of its foreign counterparts, as well as the specific patent office in which each was filed.

5. Characteristics Acquired Post-Grant

Our final data collection efforts focused on characteristics acquired by each patent since the time it was granted. First, we identified how many times each patent had been cited during the prosecution of other, newer patents (i.e., "forward citations").[212] We also determined whether each patent had changed hands post-issuance and, if so, how many times.[213] Finally, we identified the current owner of the patent—that is, the respondent to each IPR—and classified each owner as either an operating company, a "patent assertion entity" specializing in patent monetization, or some other form of "non-practicing entity" that does not presently commercialize the patented technology.[214]

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211. Here we follow the lead of Alan C. Marco et al., *Patent Claims and Patent Scope* (Hoover Inst. Working Grp. on Intell. Prop., Working Paper No. 16001, Aug. 18, 2016), https://issuu.com/hooverip2/docs/ip2-wp16001-paper [https://perma.cc/432C-3BBB].

212. *See supra* notes 27–33 and accompanying text.

213. We obtained this information from AcclaimIP, which maintains a cleaned version of the USPTO assignment database. *See Number of Post-Grant Assignment Events*, ACCLAIMIP, http://help.acclaimip.com/m/acclaimip_help/l/181377-number-of-post-grant-assignment-events -ana_anre_pexe_ct (last visited Jan. 31, 2018) [https://perma.cc/6VKE-GUWG]. USPTO assignment records include many entries that do not represent true transfers, including the recording of security interests and corporate mergers or name changes. *See, e.g.*, Carlos J. Serrano, *The Dynamics of the Transfer and Renewal of Patents*, 41 RAND J. ECON. 686, 691 (2010) (explaining that many recorded assignments do not represent "transaction[s] of patents across firm boundaries," and instead result from "administrative events, such as a name change, a security interest, a correction, and so on," or "transactions between inventors-employers and their employees-assignees").

214. We hand coded these classifications relying on publicly available data, including information provided in documents filed in patent suits, entities' websites, and other public information regarding entities' owners, parents, employees, and current and former products.

IV. BIVARIATE RESULTS

With this patent-level data collected, we next performed a bivariate comparison of each metric across high- and low-quality patents to identify promising candidates for further multi-variate analysis (reported in Part V *infra*). As discussed above, we report two comparisons for each data point. The first compares patents that were never instituted against those that were instituted at least once. The second compares patents that were not instituted at least once and patents that were instituted every time they were challenged.[215]

A. *Applicant, Prosecutor, and Examiner*

Looking first at the characteristics of patents' applicants, prosecutors, and examiners, we find a number of statistically significant differences between patents that were and were not successfully challenged in inter partes review. As shown below in Table 2, we first note that patents originally obtained by small entities are significantly less likely to pass muster in a PTAB institution decision.[216] To a lower 90 percent confidence level, the same is true of patents originally obtained by individuals. Notably, both findings are consistent with prior research suggesting that patentee sophistication and resources influence patent validity.[217]

215. For dichotomous variables, we report the results of Chi-square tests of the null that there is no difference in the institution rate of patents with or without the characteristic. For continuous variables, we report the results of t-tests comparing the mean number of the variable for patents never instituted versus instituted and separately denied institution versus always instituted.

216. We do not analyze government-assigned patents because there were only five in our dataset.

217. For example, relative to larger entities, small entities may tend to select lower-quality patent prosecution counsel, or may not be able to spend as much on prosecution-related services generally.

TABLE 2. Applicant characteristics

	N		Yes	No	*p*
Small entity?	754 / 2532	Never inst.	24% (182)	28% (489)	0.085*
		Instituted	76% (572)	72% (1289)	
		Denied inst.	30% (226)	35% (626)	0.011**
		Always inst.	70% (528)	65% (1152)	
Individual?	290 / 2532	Never inst.	23% (68)	27% (603)	0.230
		Instituted	77% (222)	73% (1639)	
		Denied inst.	29% (85)	34% (767)	0.099*
		Always inst.	71% (205)	66% (1475)	
Corporation?	2148 / 2532	Never inst.	27% (573)	26% (98)	0.661
		Instituted	73%(1575)	74% (286)	
		Denied inst.	34% (736)	30% (116)	0.128
		Always inst.	66%(1412)	70%(268)	
University?	89 / 2532	Never inst.	31% (28)	26% (643)	0.274
		Instituted	69% (61)	74% (1800)	
		Denied inst.	33% (29)	34% (823)	0.909
		Always inst.	67% (60)	66% (1620)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

Turning to choice of prosecution counsel, we also find significant results. As shown below in Table 3, we find that patents prosecuted by large firms were less likely to be instituted, while patents prosecuted by solo practitioners were more likely to be instituted. While these correlations may have many drivers,[218] we note that law firm size itself is positively correlated with hourly rates charged for legal work and attorney salaries, both of which may suggest that large law firms (on average) produce better legal work product and attract more highly skilled attorneys than their smaller counterparts.

218. For example, while these correlations may suggest that large firms produce better legal work product than smaller firms, they are also consistent with the hypothesis that inventors with especially novel inventions are disproportionately likely to hire large firms as prosecution counsel.

TABLE 3. Prosecuting counsel characteristics

	N		Yes	No	*p*
Large firm	1017 / 2532	Never inst.	31% (316)	23% (355)	0.000***
		Instituted	69% (701)	77% (1160)	
		Denied inst.	38% (390)	30% (426)	0.000***
		Always inst.	62% (627)	70% (1053)	
Medium firm	495 / 2532	Never inst.	24% (117)	27% (554)	0.112
		Instituted	76% (378)	73% (1483)	
		Denied inst.	31% (152)	34% (700)	0.124
		Always inst.	69% (343)	66% (1337)	
Small firm	439 / 2532	Never inst.	24% (107)	27% (564)	0.285
		Instituted	76% (332)	73% (1529)	
		Denied inst.	31% (138)	34% (714)	0.292
		Always inst.	69%(301)	66% (1379)	
Solo	348 / 2532	Never inst.	20% (71)	27% (600)	0.005***
		Instituted	80% (277)	73% (1584)	
		Denied inst.	28% (96)	35% (756)	0.010**
		Always inst.	72% (252)	65% (1428)	
In house	218 / 2532	Never inst.	26% (57)	27% (614)	0.936
		Instituted	74% (161)	73% (1700)	
		Denied inst.	33% (71)	34% (781)	0.765
		Always inst.	67% (147)	66% (1533)	
Pro se	15 / 2532	Never inst.	20% (3)	27% (668)	0.772
		Instituted	80% (12)	73% (1849)	
		Denied inst.	33% (5)	34% (847)	1.000
		Always inst.	67% (10)	66% (1670)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

We again see significant correlations between institution and patent examiner characteristics. In fact, as shown below in Table 4, we find a significant correlation between institution and every metric that we measured. First, and most intuitively, we find a number of significant positive correlations between likelihood of institution and the grant rates of individual examiners and art units. On average, instituted patents were more likely to have been assigned to examiners with higher overall allowance rates, to art units with higher overall allowance rates, and to examiners who granted applications more often than their counterparts in the same art unit.[219]

Second, and less intuitively, we also find a significant positive correlation between likelihood of institution and examiner experience. While at first blush one might expect examiners to improve with experience, our finding is consistent with a growing body of research indicating the opposite.[220] Prior studies have identified what we call a "promotion effect" and a "time allocation effect" that may degrade average examiner performance over time. The promotion effect captures two potential influences on examiner performance: first, a tendency for relatively lenient examiners to work for the USPTO for longer periods of time than their stricter counterparts,[221] and second, a tendency for more senior examiners with greater job security to be less diligent.[222] The time-allocation effect may reflect the

219. The first two of these three findings may reflect to some extent that examiners assigned to an art unit covering more complex technology are given more time to examine patent applications. *See* Frakes & Wasserman, *supra* note 95, at 552. However, this fact cannot explain our finding that institution is also correlated with the differential between an examiner's grant rate and that of his or her colleagues in the same art unit. It is also noteworthy that this grant rate differential is positive even for patents that were denied institution.

220. *See* Mark A. Lemley & Bhaven Sampat, *Examiner Characteristics and Patent Office Outcomes*, 94 REV. ECON. & STATS. 817, 821 (2012) (finding that examiner "grant rate[s] increase[] monotonically with experience"); Mann, *supra* note 58, at 2176 (finding "that increasing experience relates to a decline in the quality of output" of USPTO examiners); Cockburn et al., *supra* note 20, at 46–47 (finding, despite hypothesizing the opposite, that "if anything, invalid patents are associated with examiners with higher mean levels of experience, both in terms of volume and tenure").

221. *See* Lemley & Sampat, *supra* note 220, at 824 ("[T]he PTO faces significant employee attrition, particularly among examiners who have been with the agency less than five years. If examiners who were more diligent, more thorough, more technically sophisticated, or more highly educated were more likely to leave the PTO earlier in their careers, perhaps because they have better job opportunities, this could provide one explanation for our results."). Other possible causes include that delivering good news is generally viewed as more enjoyable than delivering bad news and that granting applications requires less effort than rejecting them, both of which may make the job less stressful and more manageable for those who grant more often.

222. Most notably, "[e]xaminers at pay grades GS-13 and below must have their decisions reviewed by an examiner who has 'full signatory authority.'" Frakes & Wasserman, *supra* note 95, at 552. Frakes and Wasserman find that

simple fact that more senior examiners are expected to review more applications than their more junior counterparts, and thus have less time per application to devote to the examination.[223] While we lack the data to pass judgment on the existence of either effect, our findings nonetheless suggest quite consistently that experienced examiners are sub-optimally incentivized to produce high-quality patents.[224]

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examiner "grant rate jumps distinctly once one enters [GS-Level 14] (to a degree that is 8 percentage points higher than the reference period)." *Id.* at 556; *see also* Lemley & Sampat, *supra* note 220, at 825 ("Another possibility is examiner tenure. After promotion, examiners are not subject to the same level of scrutiny. Among other things, with full signatory authority, they can sign off on their own applications without review. This could plausibly cause them to be more lax."); *id.* at 826 (finding that "more senior examiners systematically cite less prior art[, which] reinforces the inference that senior examiners are doing less work, rather than that they are merely getting it right more often than junior examiners"); Sean Tu & Chris Holt, *Office Actions per Grant Ratio (OGR): A New Metric for Patent Examiner Activity*, PATENTLY-O (Apr. 5, 2018), https://patentlyo.com/patent/2018/04/actions-examiner-activity.html [https://perma.cc/H6QA-8F5S] (reporting that "junior examiners have a much lower allowance rate and a much higher OGR score than their more experienced counterparts").

223. Frakes & Wasserman, *supra* note 95, at 552.

224. To further investigate the relationship between examiner experience and allowance rates, we ran a few additional multivariate regressions. While we found no significant correlation between examiner experience and art unit allowance rates, we did find a significant correlation between examiner experience and an examiner's overall allowance rate. When we regressed the probability of a patent's institution on both examiner experience and examiner allowance rate, we found a significant positive correlation with examiner allowance rate but not with examiner experience. We discuss this finding further in Part V *infra*, but note for now that experienced examiners tend to be more lenient while only some lenient examiners are more experienced. Finally, and interestingly, when we regressed the probability of institution on both the art unit allowance rate and the examiner's allowance rate relative to the art unit, we found a significant correlation to both. This finding suggests that petitioned patents from more lenient art units are of lower quality regardless of the leniency of the particular examiner they were assigned to, and that patents assigned to more lenient examiners are of lower quality regardless of the leniency of that examiner's art unit.

TABLE 4. Examiner characteristics

	N		Mean	*p*
No. of applications per examiner	2527	Never inst.	1121 (670)	0.001***
		Instituted	1248 (1857)	
		Denied inst.	1150 (851)	0.005***
		Always inst.	1247 (1676)	
Examiner's overall allowance rate	2527	Never inst.	73% (670)	0.000***
		Instituted	78% (1857)	
		Denied inst.	74% (851)	0.000***
		Always inst.	78% (1676)	
Art unit allowance rate	2532	Never inst.	71% (671)	0.000***
		Instituted	75% (1860)	
		Denied inst.	72% (852)	0.000***
		Always inst.	75% (1679)	
Allowance rate differential (relative to art unit)	2527	Never inst.	1.8% (670)	0.002***
		Instituted	3.6% (1857)	
		Denied inst.	2.3% (851)	0.027**
		Always inst.	3.5% (1676)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017.We exclude five patents assigned to examiners that do not appear in the PatEx database. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for p < .10; **for p < .05; and *** for p < .01.

B. Patent Characteristics

Turning next to the characteristics of challenged patents themselves, we find significant correlations. First, as shown below in Table 5, our findings suggest that "older" patents tend to be of lower quality than those filed and issued more recently. We find a significant positive correlation between likelihood of institution and the amount of time that has passed since the filing date of the earliest application to which the petitioned patent claims priority, the filing date of the application from which the petitioned patent issued, and the date on which the petitioned patent was issued.

While these correlations may have a number of explanations, it is hard to overlook the fact that courts have made a number of substantive changes to U.S. patent law in the last two decades. Due to their retroactive application, these changes will naturally tend to reduce the quality of older patents that were examined in light of older case law. In addition to case law that directly impacts the grounds on which invalidity may be raised in IPR (such as the Supreme Court's expansion of obviousness in *KSR v. Teleflex*,[225] or the Federal Circuit's alterations to claim construction rules in *Phillips v. AWH Corp.*[226]), decisions impacting other conditions of patentability may have an indirect influence as well. For example, it has long been argued that patents vulnerable to patentable subject-matter challenges are disproportionately likely to also be vulnerable to anticipation and obviousness challenges.[227] Thus, the Supreme Court's substantial tightening of the rules for patentable subject matter in *Bilski v. Kappos*,[228] *Mayo Collaborative Services v. Prometheus Labs., Inc.*,[229] *Associated Molecular Pathology v. Myriad Genetics, Inc.*,[230] and *Alice Corp. v. CLS Bank*

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225. 550 U.S. 398, 415 (2007) (rejecting the Federal Circuit's application of the "teaching, suggestion, or motivation" test as too "rigid").

226. 415 F.3d 1303, 1320 (Fed. Cir. 2005) (en banc) (criticizing earlier opinions that "placed too much reliance on extrinsic sources such as dictionaries, treatises, and encyclopedias and too little on intrinsic sources, in particular the specification and prosecution history").

227. *See* Bilski v. Kappos, 561 U.S. 593, 624 (2010) (Stevens, J., concurring) (noting that in crafting a test for abstractness there is "a risk of merely . . . seeing common attributes that track the familiar issues of novelty and obviousness that arise under other sections of the statute but are not relevant to § 101" (internal quotation marks omitted)); *see also* Michael Risch, *Everything is Patentable*, 75 TENN. L. REV. 591 (2008) (arguing that section 101 should be abandoned altogether as a check on patentability); Kristen Osenga, *Ants, Elephant Guns, and Statutory Subject Matter*, 39 ARIZ. ST. L.J. 1087, 1087 (2007) (arguing that rejecting software patents under section 101 is like "trying to kill an ant with an elephant gun" and is really a "mere[] prox[y] for . . . other statutory patentability requirements"); *but see* Brian J. Love, *Why Patentable Subject Matter Matters for Software*, 81 GEO. WASH. L. REV. ARGUENDO 1 (2010) (criticizing "recent federal circuit opinions [that] dismissively reject section 101 challenges as attacks that should have be made instead under sections 102, 103, and 112").

228. 561 U.S. 593, 603 (2010) (rejecting the "machine-or-transformation test as the sole test for what constitutes a [patentable] 'process'").

229. 566 U.S. 66, 78–79 (2012) (holding that the Patent Act's prohibition on patenting a law of nature "cannot be circumvented by attempting to limit the use of the formula to a particular technological environment," nor by adding to the claim "well-understood, routine, conventional activity previously engaged in by scientists who work in the field").

230. 569 U.S. 576, 590–94 (2013) (holding that isolated DNA segments are not patentable subject matter).

International[231] may have indirectly led in recent years to the abandonment of many applications (or shelving of many patents) that otherwise might have been of generally low quality.

In addition, many in the patent community perceive a general increase in the quality of USPTO examination in the past decade or so, particularly following the 2009 confirmation of David Kappos as Director.[232] During his tenure as Director of the USPTO, the size of the U.S. examining corps grew by 30 percent and the agency's backlog of unexamined applications began to shrink for the first time in many years.[233] While we are reluctant to ascribe these findings to any particular cause or causes, our age-related results are consistent with this hypothesis.

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231. 134 S. Ct. 2347, 2358 (2014) (holding that "the mere recitation of a generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention").

232. *See Lawyers: David J. Kappos*, CRAVATH, SWAINE & MOORE LLP, https://www.cravath.com/dkappos/ (last visited Jan. 24, 2018) [https://perma.cc/8G9V-DHQZ] ("From August 2009 to January 2013, Mr. Kappos served as Under Secretary of Commerce and Director of the United States Patent and Trademark Office (USPTO). . . . As Director of the USPTO, he led the Agency in dramatically reengineering its entire management and operational systems as well as its engagement with the global innovation community.").

233. *See, e.g.*, Dennis Crouch, *USPTO Director Kappos Will Leave in January 2013*, PATENTLY-O (Nov. 26, 2012), https://patentlyo.com/patent/2012/11/uspto-director-kappos-will-leave-in-january-2013.html [https://perma.cc/FE5Q-5P4V] ("In an effort to eliminate the patent prosecution backlog, Kappos has led the charge to greatly increase the number of patent examiners over the past two years. During this time, the number of examiners has swelled to over 8,000—a more than 30% increase from two years before."); Joff Wild, *David Kappos Will Leave a Much Better USPTO than He Found*, IAM MEDIA (Nov. 26, 2012), http://www.iam-media.com/blog/detail.aspx?g=1725fe9a-50f2-4c7a-adef-6a8a12ececa4 [https://perma.cc/W4JZ-ANJY] ("[T]he real prize for the Director, and for the vast majority of USPTO users as well as its wider community of stakeholders, has been improved quality."); Ryan Davis, *Kappos a Tough Act to Follow as USPTO Director*, LAW360 (Nov. 27, 2012), https://www.law360.com/articles/396625/kappos-a-tough-act-to-follow-as-uspto-director [https://perma.cc/UFH2-VSD4] ("[H]is tenure has drawn wide acclaim from attorneys, who said it may be difficult to find a successor who can match his commitment to improving patent quality and open communication with the patent community.").

TABLE 5. Patent age

	N		Mean	*p*
Years earliest priority to first petition	2532	Never inst.	12.8 (671)	0.001***
		Instituted	13.6 (1861)	
		Denied inst.	13.1 (852)	0.064*
		Always inst.	13.5 (1680)	
Years filing to first petition	2532	Never inst.	9.0 (671)	0.088*
		Instituted	9.4 (1861)	
		Denied inst.	9.1 (852)	0.078*
		Always inst.	9.5 (1680)	
Years to grant first petition	2532	Never inst.	5.8 (671)	0.022**
		Instituted	6.4 (1861)	
		Denied inst.	5.9 (852)	0.017**
		Always inst.	6.4 (1680)	
Grant year	2532	Never inst.	2008.7 (671)	0.004***
		Instituted	2008.0 (1861)	
		Denied inst.	2008.6 (852)	0.005***
		Always inst.	2008.0 (1680)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

We also find significant correlations between institution and various metrics for the technology or technologies to which a patent relates. First, as shown below in Table 6, we find a significant correlation between institution and the number of U.S. technology classes assigned to petitioned patents. Interestingly, our findings on this point contrast with those of Mann and Underweiser. While they initially hypothesized (consistent with our findings) that the number of technology classes would be negatively correlated with validity—because an "invention spanning multiple classes would be a more ambitious invention and thus more susceptible of invalidation because of the multiplicity of technologies from which relevant art might be found"[234]—they instead found a positive relationship, a fact that they chalked up to a large number of classes signifying either a thorough understanding of the technology by the USPTO or the cutting-edge nature of the claimed invention.[235] Consistent with Mann and Underweiser's original impulse, we suspect that our findings reflect that, to some degree, the number of USPCs an application is assigned proxies the technological breadth of the claimed invention, as well as the quantity of relevant prior art that may anticipate it.

That said, we fail to find a significant correlation between institution and CPC counts. Moreover, we find a significant correlation with respect to IPC counts that points in the opposite direction. At first, both results struck us as odd because the USPTO maintains a concordance between USPCs and both CPCs and IPCs.[236] However, neither concordance is a one-to-one match of classes. Indeed, some USPCs map to fifteen or more IPCs, while others map to none. As discussed in greater detail below, the negative correlation that we observe between institution and IPCs is driven by the relatively small number of IPCs assigned to software patents. Thus, we suspect that this correlation is principally an artifact of differing treatment of software by the two classification systems, perhaps reflecting the fact that "programs for computers" are not patentable in Europe.[237]

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234. Mann & Underweiser, *supra* note 20, at 18.

235. *Id.*

236. The entire USPC-IPC concordance is available for download here: *USPC-IPC Correspondence*, FIGSHARE, https://figshare.com/articles/USPC-IPC_Correspondence/3502742 [https://perma.cc/9ED7-86EJ].

237. Article 52 of the European Patent Convention expressly excludes from the scope of patentable subject matter "schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers." Convention on the Grant of European Patents, Belg.-Turk., art. 52, Oct. 5, 1973, 1065 U.N.T.S. 255. As applied by the European Patent Office and European courts, this provision only prohibits patenting software-based inventions that are "solely" computer algorithms and, thus, do not make a "technical" contribution to a non-excluded field. *See, e.g.*, Aerotel Ltd. v. Telco Holdings Ltd. [2006] EWCA (Civ) 1371, [75]–[76], [2007] All E.R. 225, at [45]–[47] (Eng.) (holding that the relevant inquiry is whether the invention's "contribution [is] solely of excluded matter"; in other words, "whether the contribution is 'technical'").

TABLE 6. Patent technology classes

Number of tech classes	N		Mean	*p*
USPC	2532	Never inst.	3.8	0.009***
		Instituted	4.1	
		Denied inst.	3.8	0.014**
		Always inst.	4.1	
CPC	2532	Never inst.	9.7	0.639
		Instituted	9.9	
		Denied inst.	9.8	0.928
		Always inst.	9.8	
IPC	2532	Never inst.	4.8	0.056*
		Instituted	4.4	
		Denied inst.	4.8	0.013**
		Always inst.	4.3	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for p < .10; **for p < .05; and *** for p < .01.

As shown below in Table 7, we find significant correlations between institution and a patent's classification as a "high tech," "business method," "medical," or "pharmaceutical" patent. While "high tech" patents were significantly more likely to be instituted (and thus appear to be of lower quality), the remaining categories were significantly less likely to be instituted (and thus appear to be of higher quality).

With respect to patents covering medical and pharmaceutical technology, our findings are consistent with conventional wisdom that such patents are of relatively high quality. One reason may be that pharmaceuticals are typically covered by just a handful of patents each.[238] In addition, pharmaceutical patents are likely to have clearer bounds than most other pa-

238. *See, e.g.*, Lisa Larrimore Ouellette, *How Many Patents Does It Take To Make a Drug? Follow-On Pharmaceutical Patents and University Licensing*, 17 MICH. TELECOMM. & TECH. L. REV. 299, 516–17 (2010) (reporting that pharmaceuticals are typically protected by just two to four patents per drug).

tents;[239] indeed, some claim specific molecules.[240] Relatively speaking, both facts tend to make it easier for applicants and examiners to locate and account for relevant prior art. Low patent density also tends to increase the value of individual pharmaceutical patents, which in turn may increase applicants' incentives to obtain high-quality patents. Whatever the precise cause, of all the data points that we analyzed, a patent's status as a pharmaceutical patent is one of the most impactful; 42 percent of challenged pharmaceutical patents were never instituted, compared to just 25 percent of all other patents.

Our findings with respect to "high tech" patents are, again, generally consistent with long-espoused complaints about the quality of patents covering computing and communications technology. In stark contrast to pharmaceuticals, many consumer electronics are plausibly covered by thousands of individual patents,[241] many of which were obtained reflexively to serve as small pieces of large defensive bulwarks rather than with assertion in mind.[242] In addition, there is good reason to believe that the USPTO may be ill equipped to locate important prior art to cutting-edge computing technology.[243]

239. *See*, *e.g.*, JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 107 (2008) (discussing "the comparatively clear boundaries of chemical (including pharmaceutical) patents"); Mark A. Lemley, *Software Patents and the Return of Functional Claiming*, 2013 WIS. L. REV. 905, 930 ("Unlike chemistry and biotechnology, where we have a clear scientific language for delineating what a patent claim does and doesn't cover, there is no standard language for software patents.").

240. *See, e.g.*, U.S. Patent No. 4,681,893 (filed July 21, 1987) (claiming atorvastatin calcium, the active ingredient in Lipitor).

241. For example, defensive patent aggregator RPX once placed the number of patents covering some aspect of a smartphone at approximately 250,000. RPX Corp., Registration Statement (Form S-1) 59 (Sept. 2, 2011), http://www.sec.gov/Archives/edgar/data/1509432/ 000119312511240287/ds1.htm (last visited Jan. 20, 2018) [https://perma.cc/FZY3-VV8W].

242. *See, e.g.*, Colleen V. Chien, *From Arms Race to Marketplace: The New Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 308–09 (2010) (defining "defensive patenting" as "the filing of patents in order to gain freedom to operate, for the specific purposes of maintaining patent peace, obtaining access to the technology of others, and neutralizing patent lawsuits" and noting that "[l]arge portfolios have spawned the development of other large portfolios").

243. *See* Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 CALIF. L. REV. 1, 42–43 (2001) (noting that while "[t]he patent system presumes a finite, comprehensively indexed technical literature

That said, the subset of high tech patents that cover software and business methods stand out in our results as exceptions to the conventional wisdom. No other category of patent has been criticized more heavily in recent years than these two.[244] Yet, we fail to find a significant correlation between institution and software coverage and, more surprisingly still, find a significant *negative* correlation between institution and business method coverage. Thirty-eight percent of business method patents in our study were never instituted, close to the same rate that we observe for pharmaceutical patents.

We are reluctant, however, to interpret these results as indicating that business method patents are of high quality generally. Instead, we suspect that our findings reflect selection effects caused by the availability of CBM review, in which petitioners can argue that a patent fails to meet the standards of sections 101 and 112 of the Patent Act, in addition to sections 102 and 103. We hypothesize that parties seeking to challenge the validity of business method patents generally prefer to do so in a venue where they can argue that the patent falls outside the scope of patentable subject matter or fails to meet the requirements of section 112 due to unwarranted use of broad "functional" claim language.[245] If so, business method

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and relies on individual examiners to . . . search the relevant subliteratures," it is often the case that "software innovations . . . may be documented only via developer specifications or online FAQs [, and f]requently, the source code itself is never released at all"); Margo A. Bagley, *Internet Business Model Patents: Obvious by Analogy*, 7 MICH. TELECOMM. & TECH. L. REV. 253, 279 (2001) ("Commercial business models of the type that are being applied to the Internet, are likely, if anything, to be less well documented than financial methods. There simply is no real scientific literature on business models.").

244. *See, e.g.*, Lemley, *supra* note 239, at 928 ("Software patents are widely acknowledged as creating a large number of problems for the patent system."). In fact, many commentators have argued in favor of eliminating patent protection for software. *See* Pamela Samuelson, *Benson Revisited: The Case against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1135–36 (1990).

245. *See* Williamson v. Citrix Online, LLC, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (en banc) (holding that a claim "recit[ing] function without reciting sufficient structure for performing that function" should be interpreted as a means-plus-function claim under section 112(f) and, thus, is invalid as indefinite under section 112(b) if the patent's specification fails to "disclose[ ] sufficient structure that corresponds to the claimed function" (internal quotation marks omitted)); *see also* Shong Yin, Williamson v. Citrix Online*: A Fundamental Shift and Return to Form in Means-Plus-Function Interpretation*, 31 BERKELEY TECH. L.J. 687, 707 (2016) ("The impact of the *Williamson II* decision has been expedient and immediate across the PTO and district courts. Over twenty PTAB decisions

patents challenged in inter partes review will be, relative to the broader population of business method patents, disproportionately less likely to be susceptible to challenges under sections 101 and 112 and thus *more* likely to have narrow claims that are limited to narrow applications in particular fields. Such claims, it seems safe to assume, would also be less susceptible to challenges on anticipation or obviousness grounds.[246]

TABLE 7. Patent technology areas

	N		Yes	No	*p*
High tech	1367 / 2532	Never inst.	23% (321)	30% (350)	0.000***
		Instituted	77% (1046)	70% (815)	
		Denied inst.	32% (437)	36% (415)	0.006***
		Always inst.	68% (930)	64% (750)	
Medical	423 / 2532	Never inst.	36% (151)	25% (520)	0.000***
		Instituted	64% (272)	75% (1589)	
		Denied inst.	42% (178)	32% (674)	0.000***
		Always inst.	58% (245)	68% (1435)	
Pharma	199 / 2532	Never inst.	42% (84)	25% (587)	0.000***
		Instituted	58% (115)	75% (1746)	
		Denied inst.	49% (98)	32% (754)	0.000***
		Always inst.	51%(101)	68% (1579)	
Software	599 / 2532	Never inst.	26% (158)	27% (513)	0.958
		Instituted	74% (441)	73% (1420)	
		Denied inst.	35% (208)	33% (644)	0.521
		Always inst.	65% (391)	67% (1289)	
Business methods	181 / 2532	Never inst.	38% (69)	26% (602)	0.000***
		Instituted	62% (112)	74% (1749)	
		Denied inst.	48% (87)	33% (765)	0.000***
		Always inst.	52% (94)	67% (1586)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for $p < .10$; ** for $p < .05$; and *** for $p < .01$.

As shown below in Tables 8 and 9, we additionally find significant correlations between a patent's likelihood of institution and metrics of its length and complexity. While we fail to find a

and over twenty district court decisions have cited it.").

246. *See* sources cited *supra* note 227 (linking patent ineligibility to anticipation and obviousness).

significant relationship between claim count and institution,[247] we do nonetheless find significant correlations with respect to the word count of various parts of a patent.

Looking first at the length of a challenged patent's specification, we find a significant relationship between institution and both absolute and relative length measurements. Though one might expect patent length to serve as a proxy for the patentee's sophistication and resources, our findings are a bit more nuanced. Specifically, we find that while patent length *per claim* is negatively correlated with institution, absolute patent length is positively correlated with institution. That is, we find that never-instituted patents have fewer total words, shorter abstracts, and shorter specifications, but nonetheless have more words per claim than instituted patents. While, again, there may be various factors at play here, we suspect that these results reflect two effects. First, long patents with a large number of claims may tend to cover so much ground that they overwhelm examiners and prosecutors. Second, patents with specifications that are long relative to their claim count may tend to better disclose the patented technology, including relevant prior art. If so, such disclosure may assist examiners or reflect greater pre-filing diligence on the part of their applicants or prosecutors.

247. This finding itself may be noteworthy simply because it seems logical to assume that the more claims a patent has, the more opportunities there are for the applicant or examiner to make a mistake. *See* Mann & Underweiser, *supra* note 20, at 19 ("It is easy to suggest hypotheses that would relate the number of claims or complexity of the patent to validity. For example, a patent with more claims necessarily has more places in which mistakes could have been made.").

TABLE 8. Patent length

	N		Mean	*p*
Total number of claims	2532	Never inst.	28	0.101
		Instituted	30.1	
		Denied inst.	29.1	0.543
		Always inst.	29.8	
Number of independent claims	2532	Never inst.	3.9	0.319
		Instituted	4	
		Denied inst.	3.9	0.607
		Always inst.	4	
Word count entire patent	2532	Never inst.	14678	0.053*
		Instituted	16040	
		Denied inst.	15154	0.275
		Always inst.	15945	
Patent word count per claim	2532	Never inst.	1033	0.034**
		Instituted	820	
		Denied inst.	963	0.122
		Always inst.	833	
Abstract word count	2532	Never inst.	112	0.006***
		Instituted	118	
		Denied inst.	114	0.126
		Always inst.	117	
Specification word count	2532	Never inst.	12756	0.071*
		Instituted	13969	
		Denied inst.	13109	0.238
		Always inst.	13920	
Specification word count per independent claim	2532	Never inst.	5909	0.055*
		Instituted	5121	
		Denied inst.	5731	0.103
		Always inst.	5126	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for $p < .10$; **for $p < .05$; and *** for $p < .01$.

Turning to the length of challenged patents' claims, we fail to find a significant correlation between institution and the overall length of a patent's claim set. That said, as shown below in Table 9, we do find significance for both measures of the length of claim 1. As conventional wisdom has long suggested,[248] we find that instituted patents have significantly shorter individual claims, while patents that avoided institution have significantly longer claims.

TABLE 9. Claim length

	N		Mean	*p*
Total word count of all claims	2532	Never inst.	1473	0.440
		Instituted	1536	
		Denied inst.	1546	0.619
		Always inst.	1506	
Claim 1 word count	2532	Never inst.	169	0.074*
		Instituted	158	
		Denied inst.	171	0.005***
		Always inst.	156	
Claim 1 unique word count	2532	Never inst.	60.5	0.003***
		Instituted	57.5	
		Denied inst.	60.7	0.000***
		Always inst.	57.1	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

C. Examination Intensity

Moving next to data that proxies the scrutiny each application received from the USPTO, we again find a number of significant correlations with institution. First, as shown below in Table 10, we find a significant correlation between institution and various categories of "backward citations." While one might expect institution to be negatively correlated with counts of such citations—for example, on the theory that more diligent

248. As discussed *supra* note 59 and accompanying text.

applicants and examiners will tend to find and review more prior art[249]—we actually find the opposite. We observe that never-instituted patents cited fewer pieces of prior art overall, had fewer prior art citations added by the examiner, and cited to fewer pieces of non-patent prior art.

Though perhaps initially surprising, these results are nonetheless consistent with findings by other researchers. In prior studies of patents examined by the EPO or challenged in EPO opposition procedures, both Lei and Wright[250] and Harhoff and Reitzig[251] found a negative correlation between prior art citations and patent quality. Accordingly, we suspect that these correlations tell us little about applicant and examiner diligence and instead reflect, to a much greater degree, the density and proximity of prior art to the patented invention. In other words, a large number of backward citations may simply reflect that the applicant and examiner correctly determined that the claimed invention was similar to a large number of pre-existing disclosures (some of which they may have inadvertently missed), while a small number of backward citations may similarly reflect that the applicant and examiner correctly concluded that the claimed invention is relatively unique and thus less likely to be anticipated or obvious.

249. *See, e.g.*, Kimberly A. Moore, *Xenophobia in American Courts*, 97 NW. U. L. REV. 1497, 1538 (2003) (hypothesizing that "patents that include more citations or more diverse citations are more likely to be valid").

250. Zhen Lei & Brian D. Wright, Why Weak Patents? Rational Ignorance or Pro-"Customer" Tilt? 38 (July 26, 2009) (unpublished manuscript), http://policydialogue.org/files/events/Lei_Wright_Why_Weak_Patents.pdf [https://perma.cc/R2BT-WB6M] ("[F]or the US patents in our sample, a higher number of *cited* prior patents is positively correlated with the failure at the EPO. Higher citations of prior art tend to indicate the weakness of a patent, rather than survival of a more rigorous examination, partly because issuing a US patent itself does not tell us much about its strength, as the applicant can always persist until the US examiner concedes.").

251. Harhoff & Reitzig, *supra* note 70, at 470 (finding "that there is also a significant relationship between backward citations and the incidence of opposition").

TABLE 10. Backward citations

	N		Mean	*p*
Total number of backward citations	2532	Never inst.	114	0.007***
		Instituted	142	
		Denied inst.	127	0.317
		Always inst.	138	
Added by examiner	2161	Never inst.	6.1	0.013**
		Instituted	7.1	
		Denied inst.	6.2	0.012**
		Always inst.	7.1	
Number of backward citations to foreign patent materials	2532	Never inst.	12.4	0.737
		Instituted	12.0	
		Denied inst.	12.4	0.733
		Always inst.	12.0	
Added by examiner	2211	Never inst.	0.14	0.160
		Instituted	0.18	
		Denied inst.	0.15	0.374
		Always inst.	0.18	
Number backward citations to non-patent literature	2352	Never inst.	34.5	0.002***
		Instituted	52.1	
		Denied inst.	44.0	0.438
		Always inst.	49.2	
Added by examiner	2258	Never inst.	0.64	0.427
		Instituted	0.54	
		Denied inst.	0.64	0.338
		Always inst.	0.52	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for $p < .10$; ** for $p < .05$; and *** for $p < .01$.

With respect to specific examination events, we find just a few relatively weak correlations. As shown below in Table 11, we fail to find a significant correlation between institution and the duration of the examination process, which we measure as the number of days between application filing and patent grant ("pendency"). Nor do we find a significant relationship between institution and whether a patent's applicant conducted one or more examiner interviews,[252] amended its claims after a notice of allowance,[253] or gave notice of an intent to appeal some aspect of the examination.[254] Despite the intuition that longer, more eventful examination may correlate with more rigorous examination and thus higher-quality patents, our data suggests a lack of a clear relationship between the two. To the contrary, as our findings with respect to backward citations also attest, it may be the case that more unique inventions have less prior art and thus face a speedier path to issuance.

That said, we do find a modestly significant negative correlation between institution and both the number of times an application was the subject of a final rejection and the number of times the applicant filed an information disclosure statement (IDS). More rejections may correlate with more rigorous examination or, conversely, may indicate that the patent's claims are very close to the prior art. Similarly, more frequent disclosure of prior art by an applicant may correlate with applicant diligence or, conversely, may indicate that the applicant is seeking patent protection in a field crowded with prior art. All in all, our findings suggest that backward citations and the frequency of examination events are, at best, noisy proxies for quality.

Following Marco et al., we additionally examined the change in total number of claims and word count of claim 1 from the time that each patent's application was published to the time the application issued.[255] Our results here are a mixed bag. While we do observe a larger decrease in the number of claims from publication to grant among non-instituted patents, we do not find a significant correlation between institution and

252. *See* MPEP § 713 (9th ed. Rev. Aug. 2017) (setting forth procedures for requesting and conducting "interviews" (i.e., live video, phone, or in-person discussions between applicants and examiners)).

253. *See id.* § 714.16 (setting forth procedures by which an applicant can request a claim "amendment . . . before or with the payment of the issue fee" that "may be entered on the recommendation of the primary examiner . . . without withdrawing the application from issue"). Such amendments are often referred to as "Rule 312" amendments because they are authorized by 37 C.F.R. § 1.312 (2012). Our finding with respect to Rule 312 amendments contrasts with that of Mann and Underweiser, who found a strong, positive correlation between invalidity in Federal Circuit opinions and the use of Rule 312 amendments. Mann & Underweiser, *supra* note 20, at 29.

254. *See* MPEP § 1204 (9th ed. Rev. Aug. 2017) (setting forth procedures for appealing an application's rejection).

255. Marco et al., *supra* note 211.

the change in word count of claim 1.

TABLE 11. Prosecution pendency, event counts, and effect on claim count/length

	N		Mean	*p*
Pendency	2532	Never inst.	1166	0.281
		Instituted	1126	
		Denied inst.	1163	0.236
		Always inst.	1123	
Number of final rejections	2532	Never inst.	0.57	0.104
		Instituted	0.51	
		Denied inst.	0.57	0.067*
		Always inst.	0.50	
Number of non-final rejections	2532	Never inst.	1.33	0.701
		Instituted	1.31	
		Denied inst.	1.34	0.410
		Always inst.	1.31	
Number of IDSs filed	2532	Never inst.	3.5	0.260
		Instituted	3.2	
		Denied inst.	3.5	0.073*
		Always inst.	3.2	
Examiner interview	2532	Never inst.	0.37	0.568
		Instituted	0.34	
		Denied inst.	0.37	0.518
		Always inst.	0.34	
Amendment after notice of allowance	2532	Never inst.	0.15	0.316
		Instituted	0.17	
		Denied inst.	0.17	0.679
		Always inst.	0.16	
Notice of appeal	2532	Never inst.	0.10	0.776
		Instituted	0.10	
		Denied inst.	0.10	0.923
		Always inst.	0.10	
Change in number of claim 1 words	1709	Never inst.	35.9	0.206
		Instituted	23.1	
		Denied inst.	32.6	0.337
		Always inst.	23.4	
Change in number of claims	1709	Never inst.	-0.62	0.014**
		Instituted	-0.02	
		Denied inst.	-0.48	0.047**
		Always inst.	-0.02	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

Turning next to data on patent families, we do not find a significant correlation between institution and the size of a patent's U.S. family. As shown below in Table 12, we do, however, find a significant negative correlation between institution and the number of foreign applications in a patent's family. In addition to capturing an applicant's confidence in the uniqueness and value of its invention, this finding may indicate that patent quality is enhanced when an invention is reviewed by multiple patent examiners employed by multiple patent offices. Prior and concurrent examinations may turn up additional prior art, limit applicants' ability to interpret claim language in certain ways,[256]and (at the very least) suggest that the invention is one viewed by its applicant as worth the cost of pursuing a bulwark of patent protection.

TABLE 12. Patent family

	N		Mean	*p*
Number of U.S. parent applications	2532	Never inst.	2.14	0.264
		Instituted	2.28	
		Denied inst.	2.21	0.690
		Always inst.	2.26	
Number of U.S. child applications	2532	Never inst.	2.46	0.751
		Instituted	2.38	
		Denied inst.	2.46	0.682
		Always inst.	2.37	
Number of foreign family members	2532	Never inst.	3.52	0.020**
		Instituted	2.97	
		Denied inst.	3.52	0.004***
		Always inst.	2.91	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for p < .10; **for p < .05; and *** for p < .01.

That said, despite observing a significant effect associated with foreign examination generally, we fail to detect a clear,

256. *See, e.g.*, Therasense, Inc. v. Becton, Dickinson & Co., 864 F. Supp. 2d 856, 869 (N.D. Cal. 2012) (holding that a patent-in-suit is unenforceable due to inequitable conduct stemming from failure to disclose to the USPTO briefs that were filed with the EPO during prosecution of a related application).

significant link between U.S. patent quality and concurrent examination by any of the world's next four most popular patent offices.[257] Though it is often said that at least the EPO provides more thorough examination than the USPTO,[258] we find little evidence that additional scrutiny from any particular foreign patent office improves U.S. patent quality.

TABLE 13. International patent family

	N		Yes	No	*p*
EPO family member	868/2100	Never inst.	27% (234)	26% (321)	0.651
		Instituted	73% (634)	74% (911)	
		Denied inst.	36% (310)	33% (406)	0.191
		Always inst.	64% (558)	67% (826)	
JPO family member	645/2100	Never inst.	28% (180)	26% (375)	0.309
		Instituted	72% (465)	74% (1080)	
		Denied inst.	36% (230)	33% (486)	0.319
		Always inst.	64% (415)	67% (969)	
KIPO family member	286/2100	Never inst.	29% (84)	26% (471)	0.221
		Instituted	71% (202)	74% (1343)	
		Denied inst.	40% (115)	33% (601)	0.022**
		Always inst.	60%(171)	67% (1213)	
SIPO family member	434/2100	Never inst.	28% (120)	26% (435)	0.541
		Instituted	72% (314)	74% (1231)	
		Denied inst.	35% (152)	34% (564)	0.650
		Always inst.	65% (282)	66% (1102)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

D. Post-Grant Characteristics

The final group of bivariate comparisons that we report explores correlations with patent characteristics acquired after is-

257. *See* WORLD INTELL. PROP. ORG., WIPO IP FACTS AND FIGURES 11 (2016), http://www.wipo.int/edocs/pubdocs/en/wipo_pub_943_2016.pdf [https://perma.cc/39V3-4HRM] ("Just five IP offices account for more than four-fifths of all patent filings.").

258. *See* Chien, *supra* note 3, at 15 ("Industry surveys conducted in 2010, 2011, 2012, and 2015-2016 have each consistently found the EPO to have the highest ratings among the five leading Patent Offices around the world.").

suance. Though well removed from the actual prosecution of challenged patents, these data points may nonetheless reveal how other patent-system participants assessed the patent's quality at various times post-issuance.

First, we consider "forward citations," that is, citations to the challenged patent that appear on the face of subsequent patents. As shown below in Table 14, we do not find a significant correlation between forward citations and institution. This result is noteworthy because forward citations are generally considered the single most important proxy for patent value—usually under the theory that such citations indicate "that an innovation has contributed to the development of subsequent invention."[259] Consistent with this theory, one might expect petitioned patents with more forward citations to pre-date more of the art in a particular field and, thus, possess claims that are more likely to be novel and nonobvious. However, we find no evidence supporting this hypothesis.

TABLE 14. Forward citations

	N		Mean	*p*
Number of forward citations	2532	Never inst.	48.8	0.584
		Instituted	51.4	
		Denied inst.	51.0	0.933
		Always inst.	50.6	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for $p < .10$; ** for $p < .05$; and *** for $p < .01$.

Turning next to each patent's ownership history, we do find a number of significant results. As shown below in Tables 15 and 16, we find that instituted patents are more likely to have changed hands and more likely to have changed hands frequently.

259. Jean O. Lanjouw & Mark Schankerman, *Characteristics of Patent Litigation: A Window on Competition*, 32 RAND J. ECON. 129, 137 (2001).

TABLE 15. Reassignment history

	N		Yes	No	*p*
Reassigned?	1417 / 2532	Never inst.	25% (348)	29% (323)	0.014**
		Instituted	75% (1069)	71% (792)	
		Denied inst.	32% (458)	30% (394)	0.117
		Always inst.	68% (959)	70% (721)	
Three or more reassignments?	497 / 2532	Never inst.	23% (112)	27% (559)	0.027**
		Instituted	77% (385)	73% (1476)	
		Denied inst.	31% (154)	34% (698)	0.169
		Always inst.	69% (343)	66% (1337)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

TABLE 16. Reassignment count

	N		Mean	*p*
Reassignment count	2532	Never inst.	1.2	0.003***
		Instituted	1.4	
		Denied inst.	1.3	0.191
		Always inst.	1.4	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the mean value of a trait for the 671 petitioned patents never instituted on the merits to the mean value for the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the mean value of a trait for the 852 patents denied institution on the merits in at least one petition to the mean for the 1,680 patents always instituted. Significant differences in means across institution categories designated: * for p < .10; **for p < .05; and *** for p < .01.

Also, as shown below in Table 17, we find significant positive correlations between a patent's institution and its ownership by an NPE or PAE—a finding that may reflect a tendency for NPEs and PAEs to choose patents with broad claims that are more likely to cover both popular products and the prior art. While reassignment might plausibly serve as a proxy for a number of things, we suspect that it most likely reflects whether challenged patents were sold on the secondary market for monetization purposes.[260] We explore this relationship further below.

TABLE 17. Current owner type

	N		Yes	No	*p*
Individual	57 / 2532	Never inst.	42% (24)	26% (647)	0.010**
		Instituted	58% (33)	74% (1828)	
		Denied inst.	46% (26)	33% (826)	0.065*
		Always inst.	54% (31)	67% (1649)	
NPE	1034 / 2532	Never inst.	22% (224)	30% (447)	0.000***
		Instituted	78% (810)	70% (1051)	
		Denied inst.	31% (316)	36% (536)	0.007***
		Always inst.	69% (718)	64% (962)	
PAE	788 / 2532	Never inst.	19% (149)	30% (522)	0.000***
		Instituted	81% (639)	70% (1222)	
		Denied inst.	29% (228)	36% (624)	0.001***
		Always inst.	71%(560)	64% (1120)	
University	77 / 2532	Never inst.	34% (26)	26% (645)	0.150
		Instituted	66% (51)	74% (1810)	
		Denied inst.	35% (27)	34% (825)	0.807
		Always inst.	65% (50)	66% (1630)	

Note: Population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never inst." versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. "Denied inst." versus "Always inst." compares the 852 patents denied institution on the merits in at least one petition to the 1,680 patents always instituted. Institution rates with number of patents in parenthesis. Significant differences in institution rates designated: * for p < .10; **for p < .05; and *** for p < .01.

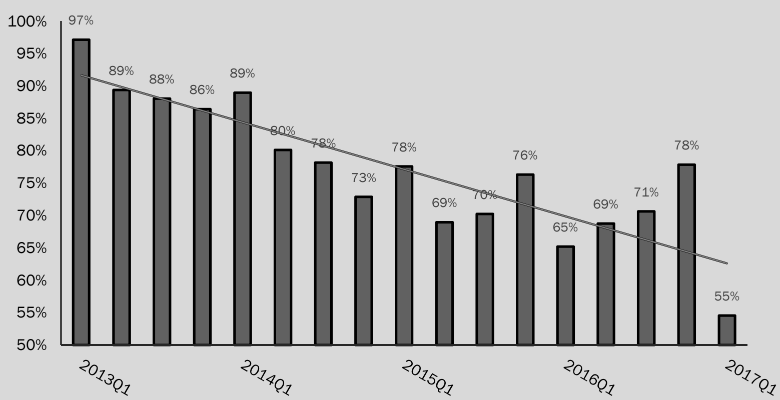
Finally, we note the potential importance of the timing of each patent's challenge. To gauge whether PTAB panels have become more or less strict over time, we grouped all challenged patents by the date of their first institution decision on the merits and calculated quarterly "first-time institution rates." As shown below in Figure 2, we observe a rather large, significant drop in that rate over time.[261] While such a drop does not

260. To explore the relationship between reassignments and NPE-ownership, we regressed the probability that a petitioned patent was never instituted on three variables: NPE-ownership and both reassignment measures. In that three-variable regression, NPE- and PAE-ownership remained highly significant, while reassignment lost significance—a finding that strongly suggests that our reassignment-related correlations are driven by ownership-type.

261. We find a significant nine-month gap (p = 0.000) between the mean quarter of first institution decision among instituted patents and the mean quarter of first institution decision among never-instituted patents.

necessarily indicate a change in PTAB institution standards—for example, petitioners may have initially challenged especially weak patents—our multivariate results (discussed below) show that this decline persists even when controlling for the other significant data points we study.[262]

FIGURE 2: First-time institution rate by quarter



Note: Quarterly first-time institution rates calculated using the population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Linear trend included with an average 1.8 percent decline in first-time institution rate each quarter. Chi-square test rejected the null that the first-time institution rate has not declined over the time period (p = 0.000).

V. MULTIVARIATE ANALYSIS

While the bivariate results reported above are interesting in their own right, many of the patent traits studied are intercorrelated. To shed more light on the driving forces behind our results, we ran three series of probit regressions to determine which of the predictors identified *supra* in Part IV survive multivariate analysis.[263] First, we examined a single regression of twenty-one of the most promising variables across our

262. Later in our multivariate analysis, we find that the quarterly trend is a significant predictor of institution with the addition of one quarter predicting a 0.7 percent decrease in the chance of institution. Accordingly, the IPR institution rate appears to have declined over time even controlling for the various patent characteristics we study.

263. We report the marginal effects for each independent variable using Stata's *dprobit* command.

population of patents.[264] Next, we analyzed a series of similar regressions that additionally compare combinations of the four examiner characteristics. Finally, we calculated a series of regressions across subsets of petitioned patents. In this third regression, we also tested whether additional variables that did not appear significant above might nonetheless show significance in smaller subsets of challenged patents.

A. *Twenty-One Variables, Across All Patents*

For the first of our multivariate regressions, we selected a set of twenty-one variables for further analysis. We selected these with two considerations in mind: first, their significance in the bivariate regressions reported above, and second, their representativeness of the various categories of data that we collected.[265] The variables that we selected are listed below in the first column of Table 18, which also presents the results of a probit regression of all twenty-one variables across 2,527 challenged patents. While each variable was significantly correlated with institution in the bivariate analysis described above, we find that many lose their significance when we control for the other twenty. That said, many others retain their significance and, thus, stand out to us as strong predictors of patent quality.

Beginning with applicant characteristics, we find that while small entity status remains significant, initial assignment of the petitioned patent to an individual is no longer a significant predictor of institution. Controlling for the other twenty variables included in Table 18, petitioned small-entity patents remain about five percent more likely to be instituted at least once. With respect to the applicant's choice of prosecution counsel, we see that petitioned patents prosecuted by large firms remain significantly more likely (about six percent) to avoid institution. That said, controlling for all twenty other variables, prosecution by a solo practitioner loses its significance, likely due to its correlation with small-entity status.[266]

264. With the exception of five patents for which we lack examiner-related data.

265. We also avoided including highly correlated or collinear variables from the same group in the same regression.

266. However, in an unreported regression that omits the large firm variable from Table 18, we find that prosecution by a solo practitioner is also a significant

Turning next to the characteristics of petitioned patents' examiners, we find significance with respect to the allowance rate of examiners' art units and the differential between examiners' allowance rates and that of the art units (though the latter is significant only at a 90 percent confidence level). We investigate the relationship between institution- and examiner-related variables in greater detail below.

Moving on to characteristics of the petitioned patents themselves, we first make the noteworthy finding that neither of the two patent age-related variables—time from priority to first petition and grant year—remains significant. Despite the high negative correlation between these two age characteristics, including both in our regressions is not the source of lost significance. Rather, additional correlation tests revealed that both variables are highly correlated with other, stronger predictors of institution, including examiner characteristics, backward citations, technology type, and PAE ownership.

Interestingly, we also fail to find significant relationships between institution and "high tech" or "pharmaceutical" subject matter.[267] As revealed below in Table 19, specification 2, pharmaceutical patents are significantly less likely to be instituted when not controlling for both examiner and art unit allowance rates. Thus, the lack of pharmaceutical significance in Table 18 is due to the strong negative correlation between pharmaceutical coverage and both examiner allowance rate and art unit allowance rate.[268] High tech subject matter is also strongly correlated with several other variables, including examiner experience, examiner allowance rate, patent age, and PAE ownership.[269]

predictor of institution, with solo-prosecuted patents 5 percent more likely to be instituted than other patents (p = 0.049). Thus, prosecutor size appears to be a robust proxy for patent quality.

267. In similar unreported regressions, we substituted "medical" subject matter for "pharmaceutical" subject matter, and separately substituted "software" subject matter for "high tech" subject matter. Neither swap reversed the lack of significance we report here.

268. The mean allowance rate among examiners of challenged pharmaceutical patents was 55 percent, while the mean allowance rate among examiners of all other challenged patents was 79 percent (p = 0.000). Similarly, the mean allowance rate among art units to which challenged pharmaceutical patents were assigned was 57 percent, while the mean allowance rate among all other art units to which challenged patents were assigned is 75 percent (p = 0.000).

269. Almost all PAE patents are high tech patents, and as we have already discussed, PAE patents are significantly more likely to be instituted. Moreover,

While our technology classification variables lose most of their explanatory power in our multivariate regressions, the number of USPCs assigned to a patent by the USPTO remains statistically significant. As shown below in Table 18, the marginal effect of one additional USPC is a 0.6 percent increase in the chance of institution.[270] We likewise continue to see a significant relationship between institution and both length-related variables that we included. The number of unique words in claim 1, in particular, appears to be a robust proxy for quality, with a marginal effect of 10 additional words reducing the risk of institution by 1 percent. For word count per claim, our regression reveals a far more modest marginal effect: a decrease of 1,000 words per claim leads to just a 1 percent increase in the probability of institution.[271]

Moving to prosecution-related variables, we continue to see modest effects. First, while the total number of backward citations remains a significant positive predictor of institution, the magnitude of the effect is small, with an additional 100 citations associated with just a 1.5 percent increase in the probability of institution.[272] We likewise find weak evidence that the

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the mean allowance rate among examiners of challenged high tech patents was 82 percent, while the mean allowance rate among examiners of all other challenged patents was 71 percent ($p = 0.000$).

270. In an unreported set of specifications in which we substituted IPC count for USPC count, IPC count was not a significant predictor of institution ($p = 0.125$).

271. In an unreported set of specifications, we found that specification-word-count-per-independent-claim also has a statistically significant, negative relationship with institution. For example, when we substituted specification-word-count-per-independent-claim for total-word-count-per-claim in specification 3 of Table 19, we found that a decrease of 1,000 words per independent claim in the specification is associated with a 0.27 percent increase in the probability of institution ($p = 0.010$). In unreported specifications, we also tested the three "absolute" length variables mentioned above—total word count, total specification word count, and total abstract word count. None of these was a significant predictor of institution, however.

272. In unreported regressions, we also found that reverse citations to NPL was a positive, statistically significant predictor of institution. In fact, the magnitude of this variable's impact (in an alternative version of Table 19 specification 3) was about twice that of total reverse citations, with an additional 100 citations to NPL leading to a more than 3 percent increase in the probability of institution (i.e., a coefficient of -0.00033 with $p = 0.001$). In yet other unreported regressions similar to those in Table 19, we found that the variable "reverse citations added by the examiner" is a positive, but not statistically significant, predictor of institution. In an alternative version of Table 19 specification 3, the marginal effect for "reverse citations added by the examiner" was -0.0018 ($p = 0.085$).

number of IDS filings in a patent's prosecution history is a useful predictor of institution. While the marginal effect is a 0.36 percent decrease in the chance of institution per additional IDS filing, it just misses significance at the 90 percent confidence level (*p* = 0.104).[273] Finally, controlling for all twenty other variables, we fail to find significance in any variable related to family size.

We do find, however, significant relationships between institution and acquired patent characteristics. First, we continue to see (with our "Quarter First Institution Decision" variable) that patents subject to institution decisions more recently are less likely to have been instituted, which suggests either that the PTAB has become easier on petitioned patents over time or that we have failed to capture in our variables one or more significant metrics that have varied over time. We also continue to see statistically significant results for patents owned by PAEs. Even after controlling for all of the other quality-related characteristics listed in Table 18, PAE patents remain nearly 8 percent more likely than all other patents to have been instituted.[274]

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273. In an unreported regression, we substituted the number of final rejections for the number of IDS filings and found rejection count to be entirely insignificant ($p > 0.600$).

274. In unreported regressions, we found that NPE ownership is likewise a statistically significant predictor of institution. Of the two, PAE ownership is the stronger predictor. Substituting NPE for PAE in Table 18 yields a coefficient of -0.051 ($p = 0.016$). As discussed above, PAE ownership is also highly correlated with all three of our reassignment history variables shown in Tables 15 and 16. We tested this relationship in three unreported regressions that each added a reassignment-related variable to Table 18. In each of these regressions, PAE ownership remained significant, while each reassignment variable lost its significance. Accordingly, our reassignment history variables appear to lack significance independent of PAE ownership.

TABLE 18. Probit estimation of the likelihood a petitioned patent was never instituted.

	Marginal effect	Robust standard error
Applicant, prosecutor, and examiner characteristics		
Small entity	-0.050**	(0.020)
Individual assignee	-0.011	(0.032)
Large firm prosecutor	0.063***	(0.019)
Solo firm prosecutor	-0.023	(0.027)
Number of applications examiner reviewed	-0.000018	(0.000013)
Art Unit allowance rate	-0.299***	(0.096)
Allowance rate differential (relative to art unit)	-0.145*	(0.082)
Patent characteristics		
Quarter first institution decision	0.0078***	(0.0023)
Years earliest priority to first petition	-0.0028	(0.0025)
Grant year	-0.0037	(0.0028)
Number of U.S. patent classes	-0.0063**	(0.0031)
High tech	0.010	(0.021)
Pharma	0.062	(0.042)
Word count per claim	0.000011**	(0.00005)
Unique word count of claim 1	0.0013***	(0.0004)
Examination intensity		
Number of backward citations	-0.00015***	(0.00004)
Number of IDSs filed	0.0036	(0.0022)
Number of foreign family members	-0.0013	(0.0020)
Post-grant characteristics		
Reassigned?	-0.008	(0.019)
Individual owned	0.172**	(0.074)
PAE owned	-0.076***	(0.021)
Log-likelihood	-1390	
Observations	2527	

Note: Population of 2,527 patents (with complete examiner data) subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never Instituted" versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. Marginal effects reported with discrete change of dummy variables from 0 to 1. Robust standard errors included in parenthesis. * p < .10; ** p < .05; and *** p < .01.

B. *Examiner Characteristics*

Among the variables that remain significant in the regression described above, patent examiner characteristics stand out as perhaps the most intriguing. Unfortunately, they are also the most highly correlated—and, in the case of allowance rates, clearly collinear. To investigate these variables further, we conducted a series of multivariate regressions, five of which are shown below in Table 19, to compare various combinations of four traits of petitioned patents' examiners: the total number of applications they have examined, their allowance rates, their art units' allowance rates, and the differential between these latter two rates.[275] Of these four variables, our results strongly suggest that examiner allowance rate is the most important.

First, we began by comparing the marginal effects of examiner allowance rate and art unit allowance rate.[276] Though we saw above that both have a significant positive correlation with institution, the two variables are clearly correlated to some extent because art units with higher overall allowance rates will naturally tend to be staffed with many examiners that have relatively high individual allowances rates. Before comparing the two variables together in a single regression, we first measured the marginal effect of each variable in a nineteen-variable regression that omits the other.[277] The regression that included only examiner allowance rate returned a coefficient of -0.248 (p = 0.000), indicating that a 10 percent increase in an examiner's allowance rate leads to a 2.5 percent decline in a probability that a patent examined by that individual will never be instituted. The regressions that included only art unit allowance rate returned a coefficient of -0.260 (p = 0.002), indicating quite similarly that a 10 percent increase in an art unit's allowance rate is associated with a 2.6 percent drop in the probability that a petitioned patent from that unit will never be instituted. Thus, our findings suggest that decreases in either examiner allowance rates or art unit allowance rates will improve patent quality.[278] When we include both variables together in a single regression, as shown below in Specification 1, the results suggest that examiner allowance rate is the stronger of the two, with a coefficient of -0.193 (p = 0.009) compared to a coefficient of -0.149 (p = 0.111) for art unit allowance rate. These results suggest that, when controlling for

275. In Table 18, we included allowance rate differential and art unit allowance rate, but omitted examiner allowance rate because the latter is simply the sum of the first two variables. In other words, each of the three variables is perfectly collinear with the other two in combination. *See supra* Table 18.

276. That is, we ran two 20-variable regressions that included only one of our examiner characteristics at a time. These two regressions are not shown below in Table 19, but are otherwise identical to those shown below in Table 19. *See infra* Table 19.

277. These two regressions are not shown in Table 19. *See infra* Table 19.

278. One may rightly question whether a 10 percent increase or decrease in the allowance rate is feasible, but our data suggests that it is. We find a standard deviation of 15.8 percent among examiner allowance rates and a standard deviation of 12.6 percent among art unit allowance rates.

art unit allowance rate, examiner allowance rate continues to have a significant impact (but not vice versa).[279]

Looking next at examiner experience, we see from Specifications 2, 4, and 5 that the number of applications an examiner has handled in his or her career is a statistically significant predictor of institution, both by itself and when controlling for art unit allowance rates or the differential between examiner and art unit allowance rates. The marginal effect of experience is large as well, with each 1,000 additional applications assigned to an examiner leading to a 2.5 percent increase in the probability that his or her patents will be instituted.[280] However, comparing Specifications 2 and 3, it appears that much of the significance of examiner experience is driven by examiner allowance rate and not the other way around. Shifting from Specification 2 to Specification 3, we find that examiner experience is not significant when controlling for examiner allowance rate ($p = 0.167$ in Specification 3). Thus, individual examiner generosity is highly correlated with examiner experience.

279. Compare Specification 2 to Specifications 4 and 5.

280. As with allowance rates, the variation in examiner experience is large with a standard deviation of 823 applications. *Accord* Cockburn et al., *supra* note 20, at 39 ("We see that although the average examiner in our sample has a lifetime experience of over 2,000 patents, a large number are associated with over 4,000 patents, with a few outliers of over 7,000 patents.").

Table 19. Probit estimation of the likelihood a petitioned patent was never instituted (examiner-related variables)

	1		2		3		4		5	
Applicant, Prosecutor and Examiner Characteristics:										
Small Entity	-0.050**	(0.020)	-0.045**	(0.020)	-0.048**	(0.020)	-0.049**	(0.020)	-0.466***	(0.124)
Individual Assignee	-0.010	(0.032)	-0.014	(0.032)	-0.011	(0.032)	-0.012	(0.032)		
Large Firm Prosecutor	0.063***	(0.019)	0.066***	(0.019)	0.064***	(0.019)	0.064***	(0.019)	0.0009	(0.0034)
Solo Firm Prosecutor	-0.025	(0.027)	-0.025	(0.027)	-0.024	(0.027)	-0.024	(0.027)	0.0021	(0.075)
No. of applications examiner			-0.000032***	(0.000012)	-0.000018	(0.000013)	-0.000027**	(0.000012)	0.0070**	(0.0034)
Examiner's overall allowance rate	-0.193***	(0.074)			-0.203***	(0.075)				
Art Unit allowance rate	0.149	(0.094)					-0.227***	(-0.000019)	0.000016**	(-0.000007)
Allowance rate differential (rel. to Art Unit)									-0.0005	(0.0008)
Patent Characteristics:										
Quarter First Institution Decision	0.0080***	(0.0023)	0.0074***	(0.0022)	0.0075***	(0.0022)	0.0078***	(0.0023)	-0.00011**	(0.00005)
Years earliest priority to first petition	-0.0031	(0.0025)	-0.0022	(0.0025)	-0.0023	(0.0025)	-0.0029	(0.0025)	-0.0006	(0.0018)
Grant year	-0.0036	(0.0028)	-0.0010	(0.0026)	-0.0026	(0.0027)	-0.0032	(0.0027)	0.0002	(0.0038)
Num. of US Patent Classes	-0.0061**	(0.0031)	-0.0062**	(0.0031)	-0.0063**	(0.0031)	-0.0062**	(0.0031)	0.016	(0.019)
High Tech	0.019	(0.020)	-0.008	(0.020)	0.007	(0.021)	0.003	(0.021)	-0.016***	(0.005)
Pharma	0.059	(0.041)	0.113***	(0.041)	0.074*	(0.042)	0.078**	(0.041)		
Word Count / Claim	0.000011**	(0.000005)	0.000012**	(0.000005)	0.000012**	(0.000005)	0.000011**	(0.000005)	0.00020	(0.00014)
Unique Word Count of Claim 1	0.0013***	(0.0004)	0.0014***	(0.0004)	0.0013***	(0.0004)	0.0014***	(0.0004)	-420	
Examination Intensity									829	
Num. Backward Citations	-0.00015***	(0.00004)	-0.00016***	(0.00004)	-0.00015***	(0.00004)	-0.00015***	(0.00004)		
Num. IDS Filed	0.0035	(0.0022)	0.0042*	(0.0022)	0.0036	(0.0022)	0.0040*	(0.0022)		
Num. Foreign Family Members	-0.0014	(0.0020)	-0.0011	(0.0020)	-0.0013	(0.0020)	-0.0013	(0.0020)		
Post-Grant Characteristics										
Reassigned?	-0.007	(0.019)	-0.007	(0.019)	-0.006	(0.019)	-0.009	(0.019)		
Individual Owned	0.173**	(0.073)	0.180***	(0.074)	0.172**	(0.073)	0.176**	(0.074)		
PAE Owned	-0.073***	(0.021)	-0.079***	(0.021)	-0.076***	(0.021)	-0.077***	(0.021)		
Log-likelihood	-1390		-1394		-1390		-1390			
Observations	2527		2527		2527		2527			

Note: Population of 2,527 patents (with complete examiner data) subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never Instituted" versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. Marginal effects reported with discrete change of dummy variables from 0 to 1. Robust standard errors included in parenthesis. * p < .10; ** p < .05; and *** p < .01.

C. Determinants of Institution by Subset of the Population of Petitioned Patents

Next, we present a series of regressions to examine the significance of variables in the context of patents from particular industry and technology groups. We do so for two reasons. First, different industries often have different visions of the ideal patent system, and we believe that these differences are justified in part due to well-documented industry and technology differences in the efficacy of patents.[281] Separating our analysis for patents related to particular industries or technologies may reveal that these differences lead to variation among proxies for patent quality. Second, in addition to observing whether this leads to changes in effect size and significance among variables included in the regressions above, this allows us to test whether other variables that failed to show significance in the population-wide bivariate regressions presented *supra* in Part VI might nonetheless have significant effects in one or more subpopulations of challenged patents.

The specifications shown below in Table 20 report regression results for six different groups of patents: (1) those prosecuted by large firms, (2) those covering medical technology, (3) those covering pharmaceutical technology, (4) those covering software, (5) those owned by NPEs, and (6) those owned by PAEs.[282] Overall, what we observe is consistent with our findings above. Variables related to examiner grant rate, number of technology classes, and number of backward citations remain significant and similarly correlated in most subpopulations.

There are, however, a few noteworthy variations across these groups. First, as shown below in Specifications 5 and 6, the sign of the coefficient for unique-word-count-of-claim-1 is flipped for NPE- and PAE-owned patents (though neither is significant), as is the sign of the overall-word-count-per-claim coefficient for PAE patents. In short, while longer claims appear to be of higher quality generally, the opposite may be true of patents owned by monetizing entities. While this finding could have a number of explanations, it may suggest, at

281. *See supra* notes 240–244 and accompanying text.

282. In Appendix Table A.1, we report these same specifications but for the probability that the patents in each group would be denied institution rather than never instituted. *See infra* Table A.1.

least in part, a disproportionate preference among monetizers for patents that are "skillfully drafted" in ways that increase word count while only superficially narrowing claim scope.[283]

Second, we find that the negative relationship noted in Table 6 between institution and IPC counts is significant in these specifications only for software patents and patents owned by NPEs. We further find that the sign of the coefficient actually reverses in the cohort of patents prosecuted by large law firms. These findings suggest to us that the significance of IPCs primarily reflects the differing classification methodologies for software-related technologies employed by the USPTO and WIPO.[284]

Third, we find that contrary to our observations above, the number of backward citations added by the examiner to a challenged patent has a negative and nearly significant ($p = 0.112$) correlation with institution in the subpopulation of pharmaceutical patents. This finding may suggest that (consistent with conventional wisdom) more examiner citations can in fact indicate a more thorough examination, but only in industries with relatively low patent density and/or relatively clear claims.

Fourth, we find that several variables that failed to yield significant results in the population of patents do have a significant correlation with institution among one or more subpopulations. We find that the count of a challenged patent's U.S. parent applications is a significant predictor of institution for pharmaceutical patents and NPE patents. Additionally (and quite interestingly), we find that the relationship runs in the opposite direction for these groups. Pharmaceutical patents with more parent applications are *less* likely to be instituted,

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283. *See* Parker v. Flook, 437 U.S. 584, 590 (1978) (explaining that the law should prevent broad claims from issuing even if their breadth has been obscured by "[a] competent draftsman"); Mark A. Lemley, *Software Patents and the Return of Functional Claiming*, 2013 WIS. L. REV. 905, 907 (noting that "experienced patent lawyers today . . . increasingly [draft patent claims to cover] . . . the function of [their client's] program, not merely the particular way they achieved that goal"); Josh Feng & Xavier Jaravel, *Who Feeds the Trolls? Patent Trolls and the Patent Examination Process* 4 (Harvard Univ. & Stanford Univ., Working Paper, July 11, 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2838017 [https://perma.cc/AQM2-9Y4R] ("We find that patents purchased by NPEs are, on average, granted by examiners who allow more incremental patents and patents with vaguer language.").

284. *See supra* notes 241–242 and accompanying text.

while NPE-owned patents with more parents are *more* likely to be instituted. The magnitude of the effect for pharmaceutical patents is also particularly striking, with one additional parent application associated with a nearly 9 percent decrease in the chance of institution. On one hand, a large number of parents may reflect applicants' desire to perfect the claims covering a valuable product, while on the other it may reflect applicants' struggle to patent a marginal innovation in a crowded technological space. Potentially, our results reflect that the former effect is more common in pharmaceutical patent prosecution, while the latter is more common among patents that eventually wind up in the hands of NPEs.[285]

Fifth, we find that the forward citation count for challenged patents, while not significant among the population of patents, has a significant negative relationship with institution for one subpopulation: patents owned by PAEs. On one hand, as discussed above, citations by subsequent patents may reveal the importance of the technology that a patent covers. On the other hand, Lerner has shown a "publicity effect" which tends to increase citations to patents that have previously been asserted,[286] which may suggest that higher quality PAE-owned patents are cited more often because they are litigated more often, not because they are more fundamental.

285. This hypothesis may also be supported by the fact that we find a negative coefficient for patents prosecuted by large law firms and a positive coefficient for software patents, though neither effect is statistically significant.

286. Josh Lerner, Trolls on State Street?: The Litigation of Financial Patents, 1976-2005 19–20 (2006) (unpublished manuscript), http://www.people.hbs.edu/jlerner/Trolls.pdf [https://perma.cc/63N9-J3Z8].

Table 20. Probit estimation of the likelihood a petitioned patent was never instituted (subset analysis)

	1 (Large)		2 (Medical)		3 (Pharma)		4 (Software)		5 (NPE)		6 (PAE)	
Applicant, Prosecutor and Examiner Characteristics:												
Allowance rate differential (rel. to Art Unit)	-0.315**	(0.124)	-0.386**	(0.171)	-0.279	(0.253)	-0.349**	(0.178)	-0.466***	(0.124)	-0.433***	(0.136)
Patent Characteristics:												
Quarter First Institution Decision	0.0100**	(0.0040)	0.0175**	(0.0069)	0.013	(0.011)	0.006	(0.005)	0.0009	(0.0034)	-0.004	(0.004)
Pendency (years)	0.014	(0.009)	0.020	(0.014)	0.017	(0.022)	-0.009	(0.011)	0.0021	(0.075)	0.0053	(0.085)
No. IPC Classes	-0.0036	(0.0037)					0.0094**	(0.0047)	0.0070**	(0.0034)	0.0050	(0.0039)
No. US Patent Classes			-0.021**	(0.010)	-0.000375							
Word Count / Claim	.000012*	(-0.000006)	0.000024**	(-0.00001)	0.000039**	(-0.000015)	0.000002	(-0.000019)	0.000016**	(-0.000007)	-0.000033	(-0.000021)
Unique Word Count of Claim 1	0.0011	(0.0008)	0.0030**	(0.0012)	0.0055**	(0.0026)	0.0022**	(0.0010)	-0.0005	(0.0008)	-0.0008	(0.0008)
Examination Intensity												
No. Backward Citations	-0.00024***	(0.00006)	-0.00027	(0.00018)	-0.0010***	(0.0004)	-0.00021***	(0.00008)	-0.00011**	(0.00005)	-0.00005	(0.00006)
No. Rev. Cites Added by Examiner	-0.0044**	(0.0022)	-0.0038	(0.0043)	0.026	(0.016)	0.0008	(0.0019)	-0.0006	(0.0018)	0.0014	(0.0019)
No. IDS Filed	0.0049	(0.0039)	-0.0032	(0.0072)	-0.003	(0.012)	0.0060	(0.0053)	0.0002	(0.0038)	-0.0001	(0.0039)
No. Final Rejections	0.013	(0.025)	0.003	(0.036)	0.014	(0.061)	0.019	(0.031)	0.016	(0.019)	-0.006	(0.022)
No. Parent Applications	0.004	(0.008)	-0.012	(0.014)	0.089***	(0.029)	-0.0083	(0.0068)	-0.016***	(0.005)	-0.010	(0.006)
Post-Grant Characteristics												
Forward citations	0.0001	(0.0002)	-0.0004	(0.0005)	0.0010	(0.0012)	0.00003	(0.00029)	0.00020	(0.00014)	0.00031**	(0.00014)
Log-likelihood	-526		-225		-106		-281		-420		-289	
Observations	874		373		181		504		829		621	

Note: analysis of six subsets of the population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never Instituted" versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. Marginal effects reported with discrete change of dummy variables from 0 to 1. Robust standard errors included in parenthesis. * p < .10; ** p < .05; and *** p < .01.

VI. IMPLICATIONS

Finally, we make a few broad observations in light of the data reported above. We then consider what patent reforms our observations suggest might help improve patent quality, and conclude with a caution that our results should be viewed with their limitations in mind.

A. Analysis

First and perhaps foremost, our findings suggest that patent quality is heavily influenced by the people and entities who are directly involved in the examination process. On the side of the applicant, we found that instituted patents are more likely to possess traits suggestive of a lack of sophistication and resources (e.g., small entity status, individual original assignees, and selection of "solo" prosecution counsel) and less likely to possess indicators of applicants' willingness and ability to pay for premium legal services (i.e., those provided by large law firms).

Also, with respect to the examiners assigned to challenged patents, we consistently found a significant, negative relationship between institution and both an examiner's overall allowance rate and the length of an examiner's tenure with the USPTO. Interestingly, these correlations survive controls for other examination-related variables including counts of rejections, IDSs, and backward citations, and thus suggest an effect that supersedes what is observable in individual prosecution histories.

We additionally find evidence that patent breadth is important to patent quality. Consistent with conventional wisdom, we find significant associations between institution and the number of U.S. technology classes assigned to a patent, the length of a patent's first claim, and the length of a patent's specification relative to its claim count.

Second, we find it noteworthy that many of the patent traits we examined had little or no correlation with institution. Despite their importance in the existing literature,[287] we found

287. *See supra* notes 27–34.

little evidence that forward citation counts are a strong predictor of quality. In the multivariate analyses reported in Tables 18 and 19, we also found little evidence that the age of petitioned patents or the technology to which they relate played a major role in IPR validity determinations. We likewise found little evidence linking validity to the prosecution of related applications in other countries. These latter three findings suggest that USPTO examination (while no doubt far from perfect) has been more consistent than many have believed over the last two decades, as well as more consistent with the quality of examination conducted overseas by foreign patent offices. Similarly, our findings suggest that the PTAB is not biased in favor of or against any particular type of technology.

That said, our findings do suggest that APJs may not be entirely insulated from outside influences. For example, our findings show that institution rates have fallen over time, even when controlling for numerous other variables. This may well be a reaction to the loud outcry from the patent bar about the high rates of invalidity seen in the first several months of the PTAB's existence, or instead a practical workload-reducing response to the PTAB's unexpectedly high caseload. We likewise see that patents owned by NPEs and PAEs are more likely to be instituted even when we control for all the other significant patent traits, a fact that plausibly reflects some degree of bias against the widely publicized litigation tactics of so-called "patent trolls."[288]

B. Recommendations

While we are reluctant to make strong causal claims based on our findings, our observations do tend to suggest a few promising avenues for improving the quality of patents issued by the USPTO. First, our findings are quite consistent with existing research indicating that U.S. patent examiners have suboptimal incentives to produce quality patents. Accordingly, our findings lend support to ongoing efforts to modify U.S. patent-examining procedures so that, for example, senior examiners are given additional time to review the applications they

288. Given that these potential influences may vary by judge, we recommend that future research in this area investigate variations in institution rates across APJs.

are assigned.[289] In addition, our findings suggest that the USPTO may wish to consider additional scrutiny of the prior art searches and office actions produced by examiners with relatively high grant rates as well as the training and oversight afforded to examiners in art units with relatively high grant rates. Indeed, the USPTO may wish to consider requiring that *all* decisions to grant applications, rather than only those made by relatively junior examiners,[290] be reviewed by a second examiner.[291]

Second, our findings suggest that relatively broad applications tend to issue as relatively low-quality patents. Accordingly, our findings suggest that the USPTO may wish to take steps to discourage, prevent, or provide additional scrutiny to especially lengthy or broad applications. For example, the USPTO could consider increasing existing "excess claim" and "size" fees,[292] or increasing the frequency with which examiners issue "restriction requirements" to break up complex applications into a series of smaller ones.[293] The USPTO may also wish to consider special examination procedures for applications that span numerous technology classes, perhaps by assigning multiple examiners with varied technical expertise to work as a team on such applications.

Third, our findings suggest that relatively small applicants are disproportionately likely to obtain low-quality patents. While this effect may have a number of explanations, its close relationship to the size of prosecution counsel tends to suggest that our findings reflect, at least to some extent, applicant sophistication and resources. Accordingly, our findings tend to support USPTO efforts to educate applicants that are relatively small and relatively new, including with respect to the importance of selecting competent counsel, the duty to disclose

289. *See* Michael D. Frakes & Melissa Wasserman, *Decreasing the Patent Office's Incentives to Grant Invalid Patents*, HAMILTON PROJECT (Dec. 2017), https://www.brookings.edu/wp-content/uploads/2017/12/es_121317_decreasing_patent_office_incentives_grant_invalid_patents_pb.pdf [https://perma.cc/656K-2KAA].

290. That is, those at pay grades GS-13 and below. *See supra* note 223.

291. *Accord* Feng & Jaravel, *supra* note 283, at 54 (estimating "that the share of NPE patents among granted patents could be reduced by 20% by implementing a 'second pair of eyes' policy").

292. USPTO, FEE SCHEDULE, https://www.uspto.gov/learning-and-resources/fees-and-payment/uspto-fee-schedule#Patent Fees (last accessed Jan. 14, 2018) [https://perma.cc/7YB7-DGTE].

293. *See* MPEP §§ 802–803 (9th ed. Rev. Aug. 2017).

prior art, careful claim drafting, and adequate technical disclosure in the specification.

Last, but not least, we believe that our findings tend to suggest that inter partes review is working as intended to eliminate low-quality patents. Despite years of criticism from many in the patent bench and bar, we find that the patents flagged as problematic by the PTAB largely bear the traditional hallmarks of low quality identified by conventional wisdom and prior academic research. At the same time, we find little evidence of bias for or against particular industries or types of patent owners (with the possible exception of PAEs). Accordingly, our findings do not tend to support ongoing efforts to radically restructure or outright eliminate inter partes review.

C. Limitations

An important caveat to the above recommendations, as well as to our findings generally, is that our data is limited in a number of respects. For one, as discussed in greater detail *supra* in Section III.B, the population of patents subjected to inter partes review is no doubt a highly selected sample of the total population of U.S. patents. While we believe that our population of patents is *less* selected than those used by many prior researchers, we nonetheless acknowledge that our findings likely reflect some degree of selection bias. As a result, our findings would likely change to at least some extent if a more diverse set of patents was challenged in inter partes review, as well as if fewer petitions settled prior to the issuance of an institution decision.[294]

In addition, inter partes review serves as a check on patent validity only with respect to anticipation and obviousness in light of printed prior art. While these are by far the most common bases on which U.S. patent applications have been rejected and issued patents have been invalidated,[295] our analysis excludes other grounds of invalidity, including limits on patentable subject matter, the substantial and specific utility requirements, enablement, written description, indefiniteness,

294. However, insofar as patents selected for IPR are only those worth spending five- or six-figures to challenge, policymakers may be less concerned about the multitude of lower-value patents missing from our study.

295. *See* Lu et al., *supra* note 82.

best mode, and the various other ways in which a patent may be invalidated under sections 102 and 103 of the Patent Act. Accordingly, our study of patent quality is, by definition, a somewhat incomplete one. As a result, our findings would likely change to at least some extent if it were possible to challenge patents on additional grounds in inter partes review proceedings.

Finally, we acknowledge the existence of two additional limitations inherent in using inter partes review institution decisions as a filter of patent quality. First, institution decisions are, to some extent, preliminary in nature and, thus, are prone to some degree of error. As discussed above, a nontrivial number of final written decisions confirm the patentability of all instituted claims. While we account for those decisions when they occurred, many inter partes reviews settled after institution but before a final written decision. In addition, though the affirmance rate is high for PTAB decisions, a nontrivial number of decisions are reversed on appeal. As a result, it is likely that a subsequent, more searching review of challenged claims would in some instances lead to a conclusion contrary to the one in this analysis. Second, while patent validity is determined on a claim-by-claim basis, our analysis focuses on the attributes of entire patents. Thus, as described in greater detail above, our analysis of institution decisions is incomplete because it lumps together all once-instituted (or always-instituted) patents despite the fact that many of these patents contain claims that were never challenged in the first place, as well as claims that were challenged but not instituted or not cancelled. In a future iteration of this project, we hope to take a claim-level view of validity in order to overcome this limitation.

CONCLUSION

Despite these limitations, we believe that this project is the most comprehensive look at patent quality undertaken to date. By taking advantage of the recent popularity of inter partes review, we were able to assemble a set of more than 2,500 U.S. patents that were the subject of at least one post-grant decision with respect to the validity of their claims. In addition, by taking advantage of the USPTO's recent releases of bulk data to the public, we were able to collect a large amount of data about each patent. Beyond information available on the face of challenged patents, we were able to identify and assess each patent's examiner and prosecution counsel, as well as information about the various kinds of documents filed during each patent's prosecution.

Merging these two sets of data, we uncovered a number of patent attributes with a strong, significant relationship to institution, including characteristics of the people who prosecuted and examined challenged patents, characteristics of the challenged patents themselves, and characteristics of the prosecution history associated with each patent. Using the results of these bivariate comparisons, we selected a subset of characteristics for further analysis in a series of multivariate regressions.

Our multivariate analysis, in turn, revealed a number of especially significant predictors of institution. Notably, our findings largely complement earlier research on patent quality. Consistent with Frakes and Wasserman, we find that more senior examiners (and those who aspire to promotion) may face incentives that are detrimental to patent quality on the margin. Similarly, consistent with Lei and Wright, we find a counterintuitive, negative relationship between backward citations and quality. At the same time, our findings reveal a number of unexpected wrinkles that we believe warrant further research. We find, for example, that software and business methods patents perform surprisingly well in IPR. We also fail to find significance among several variables that have been used as quality proxies in prior research, including forward citation counts and concurrent examination by the EPO.

In addition to refining our ability to identify high- and low-quality patents, our findings have importance for ongoing debates about how to improve ex ante patent examination and how to measure the efficacy of inter partes review. While it is impossible for us to conclude that any change in patent examination policy or procedure would be cost justified,[296] our results suggest several actions that patent offices in the United States and abroad may wish to investigate to improve patent quality, including additional oversight of examiners with high allowance rates and greater scrutiny of especially complex applica-

296. Meaning that the benefit to society from increases in patent quality would exceed the costs of making the changes necessary to achieve those increases.

tions. Further, our results suggest that to the extent that the PTAB is acting as a "patent death squad," it is a death squad targeting patents with indicia of relatively low quality, rather than indicia of relatively high value. For example, medical and pharma patents, which scholars tend to believe possess clearer boundaries and higher per-patent value, have much lower institution rates than other patents, while NPE and PAE patents, which are often used primarily for nuisance value assertion, are more likely to be instituted. As the PTAB continues to reassess the validity of hundreds of additional patents each year, we urge policymakers, PTO administrators, and scholars to follow our lead in mining that data in search of new avenues to improve patent office accuracy, efficiency, and fairness.

APPENDIX

Table A.1. Probit estimation of the likelihood a petitioned patent was denied institution (subset analysis)

	1 (Large)		2 (Medical)		3 (Pharma)		4 (Software)		5 (NPE)		6 (PAE)	
Applicant, prosecutor and examiner characteristics:												
Allowance rate differential (rel. to Art Unit)	-0.299**	(0.128)	-0.335**	(0.175)	-0.210	(0.254)	-0.179	(0.197)	-0.225	(0.144)	-0.139	(0.177)
Patent characteristics:												
Pendency (years)	-0.0011	(0.0093)	0.013	(0.014)	-0.003	(0.023)	-0.020*	(0.012)	-0.0058	(0.086)	0.0050	(0.085)
No. IPC classes	-0.0025	(0.0038)					0.012**	(0.005)	0.0068*	(0.0039)	0.0051	(0.0039)
No. U.S. patent classes			-0.018*	(0.010)	-0.020	(0.013)						
Word count / claim	0.000005	(0.000007)	0.000021**	(0.00001)	0.000036**	(0.000017)	-0.000006	(0.00002)	0.000012	(0.000008)	-0.000032**	(0.000021)
Unique word count of claim 1	0.0016**	(0.0008)	0.0029**	(0.0012)	0.0044**	(0.0022)	0.002*	(0.0011)	0.0008	(0.0009)	0.001	(0.001)
Examination intensity												
No. backward citations	-0.00008	(0.00006)	-0.00015	(0.00016)	-0.0007*	(0.0004)	-0.00009	(0.00008)	-0.00006	(0.00006)	0.00002	(0.00007)
No. rev. cites added by examiner	0.0054***	(0.002)	-0.0049	(0.0045)	0.032**	(0.016)	-0.001	(0.002)	-0.0009	(0.002)	-0.002	(0.0022)
No. IDS filed	0.0038	(0.0042)	-0.0017	(0.0074)	-0.007	(0.011)	0.0028	(0.0056)	0.0032	(0.0035)	0.0027	(0.0037)
No. final rejections	0.042	(0.027)	0.009	(0.036)	0.065	(0.063)	0.049	(0.034)	0.028	(0.022)	-0.007	(0.026)
No. parent applications	-0.001	(0.008)	-0.008	(0.014)	0.076**	(0.029)	-0.014*	(0.007)	-0.016***	(0.006)	-0.015**	(0.007)
Post-grant characteristics												
Forward citations	0.0001	(0.0003)	-0.0006	(0.0005)	0.0022	(0.0014)	-0.0003	(0.0003)	0.00015	(0.00017)	0.00023	(0.00018)
Log-likelihood	-571		-242		-113		-317		-504		-366	
Observations	874		373		181		504		829		621	

Note: analysis of six subsets of the population of 2,532 patents subject to an inter partes review institution decision on the merits between September 16, 2012, and January 31, 2017. Some patents were the subject of multiple merit institution decisions and accordingly, "Never Instituted" versus "Instituted" compares the 671 petitioned patents never instituted on the merits to the 1,861 patents instituted at least once. Marginal effects reported with discrete change of dummy variables from 0 to 1. Robust standard errors included in parenthesis. * p < .10; ** p < .05; and *** p < .01.

Session 6: Did *eBay v. MercExchange* Go Too Far?

Permanent Injunctions in Patent Litigation After *eBay*: An Empirical Study

Christopher B. Seaman[*]

ABSTRACT: The Supreme Court's 2006 decision in eBay v. MercExchange *is widely regarded as one of the most important patent law rulings of the past decade. Historically, patent holders who won on the merits in litigation nearly always obtained a permanent injunction against infringers. In* eBay*, the Court unanimously rejected the "general rule" that a prevailing patentee is entitled to an injunction, instead holding that lower courts must apply a four-factor test before granting such relief. Ten years later, however, significant questions remain regarding how this four-factor test is being applied, as there has been little rigorous empirical examination of* eBay's *actual impact in patent litigation.*

This Article helps fill this gap in the literature by reporting the results of an original empirical study of contested permanent injunction decisions in district courts for a 7.5-year period following eBay*. It finds that* eBay *has effectively created a bifurcated regime for patent remedies, as operating companies who compete against an infringer still obtain permanent injunctions in the vast majority of cases that are successfully litigated to judgment. In contrast, non-competitors and other non-practicing entities are generally denied injunctive relief. These findings are robust even after controlling for the field of patented technology and the particular court that decided the injunction request. This Article also finds that permanent injunction rates vary significantly based on patented technology and forum. Finally, this Article considers some implications of these findings for both participants in the patent system and policy makers.*

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I. INTRODUCTION

The Supreme Court's 2006 opinion in *eBay v. MercExchange*, which held that prevailing patentees in litigation are not automatically entitled to a permanent injunction,[1] is widely regarded as one of the most significant patent law decisions of the past decade.[2] It has been extensively cited by lower

1. *See* eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 393–94 (2006) (holding that the Federal Circuit erred in "articulat[ing] a general rule, unique to patent disputes, that a permanent injunction will issue once infringement and validity have been adjudged").

2. *See* Colleen V. Chien & Mark A. Lemley, *Patent Holdup, the ITC, and the Public Interest*, 98

federal courts,[3] and is the subject of numerous law review articles.[4] The case has also spawned a significant transformation in the field of remedies, reshaping the test for permanent injunctive relief in numerous areas outside of patent law.[5]

Despite its perceived importance, however, there has been little rigorous empirical examination of *eBay*'s actual impact in patent litigation.[6] This is significant because the *eBay* decision—which was unanimous—contains two concurring opinions that express seemingly divergent perspectives regarding

CORNELL L. REV. 1, 8 (2012) ("The Supreme Court's 2006 decision in *eBay* represented a sea change in patent litigation." (footnote omitted)); Ryan Davis, *Top 15 High Court Patent Rulings of the Past 15 Years*, LAW360 (July 1, 2015, 8:27 PM), http://www.law360.com/articles/674205/top-15-high-court-patent-rulings-of-the-past-15-years (ranking *eBay* as the second most important patent law decision since 2000).

3. A recent search of WestlawNext finds that *eBay* has been cited in over 2000 federal court opinions. *See Citing References for* eBay Inc. v. MercExchange L.L.C., WESTLAWNEXT (last visited May 10, 2016); *see also* Dennis Crouch, *Most Cited Supreme Court Patent Decisions (2005–2015)*, PATENTLY-O (Mar. 11, 2015), http://patentlyo.com/patent/2015/03/supreme-court-cases.html (listing *eBay* as the second most cited U.S. Supreme Court patent case of the past decade).

4. For examples of significant *eBay*-related scholarship, see generally Andrew Beckerman-Rodau, *The Aftermath of* eBay v. MercExchange*, 126 S. Ct. 1837 (2006): A Review of Subsequent Judicial Decisions*, 89 J. PAT. & TRADEMARK OFF. SOC'Y 631 (2007); Michael W. Carroll, *Patent Injunctions and the Problem of Uniformity Cost*, 13 MICH. TELECOMM. & TECH. L. REV. 421 (2007); Bernard H. Chao, *After* eBay, Inc. v. MercExchange*: The Changing Landscape for Patent Remedies*, 9 MINN. J.L. SCI. & TECH. 543 (2008); Chien & Lemley, *supra* note 2; Eric R. Claeys, *The Conceptual Relation Between IP Rights and Infringement Remedies*, 22 GEO. MASON L. REV. 825 (2015); Vincenzo Denicolò et al., *Revisiting Injunctive Relief: Interpreting* eBay *in High-Tech Industries with Non-Practicing Patent Holders*, 4 J. COMPETITION L. & ECON. 571 (2008); Douglas Ellis et al., *The Economic Implications (and Uncertainties) of Obtaining Permanent Injunctive Relief After* eBay v. MercExchange, 17 FED. CIR. B.J. 437 (2008); Mark P. Gergen, John M. Golden & Henry E. Smith, *The Supreme Court's Accidental Revolution? The Test for Permanent Injunctions*, 112 COLUM. L. REV. 203 (2012); John M. Golden, *"Patent Trolls" and Patent Remedies*, 85 TEX. L. REV. 2111 (2007) [hereinafter Golden, *Patent Trolls*]; John M. Golden, *Principles for Patent Remedies*, 88 TEX. L. REV. 505 (2010) [hereinafter Golden, *Principles*]; Ryan T. Holte, *The Misinterpretation of* eBay v. MercExchange *and Why: An Analysis of the Case History, Precedent, and Parties*, 18 CHAP. L. REV. 677 (2015) [hereinafter Holte, *Misinterpretation of* eBay]; Ryan T. Holte, *Trolls or Great Inventors: Case Studies of Patent Assertion Entities*, 59 ST. LOUIS U. L.J. 1 (2014) [hereinafter Holte, *Trolls or Great Inventors*]; Sarah R. Wasserman Rajec, *Tailoring Remedies to Spur Innovation*, 61 AM. U. L. REV. 733 (2012); Doug Rendleman, *The Trial Judge's Equitable Discretion Following* eBay v. MercExchange, 27 REV. LITIG. 63 (2007); and Karen E. Sandrik, *Reframing Patent Remedies*, 67 U. MIAMI L. REV. 95 (2012).

5. *See* Gergen et al., *supra* note 4, at 205 ("[T]he four-factor test from *eBay* has, in many federal courts, become *the* test for whether a permanent injunction should issue, regardless of whether the dispute in question centers on patent law, another form of intellectual property, more conventional government regulation, constitutional law, or state tort or contract law."); *see also* Shyamkrishna Balganesh, *Demystifying the* Right *to Exclude: Of Property, Inviolability, and Automatic Injunctions*, 31 HARV. J.L. & PUB. POL'Y 593, 598–99 (2008) (discussing *eBay*'s impact in real and personal property law); Jiarui Liu, *Copyright Injunctions After* eBay*: An Empirical Study*, 16 LEWIS & CLARK L. REV. 215, 218 (2012) (examining "how much the *eBay* decision has guided, and should guide, copyright cases").

6. *See infra* Part III.C (discussing the existing empirical work on this subject).

the availability of permanent injunctions in future patent cases.[7] In particular, it remains hotly contested whether so-called patent assertion entities ("PAEs")[8]—firms who principally exploit their patents through litigation and/or licensing rather than directly practicing them and who are sometimes pejoratively referred to as "patent trolls"[9]—should be able to obtain injunctive relief.[10]

This Article helps fill this significant gap in the literature by reporting the results of an original empirical study of contested permanent injunction decisions in the federal district courts for a 7.5 year period following *eBay*, representing the most in-depth effort to date to assess the post-*eBay* landscape. The data in this study reveal that, while the vast majority of patentees still obtain injunctive relief following *eBay*, PAEs rarely do.[11] This finding remains robust even after controlling for the field of technology of the infringed patents and the district court that decided the case.[12] Furthermore, PAEs often cannot establish the type of injury deemed "irreparable" following *eBay*,

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7. *See infra* Part III.B.3.

8. *See* FED. TRADE COMM'N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 220 n.21 (2011) ("This report uses the term 'patent assertion entity' [or PAE] . . . to refer to firms whose business model focuses on purchasing and asserting patents."); Colleen V. Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 328 (2010) (explaining that PAEs "are focused on the enforcement, rather than the active development or commercialization of their patents," and noting that PAEs "can be further divided into several types—large-portfolio companies, small-portfolio companies, and individuals"); *see also* James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. REV. 387, 390 (2014) (defining a related concept, non-practicing entities ("NPEs"), as "individuals and firms who own patents but do not directly use their patented technology to produce goods or services, instead asserting their patents against companies that do produce goods and services").

9. *See In re* Packard, 751 F.3d 1307, 1325 (Fed. Cir. 2014) (Plager, J., concurring) ("Patent trolls are also known by a variety of other names: 'patent assertion entities' (PAEs), [and] 'non-practicing entities' (NPEs)."). For an informative history of the term "patent troll" and its malleability, see Kristen Osenga, *Formerly Manufacturing Entities: Piercing the "Patent Troll" Rhetoric*, 47 CONN. L. REV. 435, 442–45 (2014). *See also* Edward Lee, *Patent Trolls: Moral Panics, Motions in Limine, and Patent Reform*, 19 STAN. TECH. L. REV. 113, 117 (2015) (conducting "the first empirical study of the use of the term 'patent troll' by U.S. media" and finding that "starting in 2006, the U.S. media surveyed used 'patent troll' far more than any other term, despite the efforts of scholars to devise alternative, more neutral-sounding terms").

10. *Compare* FED. TRADE COMM'N, *supra* note 8, at 229 (explaining that when a PAE "seeks to license broadly, denial of an injunction" may be appropriate), *and* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2035–36 (2007) (contending that a "presumptive right to injunctive relief" should apply for patent holders who compete or exclusively license to a party that does, with other patentees being subject to a less favorable rule), *with* Golden, *Patent Trolls*, *supra* note 4, at 2148 (contending that "a categorically discriminatory rule" against non-practicing patentees "is not needed"), *and* Richard A. Epstein, *The Property Rights Movement and Intellectual Property*, REG. 58, 62 (2008) (criticizing *eBay* as creating a risk of "systematic under-compensation during the limited life of a patent[, which] is likely to reduce the level of innovation while increasing the administrative costs of running the entire system").

11. *See infra* Part V.A.4.

12. *See infra* Part V.A.8.

which is a prerequisite to obtaining a permanent injunction.[13] In sum, district courts appear to have adopted a de facto rule against injunctive relief for PAEs and other patent owners who do not directly compete in a product market against an infringer—a rule which, ironically, is in tension with the Supreme Court's conclusion in *eBay* that "the District Court erred in its categorical denial of injunctive relief" to a non-practicing patentee.[14]

This Article also evaluates the impact of other considerations on permanent injunction decisions after *eBay*. It finds that grant rates vary significantly by field of technology, with injunctions nearly always granted in cases involving patented drugs and biotechnology, but much less often for disputes involving computer software.[15] The study also finds that grant rates differ by district, even after controlling for the propensity of PAE litigants to file lawsuits in particular courts.[16] Furthermore, it assesses whether several other factors mentioned in the concurring opinions in *eBay* and the district court's decision after remand—such as the patentee's willingness to license the patented technology, whether the patented technology covers only a small component of an infringing product, and a finding that the defendant willfully infringed the patent—are correlated with injunction decisions.[17]

Finally, this Article reports the results of a second, related dataset that explores whether traditionally accepted indicators of patent value are correlated with injunction decisions.[18] Somewhat surprisingly, it finds that these indicators are not predictive of whether a patentee is likely to receive an injunction.[19]

The balance of this Article is organized as follows. Part II provides an overview of the theoretical distinction between property rules and liability rules for enforcing legal rights, focusing on their application to intellectual property ("IP") rights. Part III traces the historical development of the right to exclude in patent law. It then analyzes the *eBay* litigation and concludes with an overview of the existing literature on *eBay*'s impact in patent litigation. Part IV describes the research questions considered in this empirical study and the methodology used to address them. Part V reports the study's findings and assesses their implications for patentees, users of patented technology, and the patent system and innovation policy more generally. In particular, it

13. *See infra* Part V.A.6.

14. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 394 (2006); *see also* MercExchange L.L.C. v. eBay, Inc. (*MercExchange I*), 275 F. Supp. 2d 695, 712 (E.D. Va. 2003) ("In the case at bar, the evidence of the plaintiff's willingness to license its patents, its lack of commercial activity in practicing the patents, and its comments to the media as to its intent with respect to enforcement of its patent rights, are sufficient to rebut the presumption that it will suffer irreparable harm if an injunction does not issue.").

15. *See infra* Part V.A.2.

16. *See infra* Parts V.A.3, V.A.8.

17. *See infra* Part V.A.8.

18. *See infra* notes 202, 316–19 and accompanying text.

19. *See infra* Part V.B.

considers the impact of widespread denial of injunctive relief on non-practicing patentees. Part VI concludes.

II. PROPERTY RULES, LIABILITY RULES, AND INTELLECTUAL PROPERTY: AN OVERVIEW

In their landmark article, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, now-Judge Guido Calabresi and A. Douglas Melamed developed an analytic framework for protecting "entitlements"—the right to do something, or the right to prevent others from doing something.[20] An entitlement is not self-executing. Rather, the legal system must establish some mechanism to enforce entitlements.[21] Calabresi and Melamed distinguished between two primary forms[22] of protection for an entitlement: property rules and liability rules.[23]

Under a property rule, an entitlement can only be taken or transferred with a property owner's consent.[24] As explained by Calabresi and Melamed,

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20. *See* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1090 (1972) ("The first issue which must be faced by any legal system is one we call the problem of 'entitlement.' Whenever a state is presented with the conflicting interests of two or more people . . . it must decide which side to favor. . . . Hence the fundamental thing that law does is to decide which of the conflicting parties will be entitled to prevail."); *see also* Madeline Morris, *The Structure of Entitlements*, 78 CORNELL L. REV. 822, 827–39 (1993) (describing in more detail the allocation and construction of legal entitlements).

21. *See* Calabresi & Melamed, *supra* note 20, at 1090 ("Having made its . . . choice, society must enforce that choice. Simply setting the entitlement does not avoid the problem of 'might makes right'; a minimum of state intervention is always necessary.").

22. A third form of protection for entitlements, inalienable entitlements, exists when the transfer of that entitlement "is not permitted between a willing buyer and a willing seller." *Id.* at 1092. For purposes of this Article, inalienable entitlements are not at issue, as patent rights are freely transferable to others through assignment and licensing. *See* 35 U.S.C. § 261 (2012) (noting that patents and patent applications "shall be assignable in law by an instrument in writing"); Isr. Bio-Eng'g Project v. Amgen, Inc., 475 F.3d 1256, 1264 (Fed. Cir. 2007) ("Under long established law, a patentee or his assignee may grant and convey to another: (1) the whole patent, (2) an undivided part or share of that exclusive right, or (3) the exclusive right under the patent within and throughout a specified part of the United States.").

23. Calabresi & Melamed, *supra* note 20, at 1092. Calabresi and Melamed correctly note that "[t]he[se] categories are not . . . absolutely distinct." *Id.* For instance, if monetary damages—which usually embody a liability rule—are sufficiently high, they can operate more like a property rule because potential takers of an entitlement would be deterred from doing so. *See* Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement to Facilitate Coasean Trade*, 104 YALE L.J. 1027, 1040–41 (1995) (explaining that with "relatively high damages, potential takers would be deterred from nonconsensual takings, and the entitlement would be transferred only by consensual agreement"). Some scholars have criticized the distinction between property rules and liability rules as having little relationship to the normative judgments embedded in private law remedies determinations. *See* Claeys, *supra* note 4, at 839–40 (contending that "'Cathedral'-style analysis raises normative questions more vexing than is often appreciated," including measures of efficiency and initial allocation of resource entitlements to parties).

24. *See* Calabresi & Melamed, *supra* note 20, at 1105 ("In our framework, much of what is generally called private property can be viewed as an entitlement which is protected by a property rule. No one can take the entitlement . . . unless the holder sells it willingly and at the price at

"[a]n entitlement is protected by a property rule to the extent that someone who wishes to remove the entitlement from its holder must buy it from him in a voluntary transaction in which the value of the entitlement is agreed upon by the seller."[25] For instance, a property rule would require the user of an IP right to obtain prior permission from its owner, which the owner would be free to withhold.[26] Thus, the holder of an entitlement protected by a property rule has the exclusive power to determine its value *ex ante*.[27] Injunctive relief is the dominant means for enforcing a property rule.[28]

In contrast, a liability rule exists when another party may violate an entitlement "if [it] is willing to pay an objectively determined value for it."[29] Thus, under a liability-rule regime, entitlements are protected, "but their transfer or destruction is allowed on the basis of a value determined by some [third-party authority] rather than by the parties themselves."[30] For instance, a liability rule applies when an IP right may be infringed in exchange for a predetermined royalty rate, as is the case for several compulsory licensing

which he subjectively values the property.").

25. *Id.* at 1092.

26. *See* Robert P. Merges, *Of Property Rules, Coase, and Intellectual Property*, 94 COLUM. L. REV. 2655, 2655 (1994) ("[A] property rule is a legal entitlement that can only be infringed after bargaining with the entitlement holder.").

27. *See* Calabresi & Melamed, *supra* note 20, at 1092 (explaining that a property rule "lets each of the parties say how much the entitlement is worth . . . and gives the seller a veto if the buyer does not offer enough"); *see also* Richard A. Epstein, *A Clear View of* The Cathedral*: The Dominance of Property Rules*, 106 YALE L.J. 2091, 2091 (1997) ("Because property rules give one person the sole and absolute power over the use and disposition of a given thing, it follows that its owner may hold out for as much as he pleases before selling the thing in question . . . .").

28. *See* Merges, *supra* note 26, at 2655 (calling injunctions "the classic instance of a property rule"); Henry E. Smith, *Property and Property Rules*, 79 N.Y.U. L. REV. 1719, 1720 (2004) ("Such 'property rules' would include injunctions . . . ."). As my colleague Professor Doug Rendleman has explained, however, an enjoined party "can violate an injunction and convert the plaintiff's [property] right into a cause of action for compensatory contempt, money," and monetary remedies are more characteristic of a liability rule. DOUG RENDLEMAN, COMPLEX LITIGATION: INJUNCTIONS, STRUCTURAL REMEDIES, AND CONTEMPT 128 (2010); *see also* John M. Golden, *Injunctions as More (or Less) than "Off Switches": Patent-Infringement Injunctions' Scope*, 90 TEX. L. REV. 1399, 1412–13 (2012) ("When any threat of being found in contempt is realistically limited to a threat of civil contempt . . . [the] risk of being found in contempt can essentially amount to no more than a risk of being subjected to heightened but still limited monetary sanctions.").

29. Calabresi & Melamed, *supra* note 20, at 1092.

30. *Id.* Eric Claeys has criticized the "liability rule" concept as failing to fully reflect "private law judgments about wrongs and rights" and thus "eras[ing] some of the stigma associated with" certain forms of tortious conduct. Claeys, *supra* note 4, at 845–46; *see also* Jules L. Coleman & Jody Kraus, *Rethinking the Theory of Legal Rights*, 95 YALE L.J. 1335, 1340 (1986) (asserting that because "liability rules neither confer nor respect a domain of lawful control, liability rules cannot, in this view, protect rights. . . . The very idea of a 'liability rule entitlement,' that is of a right secured by a liability rule, is inconceivable").

provisions in the Copyright Act.[31] As a result, "a liability rule denies the holder of the asset the power to exclude others."[32]

There is a sizable body of literature analyzing the normative question of whether property rules or liability rules are preferable for the enforcement of IP rights.[33] Traditionally, the property rule of injunctive relief "has dominated the law of intellectual property."[34] Several rationales have been offered in support of "the strong presumption" of property rules for IP rights.[35] First, unlike most other forms of property (e.g., real property), intellectual property is non-rivalrous and non-excludable absent effective legal protection.[36] This prevents owners of intellectual property from restricting access to "free riders" who have not incurred the costs of creation from exploiting it.[37] The difficulty

31. *See, e.g.*, 17 U.S.C. § 111 (2012) (compulsory licensing of secondary transmission of television programming by cable systems); *id.* § 114(d)–(f) (compulsory licensing of certain digital audio transmissions); *id.* § 115 (compulsory licensing of previously-released nondramatic musical works); *see also* Daniel A. Crane, *Intellectual Liability*, 88 TEX. L. REV. 253, 259–63 (2009) (discussing in further detail compulsory licensing provisions in the Copyright Act); Joseph P. Liu, *Regulatory Copyright*, 83 N.C. L. REV. 87, 108–22 (2004) (detailing the compulsory licensing provisions' depth and scope).

32. Epstein, *supra* note 27, at 2091; *see also* Andrew W. Torrance & Bill Tomlinson, *Property Rules, Liability Rules, and Patents: One Experimental View of the Cathedral*, 14 YALE J.L. & TECH. 138, 144 (2011) ("Under a liability rule, the owner of an entitlement is legally powerless to keep it exclusively for herself.").

33. *See* Mark A. Lemley & Philip J. Weiser, *Should Property or Liability Rules Govern Information?*, 85 TEX. L. REV. 783, 784 (2007) (arguing that liability rules are preferable to traditional property rights in markets where injunctive relief cannot be narrowly tailored); Merges, *supra* note 26, at 2664–65 (arguing property rights are generally preferable in protecting intellectual property); Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 116 YALE L.J. 1742, 1799–1806 (2007) (explaining how information costs help explain why copyright law relies more on liability rights and patent law relies more on property rights); Stewart E. Sterk, *Property Rules, Liability Rules, and Uncertainty About Property Rights*, 106 MICH. L. REV. 1285, 1304–08 (2008) (arguing that liability rules limit incentives to conduct searches for the scope of property rights); *see also* Crane, *supra* note 31, at 255 (reframing the "property–liability debate" by focusing more broadly on other rights inherent in intellectual property).

34. Ben Depoorter, *Property Rules, Liability Rules and Patent Market Failure*, 1 ERASMUS L. REV. 59, 61 (2008); *see also* Balganesh, *supra* note 5, at 598 ("[T]he right to exclude in the context of both tangible and intangible property has come to be associated with an entitlement to exclusionary (injunctive) relief."); Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 255 (1994) ("Remedies for infringement of a patent are, with limited exceptions, those appropriate for property. Injunctions, both permanent and temporary, are available against infringers on proof of validity and infringement.").

35. Merges, *supra* note 26, at 2667.

36. Smith, *supra* note 33, at 1744; *see also* ROBERT P. MERGES, PETER S. MENELL & MARK A. LEMLEY, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 2 (6th ed. 2012) ("All justifications for intellectual property protection . . . must contend with a fundamental difference between ideas and tangible property. Tangible property . . . is composed of atoms, physical things that can occupy only one place at a given time. This means that possession of a physical thing is necessarily 'exclusive' . . . . Ideas, though, do not have this characteristic of excludability.").

37. *See* Michael A. Carrier, *Cabining Intellectual Property Through a Property Paradigm*, 54 DUKE L.J. 1, 32–33 (2004). For the leading critique of the idea that eliminating free riding is a primary goal of intellectual property law, see Mark A. Lemley, *Property, Intellectual Property, and Free Riding*,

of valuing IP rights is another rationale advanced for a property rule.[38] "Because each asset covered by an [IP right] is in some sense unique," it can be "difficult for a court . . . to properly value the [IP] right-holder's loss."[39]

However, some scholars have argued in favor of imposing liability rules on IP rights, at least in certain circumstances.[40] One situation where liability rules may be preferred is when private ordering—for instance, *ex ante* licensing under a property rule—would result in an inefficient outcome. This might occur, for example, if high transaction costs prevent the parties from reaching an otherwise mutually beneficial agreement regarding the use of IP rights.[41] High transaction costs may exist if numerous parties are involved in the bargaining process, such as when IP rights to various aspects of a particular technology are owned by disparate entities.[42] These difficulties may be compounded by the uncertain scope of some IP rights, such as the meaning of a patent's claims.[43]

Holdup is another reason advanced by some scholars for adopting liability rules.[44] Holdup occurs when an IP owner uses the prospect of

83 TEX. L. REV. 1031, 1032 (2005).

38. *See* THOMAS F. COTTER, COMPARATIVE PATENT REMEDIES: A LEGAL AND ECONOMIC ANALYSIS 54 (2013) ("[T]he job of putting a value on patent rights is inherently difficult, particularly in industries in which the technology itself is rapidly evolving."); Golden, *Patent Trolls*, *supra* note 4, at 2152 (explaining "[t]he difficulty of assessing [damages] has in fact been one of the principal rationales for granting permanent injunctions" in patent cases).

39. Merges, *supra* note 26, at 2664. One common approach for valuing IP is to compare "the advantages it confers . . . with the next-best available alternative." COTTER, *supra* note 38, at 53–54; *see also* Christopher B. Seaman, *Reconsidering the* Georgia-Pacific *Standard for Reasonable Royalty Patent Damages*, 2010 BYU L. REV. 1661, 1711–15 (2010) (discussing the role of non-infringing alternatives in determining royalty rates for patent rights).

40. *See* Crane, *supra* note 31, at 254 ("Intellectual property is incrementally moving away from . . . . a property regime to a liability regime.").

41. *See* Ian Ayres & J.M. Balkin, *Legal Entitlements as Auctions: Property Rules, Liability Rules, and Beyond*, 106 YALE L.J. 703, 706 n.9 (1996) ("[L]egal scholars have interpreted Calabresi and Melamed to be saying that property rules are more efficient when transaction costs are low."); Merges, *supra* note 26, at 2655 ("Ever since Calabresi and Melamed, transaction costs have dominated the choice of the proper entitlement rule, with a liability rule being the entitlement of choice when transaction costs are high."). Collective rights organizations have emerged as one mechanism to mitigate this problem. *See generally* Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CALIF. L. REV. 1293 (1996).

42. *See* Lemley & Weiser, *supra* note 33, at 793 (noting "that if a buyer must aggregate rights from a number of different parties in order to achieve a useful end result, it will have to deal with a number of different sellers," thus raising transaction costs).

43. *See* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 46–72 (2008) (arguing that patents fail to provide clear notice of the scope of patent rights); Greg Reilly, *Completing the Picture of Uncertain Patent Scope*, 91 WASH. U. L. REV. 1353, 1353 (2014) ("Uncertain patent scope is perhaps the most significant problem facing the patent system."); *see also* Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 731 (2002) ("Unfortunately, the nature of language makes it impossible to capture the essence of a thing in a patent application.").

44. *See* Mark A. Lemley, *Contracting Around Liability Rules*, 100 CALIF. L. REV. 463, 468 (2012) ("The biggest risk of applying property rules in IP cases is holdup.").

injunctive relief to extract compensation significantly in excess of the IP right's economic value.[45] Proponents of a liability rule in these situations assert that "[i]njunction threats often involve a strong element of holdup in the common circumstance in which the defendant has already invested heavily to design, manufacture, market, and sell [a] product" that practices the patented technology.[46] At that point, the infringer "would be willing to pay much more than he rationally would have negotiated *ex ante* in order not to pull the product from the shelves."[47] Critics of property rules argue that holdup operates as a "tax" on new high-tech products, which ultimately impedes growth rather than promoting innovation.[48] Other scholars, however, have questioned whether holdup is a significant problem on both empirical and theoretical levels.[49]

In sum, the theoretical literature has historically favored protecting IP rights—particularly patent rights—through property rules. But as explained in more detail in the balance of this Article, *eBay* represents a significant shift away from a property rule approach, at least for certain types of patent owners.

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45. *See* FED. TRADE COMM'N, *supra* note 8, at 58 ("Under some circumstances, the grant or threat of a permanent injunction can lead an infringer to pay higher royalties than it would pay in a competitive market for a patented invention."); *see also* COTTER, *supra* note 38, at 59 ("[P]atent[ed] holdup involves the strategic use of a patent . . . to extract ex post rents that are disproportionate to the ex ante value of the invention in comparison with the next-best available alternative."); Alexander Galetovic, Stephen Haber & Ross Levine, *An Empirical Examination of Patent Holdup*, 11 J. COMPETITION L. & ECON. 549, 549–50 (2015) ("[T]he patent holdup hypothesis asserts that patent holders charge licensing royalties to manufacturing firms that exceed the true economic contribution of the patented technology, thereby discouraging innovation by manufacturers and hurting consumers."); Lemley & Shapiro, *supra* note 10, at 1993 ("[T]he threat of an injunction can enable a patent holder to negotiate royalties far in excess of the patent holder's true economic contribution.").

46. Lemley & Shapiro, *supra* note 10, at 1993 (emphasis omitted); *see also* COTTER, *supra* note 38, at 59 (explaining that the strategy of holdup "rests upon the patent owner's ability to obtain an injunction against the distribution of the end product, after the costs of designing, producing, and distributing the end product have been sunk").

47. COTTER, *supra* note 38, at 59; *see also* Lemley & Shapiro, *supra* note 10, at 1995–2008 (modeling how a patent holder can exploit the cost of switching technologies to obtain licensing revenue greater than would have occurred in an *ex ante* negotiation). The holdup problem is asserted to be particularly acute for widely-adopted technological standards, where a single patent owner can use the threat of an injunction to "extract unreasonably high royalties from suppliers of standard-compliant products and services." Microsoft Corp. v. Motorola, Inc., 696 F.3d 872, 876 (9th Cir. 2012); *see also* Mark A. Lemley, *Ten Things to Do About Patent Holdup of Standards (and One* Not *to)*, 48 B.C. L. REV. 149, 153–54 (2007).

48. Lemley & Shapiro, *supra* note 10, at 1993; *see also* FED. TRADE COMM'N, *supra* note 8, at 26 (explaining that "[a]n injunction's ability to cause patent hold-up . . . can deter innovation by increasing costs and uncertainty for manufacturers" and "raise prices to consumers by depriving them of the benefit of competition among technologies").

49. *See generally* Einer Elhauge, *Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties?*, 4 J. COMPETITION L. & ECON. 535 (2008); Golden, *Patent Trolls*, *supra* note 4, at 2148–60; J. Gregory Sidak, *Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley & Shapiro*, 92 MINN. L. REV. 714 (2008); *see also* Galetovic et al., *supra* note 45, at 552–54, 570–72 (finding no empirical evidence to support the claim of holdup for standard-essential patents).

III. PATENTS AND THE RIGHT TO EXCLUDE

This Part chronicles the historic right of patentees to a property rule excluding others from practicing patented inventions. It then analyzes the *eBay* litigation and the Supreme Court's announcement of a four-factor test to govern the district courts' equitable power to grant injunctive relief. Finally, it addresses the existing literature regarding *eBay*'s impact on the availability of permanent injunctions in patent litigation.

A. HISTORICAL DEVELOPMENT

Property rules have long predominated in patent law.[50] As Chief Justice Roberts noted in his concurrence in *eBay*, since "at least the early 19th century, courts have granted injunctive relief upon a finding of infringement in the vast majority of patent cases."[51]

The Patent Act of 1790, passed by the First Congress, granted inventors "the sole and exclusive right and liberty of making, constructing, using and vending to others to be used, the . . . invention or discovery."[52] The earliest patent laws provided only for remedies at law—that is, recovery of monetary damages for infringing conduct.[53] Starting in 1819, however, Congress expressly authorized injunctive relief to preclude future infringement:

> [T]he circuit courts of the United States . . . shall have authority to grant injunctions, according to the course and principles of courts of equity, to prevent the violation of the rights of any . . . inventors, secured to them by any laws of the United States, on such terms and conditions as the said courts may deem fit and reasonable . . . .[54]

The current statutory language in § 283 of the Patent Act is remarkably similar, providing that "courts . . . may grant injunctions in accordance with the principles of equity to prevent the violation of any right secured by patent, on such terms as the court deems reasonable."[55]

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50. *See supra* note 34; *see also* Frank H. Easterbrook, *Intellectual Property is Still Property*, 13 HARV. J.L. & PUB. POL'Y 108, 109 (1990) ("Patents give a right to exclude, just as the law of trespass does with real property.").

51. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 395 (2006) (Roberts, C.J., concurring).

52. An Act to Promote the Progress of Useful Arts, ch. 7, § 1, 1 Stat. 109, 110 (1790).

53. *See* 3 WILLIAM C. ROBINSON, THE LAW OF PATENTS FOR USEFUL INVENTIONS § 1082, 391–92 (1890) ("The acts of Congress, prior to 1819, made no provision for any suit in equity by the owner of a patent, nor for his enjoyment of any form of equitable relief in connection with his action for damages at common law."); *see also* Elizabeth E. Millard, Note, *Injunctive Relief in Patent Infringement Cases: Should Courts Apply a Rebuttable Presumption of Irreparable Harm After* eBay Inc. v. MercExchange, L.L.C.?, 52 ST. LOUIS U. L.J. 985, 992 (2008) (noting that "the earliest patent statutes provided only for remedies at law").

54. An Act to Extend the Jurisdiction of the Circuit Courts of the United States to Cases Arising Under the Law Relating To Patents, ch. 19, 3 Stat. 481, 481–82 (1819).

55. 35 U.S.C. § 283 (2012).

Prior to *eBay*, courts routinely characterized patents as conferring a property right on their owners.[56] In turn, the right to exclude has been widely viewed as the "hallmark of a protected property interest"[57] and "one of the most treasured strands in an owner's bundle of property rights."[58] As early as 1852, the Supreme Court declared that the rights conferred by a patent include "the right to exclude [others] from making, using, or vending the thing patented, without the permission of the patentee."[59]

The Court's 1908 decision in *Continental Paper Bag Co. v. Eastern Paper Bag Co.* confirmed that patents confer the right to exclude others, even if the patentee itself has not practiced the patent.[60] In that case, the patent owner, Eastern Paper Bag Co. ("Eastern"), had purchased a patent on an improved machine for making paper bags, but Eastern did not use the improved machine, nor did it license anyone else to do so, as it feared that a competitor using the improved machine would erode its profits.[61] A competing manufacturer, Continental Paper Bag Co. ("Continental"), started using a machine that allegedly infringed on Eastern's patent.[62] The trial court found Eastern's patent valid and infringed, and it granted permanent injunctive relief.[63]

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56. *See, e.g.*, Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 730 (2002) (explaining that the patent laws provide "a temporary monopoly . . . [which] is a property right"); Fla. Prepaid Postsecondary Educ. Expense Bd. v. Coll. Sav. Bank, 527 U.S. 627, 642 (1999) (noting that patents "have long been considered a species of property"); Dawson Chem. Co. v. Rohm & Haas Co., 448 U.S. 176, 215 (1980) (noting "the long-settled view that the essence of a patent grant is the right to exclude"); Hartford-Empire Co. v. United States, 323 U.S. 386, 415 (1945) (stating that it "has long been settled" that "a patent is property, protected against appropriation both by individuals and by government"); Wilson v. Rousseau, 45 U.S. (4 How.) 646, 674 (1846) (explaining that "[t]he law has thus impressed upon [a patent] all the qualities and characteristics of property"). The Patent Act provides that "patents shall have the attributes of personal property." 35 U.S.C. § 261 (2012).

57. *Fla. Prepaid Postsecondary Educ. Expense Bd.*, 527 U.S. at 643.

58. Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 435 (1982); *see also* Kaiser Aetna v. United States, 444 U.S. 164, 176 (1979) (describing "the right to exclude" as "one of the most essential sticks in the bundle of rights that are commonly characterized as property"); Lemley & Weiser, *supra* note 33, at 783 ("The foundational notion of property law is that the 'right to exclude' is the essence of a true property right."); Thomas W. Merrill, *Property and the Right to Exclude*, 77 NEB. L. REV. 730, 730 (1998) ("[T]he right to exclude others is more than just 'one of the most essential' constituents of property—it is the *sine qua non.*").

59. Bloomer v. McQuewan, 55 U.S. (14 How.) 539, 549 (1852); *see also* Herbert F. Schwartz, Note, *Injunctive Relief in Patent Infringement Suits*, 112 U. PA. L. REV. 1025, 1041–42 (1964) ("By the middle of the nineteenth century, courts generally recognized that the plaintiff was entitled to . . . an injunction against future infringements for the life of the patent." (footnotes omitted)).

60. Cont'l Paper Bag Co. v. E. Paper Bag Co., 210 U.S. 405, 429 (1908).

61. *Id.* at 407, 427–28. According to the trial court, Eastern's purpose in purchasing the patent-in-suit was to "lock[ ] up" the technology and thus prevent competitors from using it for the rest of the patent's life. *See* E. Paper Bag Co. v. Cont'l Paper Bag Co., 142 F. 479, 487 (C.C.D. Me. 1905) ("[Eastern] has never attempted to make any practical use of [the patent], either itself or through licenses, and apparently its proposed policy has been to avoid this.").

62. *Cont'l Paper Bag Co.*, 210 U.S. at 416.

63. *Id.* at 407. The court also ordered an accounting of Continental's profits derived from

On appeal, Continental argued the trial court erred in granting an injunction because Eastern had unreasonably failed to use the patented invention.[64] Continental's argument was primarily based on the policy claim that Eastern's non-use did not promote the constitutional purpose of the patent system "to promote the progress of science and useful arts."[65] The Court rejected this claim, holding that "patents are property" and thus are "entitled to the same rights and sanctions as other property."[66] Because a patent is the "absolute property" of its owner, the Court reasoned, Eastern was entitled to "insist upon all the advantages and benefits which [patent law] promises," including injunctive relief, despite its non-use.[67] It concluded by explaining that the patent "right can only retain its attribute of exclusiveness by a prevention of its violation. Anything but prevention takes away the privilege which the law confers upon the patentee."[68]

After its creation by Congress in 1982, the U.S. Court of Appeals for the Federal Circuit—which hears all appeals of patent infringement claims[69]—continued to treat patents as conferring a strong property right to exclude.[70] For instance, it stated in one early decision that "the right to exclude recognized in a patent is . . . the essence of the concept of property."[71] Although recognizing that "a district court has discretion whether to enter an injunction,"[72] the Federal Circuit declared "that an injunction should issue once infringement has been established unless there is a sufficient reason for denying it."[73] In practice, this resulted in a "general rule that courts will issue permanent injunctions against patent infringement."[74] Only in rare instances, such as to prevent harm to public health or welfare, did courts deny permanent injunctions.[75]

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the infringement. *Id.*

64. *Id.* at 422.

65. *Id.* at 422–23 (citing U.S. CONST. art. I, § 8).

66. *Id.* at 425.

67. *Id.* at 424.

68. *Id.* at 430.

69. 28 U.S.C. § 1295(a)(1) (2012).

70. *See In re* Etter, 756 F.2d 852, 859 (Fed. Cir. 1985) ("The patent right is a right to exclude. . . . The essence of all property is the right to exclude, and the patent property right is certainly not inconsequential."); Carl Schenck, A.G. v. Nortron Corp., 713 F.2d 782, 786 n.3 (Fed. Cir. 1983) ("The patent right is but the right to exclude others, the very definition of 'property.'").

71. Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 1548 (Fed. Cir. 1983) (citation omitted); *see also* Dawson Chem. Co. v. Rohm & Hass Co., 448 U.S. 176, 215 (1980) (noting "the long-settled view that the essence of a patent grant is the right to exclude").

72. Trans-World Mfg. Corp. v. Al Nyman & Sons, Inc., 750 F.2d 1552, 1564 (Fed. Cir. 1984) (citation omitted).

73. W.L. Gore & Assocs., Inc. v. Garlock, Inc. 842 F.2d 1275, 1281 (Fed. Cir. 1988).

74. MercExchange, L.L.C. v. eBay, Inc. (*MercExchange II*), 401 F.3d 1323, 1339 (Fed. Cir. 2005).

75. *See* Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1547 (Fed. Cir. 1995) ("[C]ourts have in rare instances exercised their discretion to deny injunctive relief in order to protect the public interest."); City of Milwaukee v. Activated Sludge, Inc., 69 F.2d 577, 593 (7th Cir. 1934) (denying

B. *eBay v. MercExchange*

This Subpart describes the *eBay* litigation, culminating with the Supreme Court's rejection of the "general rule" in favor of injunctive relief and its replacement with a four-factor test. As explained in more detail below, the application of this four-factor test represents a significant shift away from property rules toward liability rules for the enforcement of patent rights.

1. Initial District Court Decision

MercExchange, L.L.C., a failed startup founded by the inventor of the patent-in-suit,[76] asserted that eBay, Inc., infringed U.S. Patent No. 5,845,265 ("the '265 patent"), which claimed a method and apparatus "for an electronic market designed to facilitate the sale of goods between private individuals by establishing a central authority to promote trust among participants."[77] After a five-week trial, a jury found the '265 patent (and one other patent in the same family as the '265 patent) was valid and infringed, and it awarded MercExchange $35 million in damages.[78]

MercExchange subsequently moved for entry of a permanent injunction, which the district court denied.[79] While recognizing that "the grant of injunctive relief against the infringer is considered the norm," the district court stated that it was required to consider "traditional equitable principles," including "(i) whether the plaintiff would face irreparable injury if the injunction did not issue, (ii) whether the plaintiff has an adequate remedy at law, (iii) whether granting the injunction is in the public interest, and (iv) whether the balance of the hardships tips in the plaintiff's favor."[80]

After evaluating these factors, the district court found none of them weighed in favor of granting an injunction. First, the district court pointed to "evidence of the plaintiff's willingness to license its patents, its lack of

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a permanent injunction that would have required closing Milwaukee's sewage treatment plan and dumping untreated sewage into Lake Michigan, thus endangering "the health and the lives of more than half a million people"). One notable example of a pre-*eBay* denial of a permanent injunction occurred in *Foster v. American Machine & Foundry Co.*, where the Second Circuit affirmed the trial court's denial of a permanent injunction when a patentee who did not manufacture a product using the patented technology sought to exclude a manufacturing infringer. Foster v. Am. Mach. & Foundry Co., 492 F.2d 1317, 1324 (2d Cir. 1974).

76. For a detailed description of MercExchange and its founder, Thomas G. Woolston, who was also the inventor of the '265 patent, see Holte, *Trolls or Great Inventors*, *supra* note 4, at 23–30.

77. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 390 (2006).

78. *MercExchange I*, 275 F. Supp. 2d 695, 698–99 (E.D. Va. 2003). The district court struck $5.5 million from the jury's award for eBay's inducement of a third party to infringe the '265 patent, concluding that it would result in impermissible double counting. *Id.* at 710. In addition, the jury's $4.5 million verdict for infringement of another patent-in-suit (U.S. Patent No. 6,085,176) was subsequently vacated on appeal because that patent was invalid as anticipated. *MercExchange II*, 401 F.3d at 1333–35 (referring to *MercExchange I*, 275 F. Supp. 2d at 698–99).

79. *MercExchange I*, 275 F. Supp. 2d at 710–15. For a summary of the parties' briefing on the issue of injunctive relief at the trial court level, see Holte, *Misinterpretation of* eBay, *supra* note 4, at 691–95.

80. *MercExchange I*, 275 F. Supp. 2d at 711.

commercial activity in practicing the patents, and its comments to the media as to its intent with respect to enforcement of its patent rights" in concluding that eBay had rebutted the presumption that MercExchange would suffer irreparable harm absent an injunction.[81] Second, the district court relied on MercExchange's practice of "licens[ing] its patents to others in the past" and "its willingness to license the patents to the defendants in this case" as evidence that it had an adequate remedy at law.[82] Third, it held "the public interest factor equally supports granting an injunction to protect [MercExchange]'s patent rights, and denying an injunction to protect the public's interest in using a patented business-method that the patent holder declines to practice."[83] Finally, the district court concluded the balance of hardships favored eBay because "[a]ny harm suffered . . . by the defendants' infringement of the patents can be recovered by way of damages."[84]

2. Federal Circuit Decision

MercExchange appealed to the Federal Circuit, which affirmed the jury's findings that the '265 patent was valid and infringed by eBay in a published decision in March 2005, but it reversed the district court's denial of a permanent injunction.[85] The Federal Circuit first recounted "the general rule . . . that a permanent injunction will issue once infringement and validity have been adjudged."[86] It then concluded that the district court had failed to "provide any persuasive reason to believe this case is sufficiently exceptional to justify the denial of a permanent injunction."[87] In particular, the Federal Circuit criticized the district court's reasoning that MercExchange's willingness to license its patents meant that it did not suffer irreparable harm and that it had an adequate remedy at law, stating that offers to license "should not . . . deprive [MercExchange] of the right to an injunction to which it would otherwise be entitled. Injunctions are not reserved for patentees who intend to practice their patents, as opposed to those who choose to license."[88] It also held that the district court's "general concern regarding business-method patents" were "not a sufficient basis for denying a permanent injunction."[89] On the issue of damages, the Federal Circuit

81. *Id.* at 712.
82. *Id.* at 713.
83. *Id.* at 714.
84. *Id.*
85. *MercExchange II*, 401 F.3d at 1326.
86. *Id.* at 1338 (citing Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1246–47 (Fed. Cir. 1989)).
87. *Id.* at 1339.
88. *Id.*
89. *Id.*

declined to overturn the $25 million award for past infringement of the '265 patent.[90]

3. Supreme Court Decision

On November 28, 2005, the Supreme Court granted eBay's petition for writ of certiorari on the issue of permanent injunctive relief.[91] In particular, the Court explicitly directed the parties to brief and argue "[w]hether this Court should reconsider its precedents, including *Continental Paper Bag Co. v. Eastern Paper Bag Co.*, on when it is appropriate to grant an injunction against a patent infringer."[92] The appeal attracted significant media attention from the popular press,[93] and numerous intellectual property scholars, bar organizations, and high-technology firms filed amicus briefs with the Court.[94]

On May 16, 2006, the Court unanimously reversed the Federal Circuit.[95] The Court's opinion, delivered by Justice Thomas, is succinct—less than five full pages in the official *United States Reports.* After summarizing the parties and procedural history of the case, the Court announced that "[a]ccording to well-established principles of equity, a plaintiff seeking a permanent injunction must satisfy a four-factor test."[96] Specifically, it held that the patentee must show:

90. *Id.* at 1326; *see also supra* note 78 and accompanying text (explaining how the jury's verdict was reduced to $25 million).

91. eBay Inc. v. MercExchange, L.L.C., 546 U.S. 1029 (2005) (granting writ of certiorari).

92. *Id.* (internal citation omitted).

93. *See, e.g.*, Katie Hafner, *Justices Will Hear Patent Case Against eBay*, N.Y. TIMES (Mar. 27, 2006), http://www.nytimes.com/2006/03/27/technology/27ebay.html (noting that the *eBay* appeal "has attracted an unusual amount of public attention in part because of recent attempts by large corporations to change patent law to lessen the threat posed by so-called nonpracticing patent holders"); *see also* Joan Biskupic, *Supreme Court Hears eBay Patent Case*, USA TODAY, (Mar. 29, 2006, 9:47 PM), http://www.usatoday30.usatoday.com/tech/news/2006-03-29-ebay-case_X.htm.

94. *See, e.g.,* Brief Amici Curiae of 52 Intellectual Property Professors in Support of Petitioners, eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388 (2006) (No. 05-130), 2006 WL 1785363; Brief of Various Law & Economics Professors as Amici Curiae in Support of Respondent, *eBay*, 547 U.S. 388 (No. 05-130), 2006 WL 639164; Brief of the American Bar Ass'n as Amicus Curiae Supporting Respondent, *eBay*, 547 U.S. 388 (No. 05-130), 2006 WL 639167; Brief of American Intellectual Property Law Ass'n & Federal Circuit Bar Ass'n as Amici Curiae in Support of Neither Party, *eBay*, 547 U.S. 388 (No. 05-130), 2006 WL 148639; Brief of Amicus Curiae Yahoo! Inc. in Support of Petitioner, *eBay*, 547 U.S. 388 (No. 05-130), 2006 WL 218988; Brief of I.B.M. Corp. as Amicus Curiae in Support of Neither Party, *eBay*, 547 U.S. 388 (No. 05-130), 2006 WL 235006. A summary of the amicus briefs filed in the Supreme Court is available at Holte, *Misinterpretation of* eBay, *supra* note 4, at 691–95.

95. *eBay*, 547 U.S. at 390.

96. *Id.* at 391. Several remedies scholars have persuasively argued that the four-factor test articulated in *eBay* was in fact not "well-established." *See* DOUGLAS LAYCOCK, MODERN AMERICAN REMEDIES: CASES AND MATERIALS 339 (4th ed. 2012) (concluding that "there was no 'traditional' four-part test" for permanent injunctions); Gergen et al., *supra* note 4, at 207 (explaining how the *eBay* decision's "four-factor test differs from traditional equitable practice in at least three, and possibly four, significant ways"); Rendleman, *supra* note 4, at 76 n.71 (noting that "[r]emedies specialists had never heard of the four-point test" announced in *eBay*).

> (1) that it has suffered an irreparable injury; (2) that remedies available at law, such as monetary damages, are inadequate to compensate for that injury; (3) that, considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction.[97]

The Court then declared that this four-part test "appl[ied] with equal force to disputes arising under the Patent Act."[98]

The Court's opinion acknowledged that patents confer property rights upon their owners, including "the right to exclude others from making, using, offering for sale, or selling the invention."[99] However, it rejected the Federal Circuit's reasoning that this right "justifies [the] general rule in favor of permanent injunctive relief," asserting—without citing to any authority—that "the creation of a right is distinct from the provision of remedies for violations of that right."[100] Instead, it concluded that "injunctive relief 'may' issue only 'in accordance with the principles of equity.'"[101]

The Court held that neither the district court nor the Federal Circuit had "fairly applied . . . traditional equitable principles in deciding [MercExchange]'s motion for a permanent injunction."[102] First, it criticized the district court for apparently "adopt[ing] certain expansive principles suggesting that injunctive relief could not issue in a broad swath of cases," including when a patent owner did not commercially practice the patented invention or when it was willing to license the patent-in-suit to others, declaring that these "categorical rule[s] . . . cannot be squared with the principles of equity adopted by Congress."[103] The Court specifically cited its decision in *Continental Paper Bag* to support its conclusion that the district court could not categorically deny injunctive relief to a non-practicing patent holder.[104] At the same time, it rebuffed the Federal Circuit's adoption of a "general rule, unique to patent disputes, that a permanent injunction [should] issue" absent "exceptional circumstances," explaining that the Federal Circuit's departure "in the opposite direction" also was incompatible with the four-factor test.[105] The Court then vacated and remanded the case to the district court to apply "the traditional four-factor framework."[106]

97. *eBay*, 547 U.S. at 391.
98. *Id.*
99. *Id.* at 392 (quoting 35 U.S.C. § 154(a)(1) (2006)).
100. *Id.*
101. *Id.* (quoting 35 U.S.C. § 283 (2006)).
102. *Id.* at 393.
103. *Id.*
104. *Id.* (citing Cont'l Paper Bag Co. v. E. Paper Bag Co., 210 U.S. 405, 422–430 (1908)).
105. *Id.* at 393–94 (quoting *MercExchange II*, 401 F.3d 1323, 1339 (Fed. Cir. 2005)).
106. *Id.* at 394.

This unanimous opinion, however, only thinly veiled an apparent deep-seated disagreement between the Justices regarding the proper circumstances for granting permanent injunctions in future patent cases.[107] These diverging views burst to the forefront in two concurring opinions. In a two-paragraph concurrence, Chief Justice Roberts, joined by Justices Scalia and Ginsburg, suggested trial courts would be wise to consider "a page of history" and continue to grant injunctions in the "vast majority of patent cases" after *eBay*.[108] In particular, the Chief Justice noted the difficulty of protecting the right to exclude "through monetary remedies that allow an infringer to *use* an invention against the patentee's wishes."[109]

In a separate concurrence, Justice Kennedy, joined by Justices Stevens, Souter, and Breyer, initially expressed agreement with the Chief Justice's statement that "history may be instructive in applying [the four-factor] test," but immediately proceeded to critique the Chief Justice's assertion regarding the difficulty of protecting the right to exclude without an injunction.[110] Justice Kennedy's concurrence contended that "[b]oth the terms of the Patent Act and the traditional view of injunctive relief accept that the existence of a right to exclude does not dictate the remedy for a violation of that right."[111] It then asserted that modern patent cases often differed from historical patent litigation in several important ways, including the role of non-practicing patentees who employ injunctive relief "as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent."[112] Justice Kennedy's concurrence also explained that injunctions may be inappropriate "[w]hen the patented invention is but a small component of the product the companies seek to produce and the threat of an injunction is employed simply for undue leverage in negotiations."[113] Finally, Justice Kennedy pointed to the "burgeoning number of patents over business methods," some of which suffer from "potential vagueness and suspect validity," as another reason to potentially deny injunctive relief.[114]

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107. *See* James M. Fischer, *The "Right" to Injunctive Relief for Patent Infringement*, 24 SANTA CLARA COMPUTER & HIGH TECH. L.J. 1, 20 (2007) ("The Court's decision in *eBay*, although presented as a unanimous decision . . . is sufficiently terse, pithy, and fractured by the two concurrences as to provide some support to practically any conclusion one wishes to draw from the decision."); Paul M. Mersino, Note, *Patents, Trolls, and Personal Property: Will* eBay *Auction Away a Patent Holder's Right to Exclude?*, 6 AVE MARIA L. REV. 307, 326 (2007) ("The generality in the [C]ourt's holding [in *eBay*] was compounded by the fact that, although it was technically unanimous, the two concurring opinions were highly divergent on exactly how the holding should be applied.").

108. *eBay*, 547 U.S. at 395 (Roberts, C.J., concurring) (citation omitted).

109. *Id.*

110. *Id.* at 395–96 (Kennedy, J., concurring).

111. *Id.* at 396.

112. *Id.*

113. *Id.*

114. *Id.* at 397.

4. After Remand

An important part of the *eBay* litigation—although sometimes overlooked in the shadow of the landmark Supreme Court decision—is the decision of the district court after remand. Applying the four-factor test mandated by the Court's decisions, the district court again denied injunctive relief to MercExchange.[115] This opinion is instructive because the district court's reasoning has been widely adopted by subsequent courts when declining to grant injunctive relief to prevailing patentees.

In a detailed written decision issued on July 27, 2007, the district court found that three of the four *eBay* factors weighed against an injunction.[116] First, it concluded MercExchange could not demonstrate irreparable harm. The district court explained that the traditional presumption of irreparable harm following a finding of infringement did not survive the Supreme Court's decision, which "require[d] the [patentee] to demonstrate that it has suffered an irreparable injury."[117] MercExchange could not demonstrate such harm, the court reasoned, because it had "acted inconsistently with defending its right to exclude" by "follow[ing] a consistent course of licensing its patents to market participants."[118] In particular, MercExchange's "consistent course of litigating or threatening litigation to obtain money damages . . . indicates that MercExchange has utilized its patents as a sword to extract money rather than as a shield to protect its right to exclude."[119] Thus, it concluded MercExchange's patent licensing practice "plainly weighs against a finding of irreparable harm."[120] For similar reasons, the district court found MercExchange had an adequate remedy at law because it had demonstrated a "consistent desire to obtain royalties in exchange for a license to its intellectual property" and thus could be made whole through monetary damages.[121]

Third, the court found that the "balance of the hardships" factor favored neither party due to a variety of uncertainties, including eBay's claimed design around, the possibility that the '265 patent would be invalidated in reexamination, and the potential of eBay to lose customers if it was forced to

115. MercExchange L.L.C. v. eBay, Inc. (*MercExchange III*), 500 F. Supp. 2d 556, 559 (E.D. Va. 2007).

116. *Id.* at 569–91.

117. *Id.* at 569 (emphasis omitted); *see also id.* ("[E]ven though an affirmed jury verdict establishes that eBay is a willful infringer . . . , a permanent injunction shall only issue if *plaintiff carries its burden* of establishing that, based on traditional equitable principles, the case specific facts warrant entry of an injunction.").

118. *Id.*

119. *Id.* at 572.

120. *Id.* at 573. The District Court also noted that MercExchange's failure to seek preliminary injunctive relief and its business method patent also weighed against a finding of irreparable harm. *Id.* at 574–75.

121. *Id.* at 583 (emphasis omitted).

remove the infringing buy-it-now option from its website.[122] Fourth, the district court determined that the final *eBay* factor, the public interest, weighed slightly against entry of an injunction because the public interest favored damages—a liability rule—rather than an injunction because MercExchange was "merely seeking an injunction as a bargaining chip to increase [its] bottom line."[123] In the court's judgment, this outweighed "the public . . . benefits from a strong patent system."[124]

Following denial of a permanent injunction, the district court directed entry of final judgment that the '265 patent was willfully infringed and valid, and it confirmed the damages award.[125] eBay then launched a second appeal to the Federal Circuit,[126] but the parties resolved their dispute in February 2008 through an out-of-court settlement in which eBay agreed to purchase the '265 patent (and two other patents) for an undisclosed sum.[127]

B. *EXISTING LITERATURE ON* EBAY*'S IMPACT*

In the wake of the Supreme Court's decision, scholars and others questioned how *eBay* would affect the availability of injunctive relief in patent litigation.[128] The existing literature regarding *eBay*'s impact suggests that while permanent injunctions are still commonly granted, certain types of patent disputes have largely shifted from a property rule to a liability rule.

Several previous studies have found that prevailing patentees still receive permanent injunctions approximately three-quarters of the time following *eBay*. One article published in 2008 found that district courts awarded permanent injunctions in approximately 78% of cases.[129] Another study of injunction decisions through May 2009 disclosed that permanent injunctions

122. *Id.* at 583–86.

123. *Id.* at 588.

124. *Id.* at 587.

125. MercExchange, L.L.C. v. eBay, Inc. (*MercExchange IV*), 660 F. Supp. 2d 653, 658–59 (E.D. Va. 2007).

126. Notice of Appeal, MercExchange, L.L.C. v. eBay, Inc., No. 2:01-CV-00736 (E.D. Va. Dec. 18, 2007), ECF No. 758. eBay's appeal was docketed as No. 2008-1139.

127. *See* Press Release, *eBay Inc. and MercExchange, L.L.C. Reach Settlement Agreement*, EBAY (Feb. 28, 2008), http://investor.ebayinc.com/releasedetail.cfm?releaseid=296670.

128. *See, e.g.*, FED. TRADE COMM'N, *supra* note 8, at 217 (noting that *eBay* "created significant uncertainty concerning the circumstances under which courts would deny permanent injunctions"); F. Scott Kieff, *Removing Property from Intellectual Property and (Intended?) Pernicious Impacts on Innovation and Competition*, *in* COMPETITION POLICY AND PATENT LAW UNDER UNCERTAINTY: REGULATING INNOVATION 416, 425 (Geoffrey A. Manne & Joshua D. Wright eds., 2011) ("In the final analysis, the full impact of the *eBay* case remains an open question for debate."); Crane, *supra* note 31, at 264 ("In light of *eBay*, injunctions no longer issue as a matter of course in infringement cases, but it remains to be seen just how wide the impact of *eBay* will be."); *The Supreme Court, 2005 Term—Leading Cases*, 120 HARV. L. REV. 125, 337 (2006) (asserting that "*eBay* raises more questions about the grant of permanent injunctions than it answers" and that "the opinion leaves patent holders to speculate whether fewer permanent injunctions against infringers will issue in a post-*eBay* world").

129. *See* Ellis et al., *supra* note 4, at 441–42 nn.35–36 (finding permanent injunctions awarded in 28 of 36 district court decisions).

were granted 72% of the time.[130] Similarly, in a 2012 article, Colleen Chien and Mark Lemley reported that "courts have granted about 75% of requests for injunctions, down from an estimated 95% pre-*eBay*."[131] A recent paper by Kirti Gupta and Professor Jay Kesan found that permanent injunction motions between *eBay* and 2012 were granted 80% of the time.[132] Finally, a database of permanent injunction decisions hosted by the University of Houston Law Center's Institute for Intellectual Property and Information Law indicates permanent injunctions have been granted 75% of the time from *eBay* through 2013.[133]

Although patentees as a whole appear to enjoy a relatively high success rate in obtaining injunctive relief following *eBay*, prior commentators have noted that patent holders who primarily engage in licensing and litigation—commonly referred to as PAEs[134]—are much less successful.[135] For instance, Chien and Lemley found that through August 2011, district courts granted injunctions to PAEs only 26% of the time—and only 7% of cases where the injunction request was contested by the infringer.[136] Similarly, a report by the Federal Trade Commission found that "non-practicing patentees have been less likely than practicing patentees to receive injunctions."[137] Many of these decisions relied on the reasoning in Justice Kennedy's concurrence

130. Ernest Grumbles III et al., *The Three Year Anniversary of* eBay v. MercExchange*: A Statistical Analysis of Permanent Injunctions*, INTELLECTUAL PROP. TODAY (Nov. 2009), at 25.

131. Chien & Lemley, *supra* note 2, at 9–10 (footnotes omitted).

132. Kirti Gupta & Jay P. Kesan, Studying the Impact of *eBay* on Injunctive Relief in Patent Cases 9 fig.3 (July 10, 2015) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2629399.

133. *Post-*eBay *Permanent Injunction Rulings in Patent Cases to 12-31-13*, PATSTATS.ORG, http://patstats.org/Patstats2.html (last visited Mar. 11, 2016) [hereinafter PATSTATS.ORG]. After removing apparently duplicative entries, this database reports that permanent injunctions were granted in 174 cases and denied in 57 cases. *Id.* However, a review of the listed cases in this database indicates that a number of these decisions involved cases where the entry of a permanent injunction was unopposed by the infringer, thus skewing the overall grant rate somewhat higher. *Id; see also infra* note 175 and accompanying text.

134. *See supra* note 8 and accompanying text.

135. *See* Chien & Lemley, *supra* note 2, at 2 ("In the wake of . . . *eBay* . . . district courts rarely grant injunctions in patent infringement cases to patent-assertion entities . . . ."); Lily Lim & Sarah E. Craven, *Injunctions Enjoined; Remedies Restructured*, 25 SANTA CLARA COMPUTER & HIGH TECH. L.J. 787, 798 (2009) (finding that "an NPE's chance of getting an injunction [fell] precipitously" after *eBay* compared to "a patentee who directly competes in the marketplace"); Sandrik, *supra* note 4, at 111 (noting that "NPEs are hard-pressed to get an injunction" after *eBay*); Yixin H. Tang, Note, *The Future of Patent Enforcement After* eBay v. MercExchange, 20 HARV. J.L. & TECH. 235, 246 (2006) (asserting that after *eBay*, "patent holders who did not practice their patents found themselves in a more difficult position").

136. Chien & Lemley, *supra* note 2, at 10 fig.1; *see also id.* at 11 ("Of all groups, PAEs are least likely to obtain an injunction; they tend to succeed in their requests only when the defendant fails to object.").

137. FED. TRADE COMM'N, *supra* note 8, at 256. This report found that patentees who practiced the patent received injunctions at an 83% rate, while patentees who did not practice the patent received an injunction at a 43% rate. *Id.* at 259.

suggesting that patent holders who do not practice their patents generally should not receive an injunction because it would give them "undue leverage" in licensing negotiations.[138]

Another factor discussed in the existing literature is the relationship between the litigants.[139] When the parties-in-suit are competitors, a permanent injunction typically issues.[140] Indeed, the Federal Circuit has gone so far as to declare that the "essential attribute of a patent grant is that it provides a right to exclude *competitors* from infringing the patent."[141] According to one commentator, "[i]f the parties can fairly be described as direct competitors, the first two factors" of the *eBay* test—irreparable injury and absence of an adequate remedy at law—"will weigh heavily in favor of the [patentee]."[142] For instance, the types of competition-related harms that courts have found sufficient to demonstrate an irreparable injury include loss of market share, loss of goodwill among customers, and price erosion.[143] In

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138. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006). For examples of district court opinions citing Justice Kennedy's concurrence in denying an injunction to a non-practicing patentee, see Hynix Semiconductor Inc. v. Rambus Inc., 609 F. Supp. 2d 951, 966 (N.D. Cal. 2009); i4i Ltd. P'ship v. Microsoft Corp., 670 F. Supp. 2d 568, 600 (E.D. Tex. 2009); Commonwealth Sci. and Indus. Research Organisation v. Buffalo Tech. Inc., 492 F. Supp. 2d 600, 605 (E.D. Tex. 2007); MPT, Inc. v. Marathon Labels, Inc., 505 F. Supp. 2d 401, 419–20 (N.D. Ohio 2007); and z4 Techs., Inc. v. Microsoft Corp., 434 F. Supp. 2d 437, 441 (E.D. Tex. 2006). *See also* Ted Sichelman, *Purging Patent Law of "Private Law" Remedies*, 92 TEX. L. REV. 517, 520–22 & n.13 (2014) (discussing Justice Kennedy's "influential concurrence").

139. *See* Chao, *supra* note 4, at 549 (noting that "[o]ne category of fact patterns that has figured prominently in cases applying the *eBay* factors [is] the existence, or lack of direct competition" between the litigants).

140. *See, e.g.*, SynQor, Inc. v. Artesyn Techs., Inc., No. 2:07-CV-497-TJW-CE, 2011 WL 238645, at *3 (E.D. Tex. Jan. 24, 2011) ("The best case for obtaining a permanent injunction often occurs when the plaintiff and defendant are competing in the same market."); Advanced Cardiovascular Sys., Inc. v. Medtronic Vascular, Inc., 579 F. Supp. 2d 554, 558 (D. Del. 2008) ("Courts awarding permanent injunctions typically do so under circumstances where plaintiff practices its invention and is a direct market competitor."); Beckerman-Rodau, *supra* note 4, at 632 ("Typically, permanent injunctions continue to issue when the patent owner and the infringer are direct marketplace competitors."); Chao, *supra* note 4, at 553 ("[T]he existence of direct competition appears to be a good predictor of whether a permanent injunction will issue."); Ellis et al., *supra* note 4, at 442 ("To date, the relationship of the parties-in-suit has been the single most important determinant as to whether an injunction will issue. For the most part, when the parties-in-suit were deemed *direct* competitors, permanent injunctions were issued." (footnotes omitted)). An FTC study found that injunctions were granted 87% of the time when the patentee and the defendant competed. FED. TRADE COMM'N, *supra* note 8, at 259.

141. Acumed LLC v. Stryker Corp., 551 F.3d 1323, 1328 (Fed. Cir. 2008) (emphasis added).

142. Stacy Streur, *The* eBay *Effect: Tougher Standards but Courts Return to the Prior Practice of Granting Injunctions for Patent Infringement*, 8 NW. J. TECH. & INTELL. PROP. 67, 71 (2009); *see also* George M. Newcombe et al., *Prospective Relief for Patent Infringement in a Post-*eBay *World*, 4 N.Y.U. J.L. & BUS. 549, 559–60 (2008) (finding "the infringer was a direct horizontal competitor" to the patentee in 28 of 30 cases where a permanent injunction issued); Benjamin H. Diessel, Note, *Trolling for Trolls: The Pitfalls of the Emerging Market Competition Requirement for Permanent Injunctions in Patent Cases Post-*eBay, 106 MICH. L. REV. 305, 318 (2007) ("The market competition requirement, more than merely correlating with results, appears to be dispositive in determining whether to grant an injunction.").

143. Newcombe et al., *supra* note 142, at 560–62. The Federal Circuit itself has explained

contrast, "district courts appear to have consistently denied permanent injunctions in cases where . . . the infringer and patent holder were not competitors."[144]

A third consideration is whether the patentee has licensed or offered to license the patented technology to others.[145] As the district court concluded after remand in *eBay*, a patentee's licensing activity may demonstrate both lack of irreparable harm and the existence of an adequate remedy at law.[146] However, a recent report by the Federal Trade Commission found that permanent injunctions were still granted in the majority of cases where the patentee licensed others to practice the patent.[147]

Whether the patented invention is a "small component" of an infringing product also may be relevant. Justice Kennedy's concurring opinion in *eBay* suggested that situations where "the patented invention is but a small component of the [infringing] product" may be inappropriate for injunctive relief due to the threat of holdup.[148] Existing scholarship suggests that district courts frequently deny injunctive relief in these situations.[149]

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that "facts relating to the nature of the competition between the parties undoubtedly are relevant to the irreparable harm inquiry." Robert Bosch LLC v. Pylon Mfg. Corp., 659 F.3d 1142, 1150 (Fed. Cir. 2011).

144. Golden, *Patent Trolls*, *supra* note 4, at 2113; *see also* FED. TRADE COMM'N, *supra* note 8, at 259 (finding permanent injunctions were granted only 25% of the time when patentee and infringer did not compete).

145. *See* Jay Dratler, Jr., eBay*'s Practical Effect: Two Differing Visions*, 2 AKRON INTELL. PROP. J. 35, 49 (2008) ("If the patent at issue already has been licensed to multiple parties on a nonexclusive basis, at a standard royalty rate, all four equitable factors ordinarily favor denying an injunction." (emphasis omitted)); Ellis et al., *supra* note 4, at 452 ("[C]ompanies and individuals . . . who license to un-related entities have been less successful in their requests for an injunction."); *see also* T.J. Smith & Nephew Ltd. v. Consol. Med. Equip., Inc., 821 F.2d 646, 648 (Fed. Cir. 1987) (concluding in a pre-*eBay* case that licensing the patent is "incompatible with the emphasis on the right to exclude that is the basis for the presumption" of irreparable harm).

146. *See supra* notes 118–21 and accompanying text (discussing the district court's reasoning); *see also* Telcordia Techs., Inc. v. Cisco Sys., Inc., 592 F. Supp. 2d 727, 748 n.10 (D. Del. 2009) (concluding that the patentee's "willingness to license its patents also suggests that its injury is compensable in monetary damages, which is inconsistent with the right to exclude"); Sundance, Inc. v. DeMonte Fabricating Ltd., No. 02–73543, 2007 WL 37742, at *2 (E.D. Mich. Jan. 4, 2007) (concluding that the patentee's "licens[ing] the [patent-in-suit] to others, and offer[ing] to license it to [the defendant] prior to filing suit . . . demonstrate[es] that money damages are adequate"); Andrei Iancu & W. Joss Nichols, *Balancing the Four Factors in Permanent Injunction Decisions: A Review of Post-*eBay *Case Law*, 89 J. PAT. & TRADEMARK OFF. SOC'Y 395, 398 (2007) (noting "the predilection some courts have to deny an injunction upon a showing of a willingness to license").

147. FED. TRADE COMM'N, *supra* note 8, at 259; *see also id.* at 264 ("District courts have also granted injunctions to organizations that often seek to license their patents non-exclusively.").

148. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006) (Kennedy, J., concurring).

149. *See* Benjamin Petersen, Note, *Injunctive Relief in the Post-*eBay *World*, 23 BERKELEY TECH. L.J. 193, 198 (2008) ("[I]n five of the ten cases where courts denied an injunction, the court found that the patented invention is merely a small component of the infringing product. There were no instances where a court awarded an injunction after determining that the patent covers

One additional factor that has been mentioned as potentially favoring entry of an injunction is a finding of willful infringement. Willful misconduct is traditionally considered in determining the availability of equitable relief.[150] For example, after remand in *eBay*, the district court concluded that eBay's "status as a willful infringer . . . plainly favors [the patentee] when conducting an equitable balancing" in the injunction analysis.[151] However, other district courts have denied injunctions against willful infringers,[152] and scholarship published shortly after *eBay* concluded that "willful infringement does not appear to be a significant factor in predicting or explaining judicial decisions that grant or deny permanent injunctions."[153]

While valuable, the existing scholarship on *eBay*'s impact is limited in several important respects. First, many of the studies rely on a relatively small number of decisions—usually several dozen cases—issued within a few years of the Supreme Court's decision.[154] This small size makes it difficult to

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only a small component of the infringing product."); *cf.* Bernard Chao, *Causation and Harm in a Multicomponent World*, 164 U. PA. L. REV. ONLINE 61, 76 (2016) (arguing that courts should not grant injunctions in patent cases involving infringing features for multicomponent devices if it will cause holdup).

150. *See* Precision Instrument Mfg. Co. v. Auto. Maint. Mach. Co., 324 U.S. 806, 815 (1945) ("Any willful act concerning the cause of action which rightfully can be said to transgress equitable standards of conduct is sufficient cause for the invocation of the maxim by the chancellor."); *see also* Beckerman-Rodau, *supra* note 4, at 656 (noting that "[w]illful infringement, arguably, should be relevant when the remedy being sought, such as permanent injunctive relief, is equitable in nature"); Diessel, *supra* note 142, at 317 (explaining that "historically willfulness has weighed heavily on the decision to grant an injunction"); William R. Everding, Comment, "*Heads-I-Win, Tails-You-Lose*"*: The Predicament Legitimate Small Entities Face Post* eBay *and the Essential Role of Willful Infringement in the Four-Factor Permanent Injunction Analysis*, 41 J. MARSHALL L. REV. 189, 211–17 (2007) (contending that willful infringement is relevant in several factors of the *eBay* test).

151. *MercExchange III*, 500 F. Supp. 2d 556, 590 (E.D. Va. 2007) (emphasis omitted); *see also* Wald v. Mudhopper Oilfield Servs., Inc., No. CIV-04-1693-C, 2006 WL 2128851, at *5 (W.D. Okla. July 27, 2006) (explaining that "the Court is unpersuaded that there is no need for an injunction" in light of, *inter alia*, "the finding of willful infringement").

152. *See, e.g.*, Fractus, S.A., v. Samsung Elecs. Co., 876 F. Supp. 2d 802, 828–30, 852–54 (E.D. Tex. 2012); Creative Internet Advert. Corp. v. Yahoo! Inc., 674 F. Supp. 2d 847, 849–52 (E.D. Tex. 2009); Voda v. Cordis Corp., No. CIV–03–1512–L, 2006 WL 2570614, at *1, *5–6 (W.D. Okla. Sept. 5, 2006), *aff'd*, 536 F.3d 1311 (Fed. Cir. 2008); z4 Techs., Inc., v. Microsoft Corp., 434 F. Supp. 2d 437, 438–44 (E.D. Tex. 2006).

153. Beckerman-Rodau, *supra* note 4, at 656; *see also* Diessel, *supra* note 142, at 312–17 (analyzing the first twenty-five district court cases applying *eBay* and concluding "[w]hether infringement was willful d[id] not bear on whether a plaintiff obtain[ed] an injunction"); Sandrik, *supra* note 4, at 111 ("Another area of tension within the structure of patent remedies is in cases where a willful infringer is permitted to continue engaging in behavior that was deemed punish-worthy.").

154. *See* FED. TRADE COMM'N, *supra* note 8, at 257 (surveying 49 district court injunction decisions from *eBay* through December 2008); Ellis et al., *supra* note 4, at 441–42 & nn.35–36 (studying 36 district court decisions issued from *eBay* through early 2008); Grumbles III et al., *supra* note 130, at 26 (reviewing 67 district court cases issued since the *eBay* decision); Newcombe et al., *supra* note 142, at 557–59 & n.57, n.59 (evaluating 38 district court decisions from *eBay* through February 2008); Petersen, *supra* note 148, at 196 (studying 33 district court decisions applying *eBay* through February 2008). The exceptions are Chien & Lemley, *supra* note 2, at

conduct rigorous empirical analysis due to the lack of statistical power.[155] Second, several of these studies appear to be limited to district court decisions that are reported in the *Federal Supplement* or commercial electronic databases like LexisNexis and Westlaw,[156] which may not be representative of all injunction decisions.[157] Third, most studies report only a few data points for each decision, such as the ultimate outcome on injunctive relief, the identity of the patent owner, and whether the litigants were competitors.[158] This introduces the possibility of omitted variable bias by failing to include one or more potentially important factors in assessing the district court's reasoning for why an injunction was granted or denied.[159] Finally, the existing literature does not study the characteristics of the patents at issue in these decisions—such as the number of claims in each patent, the number of citations to prior art, and the technological field of the patented invention—to determine whether they are related to the grant or denial of injunctive relief.[160]

9–10 & n.46 (analyzing 192 decisions from July 2006 through August 2011); Gupta & Kesan, *supra* note 132, at 6 tbl.1 (tallying 514 permanent injunction motions after *eBay)*; and PATSTATS.ORG, *supra* note 133 (collecting 231 district court decisions from *eBay* through December 2013).

155. *See* THE SAGE GLOSSARY OF THE SOCIAL AND BEHAVIORAL SCIENCES 489 (Larry E. Sullivan ed. 2009) (explaining statistical power as "the probability of correctly rejecting a false null hypothesis").

156. *See* Ellis et al., *supra* note 4, at 441–42 nn.35–36 (relying on decisions reported in the *Federal Supplement* and LexisNexis); Newcombe et al., *supra* note 142, at 557–59 & n.57, n.59 (same).

157. *See* Michael Heise, *The Past, Present, and Future of Empirical Legal Scholarship: Judicial Decision Making and the New Empiricism*, 2002 U. ILL. L. REV. 819, 843–44 ("Many [empirical legal] studies are confined to a universe of written and published decisions. The focus on such decisions . . . reduces the generalizability of the findings."); David A. Hoffman et al., *Docketology, District Courts, and Doctrine*, 85 WASH U. L. REV. 681, 686 (2007) (noting that published "opinions might be unrepresentative of how trial courts resolve legal problems"); *see also* Hillel Y. Levin, *Making the Law: Unpublication in the District Courts*, 53 VILL. L. REV. 973, 982 (2008) ("If we accept that the law is what judges do, then we cannot evaluate the legal system by reference to only published decisions because they may not reflect what goes on in the majority of cases." (emphasis omitted)).

158. *See* Chien & Lemley, *supra* note 2, at 9–11 & 10 fig.1 (reporting permanent injunction grant rates by entity type—university, individual practicing company, and patent assertion entity); Grumbles III et al., *supra* note 130, at 27–29 (reporting injunction decision, case name, date of decision, district court, and whether the patentee and infringer were competitors); Gupta & Kesan, *supra* note 132, at 7 fig.1 (reporting preliminary and permanent injunction motion and grant rates by year); PATSTATS.ORG, *supra* note 133 (reporting permanent injunction decision, names of plaintiff and defendant, district court, date of decision, and judge).

159. *See* OXFORD DICTIONARY OF ECONOMICS (John Black et al. eds., 4th ed. 2012) (defining omitted variable bias as "[a] bias . . . of a coefficient in a linear regression caused by the omission of a relevant variable from the regression, when this variable is correlated with one or more of the variables included in the regression").

160. *See* John R. Allison, Mark A. Lemley, Kimberly A. Moore & R. Derek Trunkey, *Valuable Patents*, 92 GEO. L.J. 435, 438 (2004) (studying these and other patent characteristics and concluding "that valuable patents differ in substantial ways from ordinary patents"); Colleen V. Chien, *Predicting Patent Litigation*, 90 TEX. L. REV. 283, 287 (2011) (finding that "patents that do end up in litigation differ markedly from patents that do not").

IV. METHODOLOGY

This Part first describes the research questions addressed through an empirical study of district court decisions on permanent injunctions following *eBay*. It then explains the study design and collection process for the data and findings reported in this Article.[161] Finally, it describes some limitations of the datasets.[162]

A. RESEARCH QUESTIONS

This study seeks to evaluate how district courts have applied *eBay*'s four-factor test for permanent injunctions in patent cases. In particular, it attempts to determine how often injunctions are granted to prevailing patentees following *eBay*, both in general and for particular types of patentees such as PAEs. It also focuses on several considerations related to injunctive relief mentioned in Justice Kennedy's concurrence, such as the patentee's willingness to license the patent(s)-in-suit and the assertion of a "business method" patent.[163] Furthermore, it seeks to determine whether injunction grant rates vary based on several other factors, such as the field of technology, the district court deciding the injunction request, and whether the infringer acted willfully. In addition, this study seeks to determine if infringed patents' characteristics correlate to district courts' decisions on injunctive relief. Previous empirical studies have found patents' characteristics to be useful in predicting their value and whether they will likely be the subject of an infringement lawsuit.[164]

Empirical studies like this one use observations of data and statistical analysis to evaluate causal inference—that is, "whether one factor or set of factors leads to (or causes) some outcome."[165] Empirical analysis can "allow[]

161. *See* Susan D. Franck, *Empiricism and International Law: Insights for Investment Treaty Dispute Resolution*, 48 VA. J. INT'L L. 767, 786–88 (2008) (explaining the importance of transparency regarding methodology, data collection, and analysis in empirical legal research). The data collected in this study will be made publicly available upon this Article's publication.

162. *See infra* Part IV.C.

163. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396–97 (2006).

164. *See, e.g.*, Allison et al., *supra* note 160, at 448–60 (finding certain patent characteristics correlated with assertion in litigation and thus patent value); Chien, *supra* note 160, at 297–326 (finding that litigated characteristics have different intrinsic and acquired characteristics than non-litigated patents); Dietmar Harhoff et al., *Citations, Family Size, Opposition and the Value of Patent Rights*, 32 RES. POL'Y 1343, 1344–45 (2003) (finding that various patent characteristics are correlated with patent value); Jean O. Lanjouw & Mark Schankerman, *Characteristics of Patent Litigation: A Window on Competition*, 32 RAND J. ECON. 129, 129 (2001) ("[T]he frequency of legal disputes is strongly correlated with a variety of characteristics of innovations and their owners . . . ."); Kimberly A. Moore, *Worthless Patents*, 20 BERKELEY TECH. L.J. 1521, 1551 (2005) ("The fact that certain patent characteristics do predict . . . likelihood of patent litigation suggests that they are useful predictors of value.").

165. Lee Epstein & Gary King, *The Rules of Inference*, 69 U. CHI. L. REV. 1, 34–35 (2002); *see also* Kevin M. Clermont & Theodore Eisenberg, *Litigation Realities*, 88 CORNELL L. REV. 119, 125 (2002) ("Empirical methods are those that employ means for the systematic observation of experience in pursuit of inductive ends.").

scholars to verify or refute . . . claims about case law,"[166] such as "the impact of a new precedent,"[167] thus helping "identify[] previously unnoticed patterns that warrant deeper study."[168] This study engages in the technique of "content analysis," in which the investigator identifies relevant court decisions, systematically reads and codes these decisions for information about the issue(s) being studied, and then analyzes the resulting data.[169] Numerous prior studies in the field of patent law have utilized a similar methodology.[170]

B. STUDY DESIGN AND DATA COLLECTION

Two original datasets were created for this study. For the first dataset (the "Decisions Dataset"), the author sought to identify all contested permanent injunction decisions by federal district courts in patent infringement cases from the date of the Supreme Court's decision in *eBay* (May 13, 2006) through December 2013. This represents over 7.5 years of court decisions on injunctive relief.

Several sources were utilized to create a comprehensive list of these injunction decisions. First, the author started with a spreadsheet of injunction rulings compiled by Patstats.org from *eBay* through May 2013.[171] The author also searched the Lex Machina database of intellectual property litigation[172] and the permanent injunction decisions listed in the Federal Trade Commission's 2011 report on patent notice and remedies[173] to identify

166. Mark A. Hall & Ronald F. Wright, *Systematic Content Analysis of Judicial Opinions*, 96 CALIF. L. REV. 63, 77 (2008).

167. *Id.* at 91.

168. *Id.* at 87.

169. *See id.* at 67–76 (describing the methodology of content analysis in the context of legal studies).

170. *See generally* John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185 (1998); John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769 (2014); Kimberly A. Moore, Markman *Eight Years Later: Is Claim Construction More Predictable?*, 9 LEWIS & CLARK L. REV. 231 (2005); Lee Petherbridge, Jason Rantanen & Ali Mojibi, *The Federal Circuit and Inequitable Conduct: An Empirical Assessment*, 84 S. CAL. L. REV. 1293 (2011); Lee Petherbridge & R. Polk Wagner, *The Federal Circuit and Patentability: An Empirical Assessment of the Law of Obviousness*, 85 TEX. L. REV. 2051 (2007); Jason Rantanen, *The Federal Circuit's New Obviousness Jurisprudence: An Empirical Study*, 16 STAN. TECH. L. REV. 709 (2013); Christopher B. Seaman, *Willful Patent Infringement and Enhanced Damages After* In re Seagate*: An Empirical Study*, 97 IOWA L. REV. 417 (2012).

171. *Post-*eBay *Permanent Injunction Rulings in Patent Cases*, PATSTATS.ORG, http://patstats.org/Injunction_rulings_post-eBay_to_5-26-2013.xls (last visited Mar. 11, 2016) (hereinafter *Post-*eBay *Permanent Injunction Rulings*). This document was updated to include injunction rulings up to Dec. 31, 2013. *See id.*

172. LEX MACHINA, https://lexmachina.com (last visited Mar. 11, 2016). The following steps were taken to search Lex Machina: (1) selected "Documents" tab; (2) entered the following text in the search bar: "permanent injunction" OR eBay; (3) selected "Order re: Injunction" in "Document Tags"; (4) selected "Patent" in "Case Types"; and (5) reviewed entries for contested injunction decisions issued between May 15, 2006 and December 31, 2013.

173. *See* FED. TRADE COMM'N, *supra* note 8, at 272–78. Five cases listed in the FTC's report

additional relevant decisions. Injunctions that were uncontested, such as those following entry of a default judgment or where the infringer consented to a permanent injunction, were excluded from the dataset.[174] Decisions involving preliminary (rather than permanent) injunctions were also omitted,[175] as were cases involving design patents.[176] In total, 218 district court decisions on permanent injunctive relief were identified and included in the Decisions Dataset.[177] A list of these decisions is included in Appendix A.

Each injunction decision then was hand coded[178] for a variety of information using standardized coding instructions.[179] Coded information

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were excluded for not satisfying the criteria for this study: Zen Designs Grp., Ltd. v. Clint, No. 08-CV-14309, 2009 WL 4050247 (E.D. Mich. Nov. 23, 2009) (default judgment entered against accused infringer); Acticon Techs. v. Heisei Elecs. Co., No. 06-CV-4316 (KMK), 2008 WL 356872 (S.D.N.Y. Feb. 5, 2008) (default judgment entered against accused infringer); Nichia Corp. v. Seoul Semiconductor, Ltd., No. 06–0162 MMC, 2008 WL 346416 (N.D. Cal. Feb. 7, 2008) (design patents); U.S. Philips Corp. v. KXD Tech., Inc., No. CV 05-8953 ER (PLAx), 2007 WL 4984150 (C.D. Cal. Sept. 7, 2007) (default judgment entered against accused infringer); and Telequip Corp. v. Change Exch., No. 5:01-CV-1748 (FJS/GJD), 2006 WL 2385425 (N.D. N.Y. Aug. 15, 2006) (default judgment entered against accused infringer).

174. Uncontested injunction decisions were excluded for two reasons. First, counting these injunctions would likely have skewed the grant rate higher. Second, because uncontested injunctions are typically granted with little or no discussion by the district court, they provide little illumination regarding *why* an injunction was granted.

175. Preliminary injunction decisions in patent cases apply a distinct four-part test because of the motion's procedural posture—namely, the accused infringer's liability has not yet been determined, so the patentee's likelihood of success must be considered as part of the court's analysis. *See* Trebro Mfg., Inc. v. Firefly Equip., LLC, 748 F.3d 1159, 1165 (Fed. Cir. 2014) ("A plaintiff seeking a preliminary injunction must establish that he is likely to succeed on the merits, that he is likely to suffer irreparable harm in the absence of preliminary relief, that the balance of equities tips in his favor, and that an injunction is in the public interest." (quoting Winter v. Nat. Res. Def. Council, Inc., 555 U.S. 7, 20 (2008))). In addition, grants of preliminary injunctions appear to be significantly less frequent than permanent injunctions. *See* Chien & Lemley, *supra* note 2, at 2 (noting that patentees can obtain a preliminary injunction only "rarely"). *But cf.* M. A. Cunningham, *Preliminary Injunctive Relief in Patent Litigation*, 35 IDEA J.L. & Tech. 213, 231 (1995) (finding that district courts granted preliminary injunctions in slightly over 61% of the time in district court cases between 1982 and 1993).

176. *See* 35 U.S.C. §§ 171–173 (2012) (statutory provisions governing design patents).

177. Two cases were counted as each having two separate decisions on permanent injunctive relief: Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901 (N.D. Ill. 2012) (district court denying permanent injunctions for both Motorola and Apple); and O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co., No. 2-04-CV-32 (TJW), 2007 WL 869576 (E.D. Tex. Mar. 21, 2007) (denying permanent injunction), *vacated*, 521 F. 3d 1351, *remanded to* No. 2:04-CV-00032-CE, 2010 WL 8753254 (E.D. Tex. Sept. 27, 2010) (denying permanent injunction again after remand from the Federal Circuit).

178. Several student research assistants conducted an initial draft of the coding. The author then personally reviewed the coding decisions for each case and made a final decision for all variables. The coding process took several hundred hours of time in the aggregate. *See* Allison et al., *supra* note 170, at 1773–74 (explaining that "[c]oding of outcomes, especially in patent cases, is notoriously difficult and time consuming"); *see also* Heise, *supra* note 157, at 829 ("Unfortunately, data gathering is frequently labor-intensive and time-consuming and, consequently, often quite expensive." (footnote omitted)).

179. In empirical research, written coding instructions are preferred so that all coders apply the same criteria for each coding decision. This helps promote consistency in coding and serves

included the names of the litigants,[180] the district court that decided the injunction request,[181] whether the injunction was granted or denied,[182] and other basic information about the case and injunction decision.[183] The patent owner in each case was classified into one of eight different types of entities.[184] The technological field of the asserted patent(s),[185] whether the patent(s)-in-suit claimed a business method,[186] and whether the case involved a claim of infringement by a pharmaceutical manufacturer under the Hatch–Waxman Act[187] were also captured. The district court's conclusions on each of the four

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as "a check against looking, consciously or not, for confirmation of predetermined positions." Hall & Wright, *supra* note 166, at 81; *see also* Lee Epstein & Andrew Martin, *Coding Variables*, *in* 1 ENCYCLOPEDIA OF SOCIAL MEASUREMENT 321, 325 (Kimberly Kempf-Leonard ed., 2005) (explaining that "the overriding goal of a codebook is to minimize human judgment—to leave as little as possible to interpretation"). In addition, written coding instructions are desirable "because the scientific standard of replicability requires a written record of how categories were defined and applied." Hall & Wright, *supra* note 166, at 109. A copy of the author's written coding instructions are available upon request.

180. Variable names are listed in capital letters and brackets in the following footnotes. String variables were used for the name of the plaintiff [PLAINTIFF] and the defendant [DEFENDANT] in the case. If multiple plaintiffs or defendants existed, only the first-named party was used. The type of the patent owner—for instance, whether it was a PAE—was also classified as a separate variable, as explained in more detail below. *See infra* note 184.

181. The district court was initially recorded as a string variable [DISTRICT] using a three- or four-letter abbreviation consistent with PACER Case Locator. *See* U.S. Courts, *Individual Court Sites*, PACER, https://www.pacer.gov/psco/cgi-bin/links.pl (last visited Mar. 11, 2016). This string variable was then encoded into a separate, categorical (numeric) variable [DISTRICT_N] for use in statistical analysis.

182. This was coded as a binary variable [INJUNCTION] indicating whether a permanent injunction was granted for at least one claim of the patent(s)-in-suit.

183. These variables included the docket number for the case [DOCKET], a citation to the injunction decision in Westlaw or PACER [CITE], and the date of the injunction decision [DATE].

184. Each patent holder for this variable [PATENTEE] was coded into one of the following categories: "(1) University; (2) Individual Inventor; (3) Large Patent Aggregator; (4) Failed Operating or Start-up Company; (5) Patent Holding Company; (6) Operating Company; (7) IP Holding Company Owned by Operating Company; and (8) Technology Development Company." These classifications were adopted from a recent empirical study by several patent scholars on the types of patent holders in patent litigation. *See* Christopher A. Cotropia, Jay P. Kesan, and David L. Schwartz, *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649, 667–70 (2014) (defining each category). The author used information from the complaints and other publicly available sources, such as the patentee's website, to make classification decisions for this variable. *Id.* at 667–68.

185. This variable [TECH] was broken down into 9 different technological categories: (1) Computer Software; (2) Electronics; (3) Electrical; (4) Mechanical, (5) Chemical; (6) Biotechnology, (7) Drugs; (8) Medical Devices, and (9) Other. These categories were modified from John R. Allison, Mark A. Lemley & Joshua Walker, *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U. PA. L. REV. 1, 6–8 (2009).

186. This was coded as a binary variable [BUSMETHOD].

187. This was coded as a binary variable [ANDA]. *See* Drug Price Competition and Patent Term Restoration Act of 1984, Pub. L. No. 98-417, 98 Stat. 1585 (codified as amended at 21 U.S.C. § 355(j) (1984) and 35 U.S.C. § 271(e) (1984)) (commonly known as the Hatch–Waxman Act). For an overview of patent litigation under the Hatch–Waxman Act, see FED. JUDICIAL CTR., PATENT CASE MANAGEMENT JUDICIAL GUIDE 10-1 to 10-11 (Peter S. Menell et al. eds., 2009).

eBay factors were coded as well.[188] Finally, the Decisions Dataset included other factors potentially related to decisions on injunctive relief, such as whether the litigants were found to be competitors,[189] whether the patent holder had licensed or offered to license the patent(s)-in-suit to others,[190] whether the district court found that the patented invention was a "small component" of the accused product,[191] and whether the infringer willfully infringed the patent(s)-in-suit.[192]

A second dataset consisting of the patents-in-suit at issue in these injunctions decisions (the "Patents Dataset") was also created to help determine if these patents' characteristics were correlated with the outcomes of these injunction decisions.[193] The Patents Dataset includes 392 separate U.S. patents.[194] In addition to the outcome on injunctive relief for each patent, several variables regarding each patent-in-suit were hand coded. These variables include the total number of claims in the patent,[195] the number of prior art references cited by the patent,[196] the number of predecessor (parent) applications for the issued patent,[197] whether the original patentee was a small entity,[198] and the number of years between the patent's issuance and the injunction decision.[199] The National Bureau of Economic Research

188. These were coded as binary variables: (1) irreparable harm [FACTOR1]; (2) inadequate remedy at law [FACTOR2]; (3) balance of hardships [FACTOR3]; and (4) the public interest would not be disserved by an injunction [FACTOR4].

189. This was coded as a binary variable [COMPETE]. Parties were classified as competitors if they competed in a product market at any time during the patent term. Licensing of the patent alone was considered insufficient to demonstrate competition. In addition, litigation involving generic pharmaceutical manufacturers who indicated an intent to compete with an original (brand name) drug manufacturer by filing an Amended New Drug Application ("ANDA") under the Hatch–Waxman Act were classified as competitors.

190. This was coded as a binary variable [LICENSE]. Exclusive licenses by the patent owner to a co-plaintiff were excluded.

191. This was coded as a binary variable [COMPONENT].

192. This was coded as a binary variable [WILLFUL].

193. *See supra* notes 160, 164 and accompanying text.

194. Four patents are included in the dataset twice (for a total of 396 entries) because they were either the subject of multiple patent lawsuits that resulted in a contested injunction decision or because they were the subject of more than one decision on injunctive relief in the same case. These patents are: U.S. Patent No. 5,790,512; U.S. Patent No. 5,972,401; U.S. Patent No. 6,259,615; and U.S. Patent No. 6,396,722.

195. This was coded as a numeric variable [CLAIMS].

196. This was coded as a numeric variable [PRIORART].

197. This was coded as a numeric variable [PARENT]. "Parent" applications included continuation and continuation-in-part applications. *See* 35 U.S.C. §§ 120, 361–376 (2012); *see id.* § 121 (PCT applications). It excluded other foreign patent application filings, provisional patent applications, and reissue/reexamination applications.

198. This was coded as a binary variable [SMALL]. A small entity is defined as an individual, small business concern, or nonprofit organization (including a university) who meet certain criteria. 37 C.F.R. § 1.27(a) (2010). Small entities are entitled to a 50% reduction in patent fees. 35 U.S.C. § 41(h) (2012); 37 C.F.R. § 1.27(b) (2010).

199. This was coded as a numeric variable [ISSUE2INJUNCTION].

("NBER") technology classification for each patent was included as well.[200] Finally, the number of subsequent citations by later-issued U.S. patents to each patent-in-suit (i.e., forward citations), which is a common proxy for patent value and quality,[201] was coded.[202]

C. LIMITATIONS

Before discussing the study's findings, it is important to note several potential limitations of the methodology employed.[203] First, patent litigation is extremely complex and frequently involves "numerous issues raised by the parties," such as claim construction, infringement (direct and indirect), various grounds for invalidity (including anticipation, obviousness, and patentable subject matter), other defenses (such as inequitable conduct, exhaustion, laches, and prosecution history estoppel), and remedies (including injunctive relief and damages).[204] Moreover, the underlying technology and the parties' strategic objectives can vary greatly as well.[205] As a result, it can be "difficult to make generalizations about patent litigation from the study of individual cases."[206]

Second, this study is based primarily on litigated court decisions, which are subject to selection effects. "[T]he selection effect refers to the

200. This variable [TECH] coded for NBER's six primary technology categories: (1) Chemical (excluding Drugs); (2) Computer and Communications; (3) Drugs and Medical; (4) Electrical and Electronics; (5) Mechanical; and (6) Other. *See* Bronwyn H. Hall et al., *The NBER Patent Citations Data File: Lessons, Insights, and Methodological Tools* 13, 41–42 (Nat'l Bureau of Econ. Research, Working Paper No. 8498, 2001), http://papers.nber.org/papers/w8498.pdf.

201. *See generally* Bronwyn Hall et al., *Market Value and Patent Citations*, 36 RAND J. ECON. 16 (2005). *But see* David S. Abrams et al., *Patent Value and Citations: Creative Destruction or Strategic Disruption?* (Pa. Inst. for Econ. Research, Working Paper 13-065, 2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2351809 (questioning this assumption); Alan C. Marco, *The Dynamics of Patent Citations*, 94 ECON. LETTERS 290, 294 (2007) (finding an unobserved heterogeneity in the rate of patent citations because forward citations to a patent may beget more forward citations).

202. The number of forward citations to a patent by later-issued U.S. patents (as of July 2014) is included in the "Referenced By" portion of each patent's page on Google Patents. *See generally* Patents, GOOGLE.COM, https://www.google.com/?tbm=pts&gws_rd=ssl (last visited Mar. 11, 2015) (search "Patents" in the search field). This information was then captured in two separate numeric variables—one that included the total number of forward citations [FWDCITE], and a second that captured the average number of forward citations per year since the patent's issuance [FWDCITEPERYEAR]. The latter variable was included to address the problem of truncation due to unobserved future citation behavior.

203. *See* William M. Sage, *Judicial Opinions Involving Health Insurance Coverage: Trompe L'oeil or Window on the World?*, 31 IND. L. REV. 49, 61–68 (1998) (noting that "[e]mpirical studies of judicial decisions suffer from significant limitations," including sample size, time lag, selection bias, and unstated rationales, but "[d]espite these limitations, the study of judicial decisions has redeeming qualities"); David L. Schwartz, *Explaining the Demise of the Doctrine of Equivalents*, 26 BERKELEY TECH. L.J. 1157, 1187 (2011) ("All projects involving empirical studies of legal decisions have limitations . . . .").

204. Schwartz, *supra* note 203, at 1187.

205. *Id.*

206. *Id.*

proposition that the selection of tried cases is not a random sample of the mass of underlying cases."[207] This is because "[c]ases only go to trial when the parties substantially disagree on the predicted outcome."[208] Thus, when the applicable legal standard clearly favors one side or the other, parties tend to settle their disputes rather than incur the expense of litigation,[209] which can be considerable, particularly in patent litigation.[210] As a result, "the disputes selected for litigation . . . will constitute neither a random nor a representative sample . . . of all disputes."[211]

Here, the court decisions studied are not representative of all patent disputes, or even all patent infringement litigation, because they require that the patentee have both filed suit and then prevailed on liability (i.e., infringement and validity), which occurs in only about a quarter of all cases litigated to judgment.[212] The selection criteria also require that the winning patentee seek a permanent injunction[213] instead of monetary damages to compensate for future infringement, such as an ongoing royalty.[214] The selection effect is compounded by the asymmetric stakes of injunctive relief, which typically "harms the infringer more than it benefits the patentee."[215] These factors may result in underrepresentation of certain types of patent cases. For instance, injunction decisions involving PAEs appear to be underrepresented in the Decisions Dataset, as they are patentees in approximately 12% (25 of 218 cases) of permanent injunction decisions, but PAE litigation may represent as much as almost half of all patent cases filed.[216]

207. Kevin M. Clermont & Theodore Eisenberg, *Trial by Jury or Judge: Transcending Empiricism*, 77 CORNELL L. REV. 1124, 1129 (1992) (alteration in original) (quoting Theodore Eisenberg, *Testing the Selection Effect: A New Theoretical Framework with Empirical Tests*, 19 J. LEGAL STUD. 337, 337 (1990)). For the seminal article on the "selection effect," see generally George L. Priest & Benjamin Klein, *The Selection of Disputes for Litigation*, 13 J. LEGAL STUD. 1 (1984). *But see* Theodore Eisenberg, *Testing the Selection Effect: A New Theoretical Framework with Empirical Tests*, 19 J. LEGAL STUD. 337, 339–40 (1990) (concluding that the refined Priest/Klein hypothesis "can be rejected as a description of all civil litigation" but that it may accurately describe products liability litigation).

208. Clermont & Eisenberg, *supra* note 207, at 1129.

209. *Id.*

210. The most recent edition of the *AIPLA Report of the Economic Survey* reports that median litigation costs exceed $5 million in patent infringement suits where more than $25 million is at stake. AM. INTELLECTUAL PROP. LAW ASS'N, AIPLA 2015 REPORT OF THE ECONOMIC SURVEY 37 (2015).

211. Priest & Klein, *supra* note 207, at 4.

212. *See* Allison et al., *supra* note 170, at 1787–88 & fig.5 (finding that patentees prevailed in only 26% of cases litigated to final judgment that were filed in 2008 and 2009).

213. *See* Gupta & Kesan, *supra* note 132, at 8 fig.2 (finding that the filing of permanent injunction motions in patent cases decreased from 3.3% of all cases in 2000 to 0.6% in 2012).

214. *See* Paice LLC v. Toyota Motor Corp., 504 F.3d 1293, 1314 (Fed. Cir. 2007) ("Under some circumstances, awarding an ongoing royalty for patent infringement in lieu of an injunction may be appropriate."). *See generally* Christopher B. Seaman, *Ongoing Royalties in Patent Cases After* eBay*: An Empirical Assessment and Proposed Framework*, 23 TEX. INTELL. PROP. L.J. 203 (2015) (reporting the results of an empirical study of ongoing royalty awards after *eBay*).

215. David L. Schwartz, *Pre-*Markman *Reversal Rates*, 43 LOY. L.A. L. REV. 1073, 1105 (2010).

216. *See* Cotropia et al., *supra* note 184, at 674 fig.1 (combining percentage of cases filed by Large Aggregators, Failed Operating Company/Start-up, Patent Holding Company, and

Thus, selection effects may have a significant, although difficult to ascertain, impact on the cases studied.

Third, there are several limitations inherent in content analysis. For example, if the coding instructions are imprecise or include room for subjectivity, this could introduce errors and negatively impact reproducibility.[217] However, this concern can be mitigated by creating, pilot testing, and implementing clear written coding rules that all coders must follow, as was done in this study.[218] Another possible concern is that judicial opinions may exhibit circularity. Circularity occurs when the court's opinion incompletely or selectively describes the relevant facts to justify its outcome.[219] Thus, "the facts and reasons found in [the court's] opinion might or might not accurately describe the real world facts or the true nature of the judge's decision-making process."[220] In addition, information about the court's reasoning may not be publicly available—for instance, if the opinion granting the injunction is under seal,[221] or if the court's reasoning for granting or denying an injunction is given orally in court and a transcript of the proceeding is inaccessible.[222]

Fourth, this study is limited to district court decisions; as a result, it does not consider the outcome of any appeal to the U.S. Court of Appeals for the Federal Circuit or the reasoning by that court for its decision.[223] Thus, if a

Technology Development Company for 2012); *see also infra* note 243 and accompanying text. For instance, one recent study finds that operating companies prevail on the merits in patent litigation almost twice as often as non-practicing entities, thus suggesting that fewer PAEs would be in a position to seek an injunction. *See* John R. Allison, Mark A. Lemley & David Schwartz, *How Often Do Non-Practicing Entities Win Patent Suits?* BERKELEY TECH. L.J. (forthcoming) (Stanford Law & Econ. Olin Working Paper No. 485, at 42 tbl.6a), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2750128 (finding that operating companies won 30.6% of definitive patent rulings in cases filed in 2008 and 2009 compared to only 14.4% of NPEs, and this difference was statistically signficant).

217. *See* Rantanen, *supra* note 170, at 723–24.

218. *See* Hall & Wright, *supra* note 166, at 109–16; *see also supra* note 179 and accompanying text (explaining the importance of written coding rules).

219. Hall & Wright, *supra* note 166, at 95–96; *see also* Ann Juliano & Stewart J. Schwab, *The Sweep of Sexual Harassment Cases*, 86 CORNELL L. REV. 548, 559 (2001) ("The judicial opinion is the judge's story justifying the judgment. The cynical legal realist might say that the facts the judge chooses to relate are inherently selective and a biased subset of the actual facts of the case.").

220. Hall & Wright, *supra* note 166, at 95; *see also* Rantanen, *supra* note 170, at 724 ("An opinion author might present a biased view of the facts or might not reveal his or her true reasoning.").

221. *See, e.g.*, Order, O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co., No. 2-04-CV-32 (TJW) (E.D. Tex. July 2, 2010), ECF No. 662 (sealed decision on injunctive relief). *See generally* Bernard Chao & Derigan Silver, *A Case Study in Patent Litigation Transparency*, 2014 J. DISPUTE RESOL. 83 (2014) (describing the problem of lack of transparency in patent litigation proceedings).

222. *See, e.g.*, Transcript of Hearing on Post-Trial Motions, Affinity Labs of Tex., LLC v. BMW N.A., LLC, No. 9:08-CV-00164 (E.D. Tex. Feb. 14, 2011), ECF No. 546 (injunction hearing transcript under seal); Transcript of Post-Trial Motion Hearing, Finisar Corp. v. DirectTV Group Inc., No. 1:05-CV-00264 (E.D. Tex. July 6, 2006), ECF Nos. 318, 334 (transcript of court hearing unavailable on PACER).

223. The author is collaborating with Professor Ryan T. Holte on an empirical study of

decision on injunctive relief is vacated or reversed on appeal, this information is not included in the Decisions Dataset.[224] Finally, this study treats permanent injunction decisions as a binary variable (granted or denied) without considering the timing, duration, or scope of any injunction entered.[225]

V. Results and Discussion

This Part first describes various findings from the Decisions Dataset and the Patents Dataset, respectively.[226] It then discusses some implications of these findings.

A. *Decisions Dataset*

1. Overall Grant Rate

The overall grant rate for contested permanent injunction requests following *eBay* was a principal issue investigated. As shown in Figure 1, below, permanent injunctions were granted slightly less than three-quarters of the time (72.5%) during the time period studied (May, 2006 to December, 2013). This figure is consistent with previous empirical scholarship on the rate of permanent injunctions following *eBay*, which range between 72% and 75%.[227] However, it represents a decline from the state of play before *eBay*, when injunctions were granted to prevailing patentees in almost all cases.[228]

Federal Circuit decisions on permanent injunctive relief following *eBay* for the cases contained in this dataset.

224. *See, e.g.*, Douglas Dynamics, LLC v. Buyers Prods. Co., 747 F. Supp. 2d 1063 (W.D. Wis. 2010) (denying permanent injunction), *rev'd and remanded to* 717 F.3d 1336, 1344–46 (Fed. Cir. 2013); Presidio Components Inc., v. Am. Tech. Ceramics Corp., 723 F. Supp. 2d 1284 (S.D. Cal. 2010) (denying permanent injunction), *vacated and remanded in relevant part to* 702 F.3d 1351 (Fed. Cir. 2012) (holding the district court clearly erred in concluding that no irreparable injury existed and remanding to district court); Robert Bosch, LLC v. Pylon Mfg. Corp., 748 F. Supp. 2d 383 (D. Del. 2010) (denying permanent injunction), *rev'd and remanded to* 659 F.3d 1142 (Fed. Cir. 2011).

225. *See* Golden, *supra* note 28, at 1405–09 (raising concerns about the scope of permanent injunctions in patent cases).

226. All data analysis was conducted using Stata/IC 14.0.

227. *See* Chien & Lemley, *supra* note 2, at 9 (finding that permanent injunctions were "granted about 75%" of the time from July 2006 to August 2011); Grumbles III et al., *supra* note 130, at 26 (finding that permanent injunctions were "granted approximately 72% of" the time between May 2006 and May 2009); Gupta & Kesan, *supra* note 132, at 9 fig.3 (finding that permanent injunctions were granted about 80% of the time between May 2006 and December 2012); *see also* PATSTATS.ORG, *supra* note 133 (finding that permanent injunctions were granted 75% of the time between May 2006 and May 2013).

228. *See supra* notes 74–75 and accompanying text; *see also* Lim & Craven, *supra* note 135, at 798 ("Before *eBay*, courts granted patentees injunctions 95% of the time after finding infringement.").

Figure 1. Permanent Injunction Grant Rate: May 2006 to December 2013

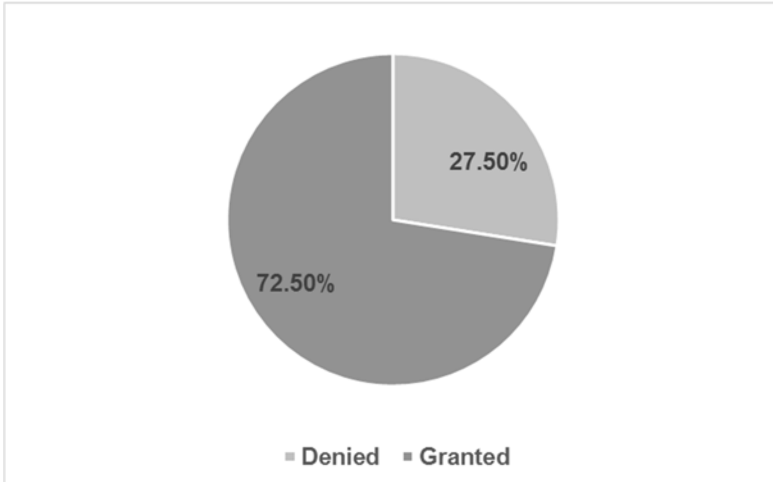
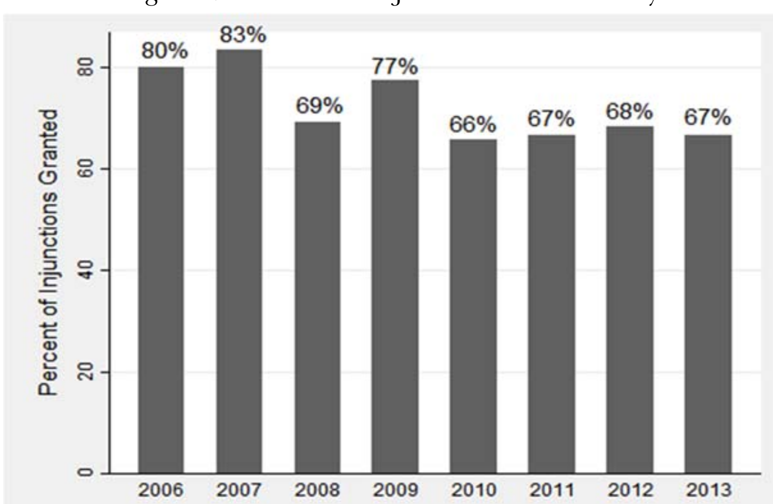


Figure 2 illustrates the injunction grant rate by year. Notably, injunctions were granted over 80% of the time in the 1.5 year period following *eBay* (2006–2007), but after that, injunctions were generally granted slightly less than 70% of the time (the exception is 2009, where 77% of contested injunction motions were granted).

Figure 2. Permanent Injunction Grant Rate by Year



In sum, the overall injunction grant rates suggest that Chief Justice Roberts's concurring opinion was accurate in contending that injunctive relief would continue to be granted to prevailing patentees "in the vast majority of patent cases."[229] However, as described in more detail below, injunctions are rarely granted in several types of patent disputes, suggesting that these cases have shifted to a liability rule following *eBay*.

2. Grant Rate by Patented Technology

A second issue is whether the injunction grant rate varies based on the field of patented technology. Patent litigation has long varied by industry, with electronics, computer software, pharmaceuticals, and medical devices among the most-litigated technologies.[230] Table 1 depicts the injunction grant rate by technological field.

Table 1. Injunction Grant Rate, by Technology

Technology	**Grant Rate**	***N***
Biotechnology	100%	4
Pharmaceuticals	92%	25
Other	87%	23
Electrical	83%	12
Chemistry	78%	9
Mechanical	75%	36
Electronics	67%	39
Medical Devices	65%	34
Software	53%	36

As illustrated above, permanent injunctions are almost always granted in cases where the patented technology at issue involves biotechnology (100%) or pharmaceuticals (92%).[231] In contrast, injunctions were granted only

229. eBay Inc. v. MercExchange, L.L.C., 547 U.S 388, 395 (2006) (Roberts, C.J., concurring).

230. *See* PRICEWATERHOUSECOOPERS LLP, 2014 PATENT LITIGATION STUDY 12 fig.7a (2014), http://www.pwc.com/en_US/us/forensic-services/publications/assets/2014-patent-litigation-study.pdf (listing consumer products as 17% of all patent cases, biotechnology and pharmaceuticals as 14% of all patent cases, computer hardware and electronics at 10% of all patent cases, medical devices as 9% of all patent cases, and software as 7% of all patent cases from 1995–2013).

231. In the two pharmaceutical cases where an injunction was not issued, the district court found the patent(s)-in-suit's listing in the Orange Book and final judgment in the patentee's favor was

about two-thirds of the time for electronics (67%), and for medical devices (65%). Most notably, permanent injunctions were granted only slightly over half the time in cases involving computer software (53%)—a result that was statistically significant.[232]

3. Grant Rate by District

A third issue considered was whether permanent injunction grants varied by district. This is a salient consideration because patentees have significant leeway under the existing venue rules to choose the forum where they wish to litigate.[233] The existing literature suggests that the forum selected can play an important role in the ultimate outcome of the litigation.[234] Table 2 depicts the injunction grant rates for all districts with at least ten decisions during the relevant time period, with the national average for purposes of comparison.

Table 2. Injunction Grant Rate by District (Minimum of 10 Decisions)

District Court	**Grant Rate**	***N***
District of New Jersey	92%	13
District of Massachusetts	82%	11
Central District of California	73%	11

sufficient to protect its right to exclude. *See* Order Denying Motion for Injunctive Relief, Valeant Int'l v. Watson Pharms., Inc., No. 1:10-CV-20526 (S.D. Fla. July 9, 2012), ECF No. 198; Alcon, Inc. v. Teva Pharm., USA, Inc., Civ. No. 06-234-SLR, 2010 WL 3081327 at *2–*3 (D. Del. Aug. 5, 2010).

232. $p = 0.004$ using Pearson's chi-square (χ^2). This result remained statistically significant at the $p < 0.05$ level after imposing a multiple testing penalty (Bonferroni adjustment) for the nine different technology categories.

233. *See* 28 U.S.C. § 1400(b) (2012) (providing that a "patent infringement [action] may be brought in the judicial district where the defendant resides, or where the defendant has committed acts of infringement and has a regular and established place of business"); *id.* § 1391(c)(2) (providing that for venue purposes, an entity is "deemed to reside . . . in any judicial district in which such defendant is subject to the court's personal jurisdiction with respect to the civil action in question"); *In re* TC Heartland LLC, __ F.3d __, 2016 WL 1709433 (Fed. Cir. Apr. 29, 2016) (reaffirming that the patent venue statute, 28 U.S.C. § 1400, incorporated the definition of corporate residence in the general venue statute, 28 U.S.C. § 1391(c)); Kimberly A. Moore, *Forum Shopping in Patent Cases: Does Geographic Choice Affect Innovation?*, 79 N.C. L. REV. 889, 889–90 (2001) ("[T]he patent jurisdiction and venue statutes allow plaintiffs to bring their patent suits in virtually any district in the country."); *see also* Richard C. Wydick, *Venue in Actions for Patent Infringement*, 25 STAN. L. REV. 551, 551 (1973) ("All too often, patent infringement suits begin with a battle over where the war is to be fought."). Pending legislation in Congress, if adopted, would significantly limit patentees' choice of venue. *See infra* note 356 and accompanying text.

234. *See* Moore, *supra* note 233, at 917–19 & tbl.8 (finding a "significant difference in outcome (patent holder win rate)" among the top ten patent districts); Matthew Sag, *IP Litigation in U.S. District Courts: 1994 to 2014*, 101 IOWA L. REV. 1065, 1104 (2016) (explaining that "the Eastern District of Texas and the District of Delaware have consciously adopted norms, practices, and procedures" that make these forums "better for patent plaintiffs and worse for patent defendants"). *See generally* Mark A. Lemley, *Where to File Your Patent Case*, 38 AIPLA Q.J. 401 (2010).

National Average	72.5%	
Eastern District of Texas	61%	36
Northern District of California	60%	10
District of Delaware	50%	26

Injunction grant rates are far from uniform, ranging from over 90% in the District of New Jersey (92%) to a low of 50% in the District in Delaware. Notably, two districts that are preferred forums for patent assertion entities (PAEs)—the Eastern District of Texas and the District of Delaware[235]—have injunction grant rates that fall below the national average, with the District of Delaware's difference from the national average being statistically significant.[236] Conversely, the District of New Jersey has a large proportion of pharmaceutical litigation, which may help explain its high injunction grant rate.[237]

4. Grant Rate by PAE Status

Fourth, this study attempted to determine whether injunction grant rates varied based on the identity of the patentee. The past decade has seen a significant increase in patent holders who do not manufacture products, but instead attempt to monetize their patent portfolio through litigation and licensing.[238] These actors, commonly referred to as PAEs, have been highly controversial; some scholars have argued that PAEs are costly and harmful to innovation and the broader economy,[239] while others contend that at least

235. *See* Daniel Klerman & Greg Reilly, *Forum Selling*, 89 S. CAL. L. REV. 241, 268 (2016) ("Notably, the Eastern District of Texas is especially popular with patent assertion entities . . . ."); Yan Leychkis, *Of Fire Ants and Claim Construction: An Empirical Study of the Meteoric Rise of the Eastern District of Texas as a Preeminent Forum for Patent Litigation*, 9 YALE J.L. & TECH. 193, 214 (2007) (finding that patent trolls "have shown a clear preference for the Eastern District [of Texas] over other venues"); Mark Liang, *The Aftermath of* TS Tech*: The End of Forum Shopping in Patent Litigation and Implications for Non-Practicing Entities*, 19 TEX. INTELL. PROP. L.J. 29, 42–43 tbl.1 (2010) (listing the Eastern District of Texas as the top forum for infringement suits by non-practicing entities); Fabio E. Marino & Teri H.P. Nguyen, *Has Delaware Become the "New" Eastern District of Texas? The Unforeseen Consequences of the AIA*, 30 SANTA CLARA HIGH TECH. L.J. 527, 529–30 (2014) ("Recent survey data on new patent suit filings suggests that [non-practicing entities] have found a new 'forum of choice' in the District of Delaware. . . .").

236. $p = 0.006$ using Pearson's chi-square (χ^2). This result remained statistically significant at the $p < 0.05$ level after imposing a multiple testing penalty (Bonferroni adjustment) for the six top districts being studied.

237. *See* Eric H. Weisblatt & Claire Frezza, *Who to Sue and Where in ANDA Litigation: Personal Jurisdiction Post-*Daimler, 69 FOOD & DRUG L.J. 351, 351 (2014) (noting that pharmaceutical patent holders in Abbreviated New Drug Application (ANDA) litigation often sue in the District of New Jersey).

238. *See* eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006) (Kennedy, J., concurring) ("An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees."); Cotropia et al., *supra* note 184, at 649–50.

239. *See* Bessen & Meurer, *supra* note 8, at 389 (estimating the "direct, accrued costs of NPE

some PAEs play a valuable role by helping compensate small inventors and companies for their innovations.[240] This debate is currently playing out in numerous arenas, most notably in Congress where legislation to curb so-called "patent trolls" is being considered.[241]

This study classified each patent holder into one of eight categories based on a classification system developed in a recent empirical study by Christopher Cotropia, Jay Kesan, and David Schwartz regarding the role of PAEs in the patent system.[242] It then aggregated several of these categories into a single PAE category for data analysis.[243] Figure 3 shows the injunction grant rates for PAEs compared to all other patentees.

patent assertions totaled $29 billion in 2011"); Sannu K. Shrestha, *Trolls or Market-Makers? An Empirical Analysis of Nonpracticing Entities*, 110 COLUM. L. REV. 114, 129 (2010) (noting that NPEs "may reduce social welfare" or "have an efficiency-reducing effect").

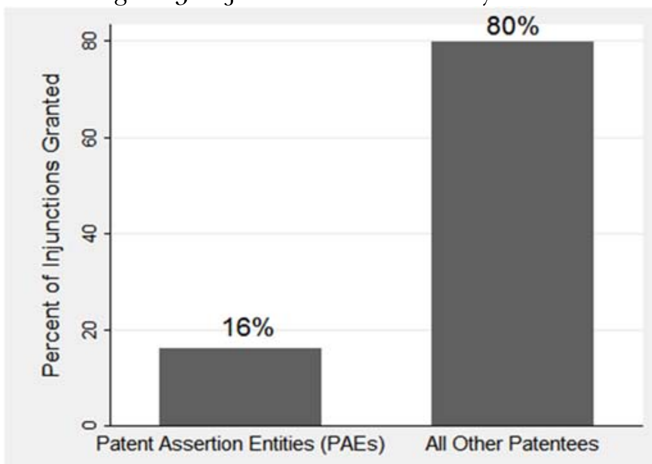
240. *See, e.g.*, FED. TRADE COMM'N, *supra* note 8, at 9 ("Some argue that PAEs encourage innovation by compensating inventors . . . ."); Peter N. Detkin, *Leveling the Patent Playing Field*, 6 J. MARSHALL REV. INTELL. PROP. L. 636, 636 (2007) ("Small companies and individuals have few good options for licensing their patents or developing their inventions without interference from infringers."); James F. McDonough III, Comment, *The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy*, 56 EMORY L.J. 189, 190 (2006) (contending that PAEs "actually benefit society" by "act[ing] as a market intermediary in the patent market . . . provid[ing] liquidity, market clearing, and increased efficiency to the patent markets"). *But see* Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 BERKELEY TECH. L.J. 1583, 1588 (2009) (questioning arguments that allege that all PAEs are beneficial to economic activity).

241. *See, e.g.*, Innovation Act, H.R. 9, 114th Cong. (2015); PATENT Act, S. 1137, 114th Cong. (2015).

242. *See* Cotropia et al., *supra* note 184, at 654, 660–71; *see also supra* note 184 (listing the eight categories).

243. This was coded as a binary variable [PAE]. The following categories from Cotropia et al., *supra* note 184, were classified as PAEs for purposes of data analysis: Large Patent Aggregator; Failed Operating or Start-Up Company; Patent Holding Company; and Technology Development Company. Universities were excluded from the PAE category because their primary business is the creation of knowledge and education of students, not the assertion of patents. *See* FED. TRADE COMM'N, *supra* note 8, at 8 n.5 ("Taken literally, the term NPE encompasses patent owners that primarily seek to develop and transfer technology, such as universities . . . . Patent assertion entities do not include this latter group."); *see also* Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 612 (2008) ("Universities are non-practicing entities. They share some characteristics with trolls, at least if the term is broadly defined, but they are not trolls."). Individual inventors were also excluded from the PAE category because at least some individual inventors actually make and/or sell a product that practices the patented technology or attempt to do so. *See* Christopher A. Cotropia, *The Individual Inventor Motif in the Age of the Patent Troll*, 12 YALE J.L. & TECH. 52, 63–64 (2009) (contending that some individual inventors "are legitimately patent trolls" but that "a significant number [are] certainly not"). Even if both of these categories of patentees were classified as PAEs, the difference would remain highly statistically significant ($p < 0.001$).

Figure 3. Injunction Grant Rate by PAE Status



As illustrated above, PAEs rarely obtained a permanent injunction after prevailing on liability (16%; 4 of 25 cases),[244] while other patentees are successful in obtaining injunctions in the vast majority of cases (80%; 154 of 193 cases). This difference in grant rates was highly statistically significant, suggesting that it was not due to chance alone.[245] This finding appears to lend weight to the view expressed in Justice Kennedy's concurrence that district courts should be reluctant to grant injunctions when the patentee is using the patent "not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees."[246] It also is consistent with prior studies finding that PAEs are rarely granted injunctions.[247]

Even in the rare cases where a PAE was granted an injunction, the patentee was generally a failing or failed operating company that had previously sought to commercialize the patent and thus was only a non-practicing entity at the time of the injunction decision.[248] For instance, in *800*

244. 25 district court cases in the Decisions Dataset were found to involve PAEs. PAEs were granted injunctions in only 4 of these 25 cases. *See, e.g.*, i4i Ltd. P'ship v. Microsoft Corp., 670 F. Supp. 2d 568 (E.D. Tex. 2009); 800 Adept, Inc. v. Murex Sec., Ltd., 505 F. Supp. 2d 1327 (M.D. Fla. 2007); Commonwealth Sci. & Indus. Research Organisation v. Buffalo Tech. Inc., 492 F. Supp. 2d 600 (E.D. Tex. 2007); Reporter's Transcript of Hearing on Post-Trial Motions, Anascape, Ltd. v. Microsoft Corp., No. 9:06-cv-00158 (E.D. Tex. July 18, 2008), ECF No. 395.

245. $p < 0.001$ using Pearson's chi-square (χ^2).

246. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006) (Kennedy, J. concurring).

247. *See* Chien & Lemley, *supra* note 2, at 10 fig.1 (finding that PAEs were granted injunctions in 26% of all decisions, including only 7% of cases where the injunction request was contested by the infringer); *see also* Shrestha, *supra* note 239, at 134–35 (noting the "post-*eBay* trend" that "[d]istrict courts in an increasing number of cases have refused to issue injunctions when the patent owner did not practice the invention").

248. *See* Cotropia et al., *supra* note 184, at 657 (defining "Failed Operating Companies" as firms that "either manufactured products or seriously attempted to break into the market. For some reason, these entities failed at selling or developing products or services. They retained their original patents, and later seek to enforce them.").

Adept, Inc. v. Murex Securities, the district court found that the patentee and the defendants were "competitors in the market for telephone call routing services,"[249] although at the time of the injunction the patentee—who faced significant financial challenges—only had a "small share of that market"[250] and was simultaneously engaged in a widespread patent litigation campaign against numerous competitors and end users (mainly former customers) of the patented technology.[251] The district court concluded that the defendants' attempts to reduce the patentee's market share supported a finding of irreparable harm.[252] Similarly, in *Anascape, Ltd. v. Microsoft Corp.*, the district court found irreparable harm and granted an injunction because although the patentee did not presently offer a product that practiced the patented technology (an analog stick for a video game system controller), it had been denied what the district court called "the opportunity to go forward"—in other words, the ability to introduce its own competing controller—due to defendant's infringement.[253] And in *i4i Limited Partnership v. Microsoft Corp.*, the district court found that Microsoft's inclusion of the patented custom XML technology into Microsoft Word created irreparable harm because it "would not only directly compete with [the patentee]'s products, but render them obsolete within the market."[254] At the time of the injunction, however, the patentee's primary business appeared to be patent litigation.[255] These cases suggest that a patentee who has attempted to commercialize its invention—even if that effort was ultimately unsuccessful—has a better chance than other PAEs of demonstrating irreparable harm, which is a critical part of the *eBay* analysis.

249. *800 Adept, Inc.*, 505 F. Supp. 2d at 1337.

250. *Id.* at 1338.

251. For example, in 2007, 800 Adept sued nearly two dozen defendants for patent infringement in the Eastern District of Texas. *See, e.g.*, Complaint for Patent Infringement, 800 Adept, Inc. v. Enterprise Rent-A-Car Co., No. 5:07-CV-00057 (E.D. Tex. filed Apr. 10, 2007); Complaint for Patent Infringement, 800 Adept, Inc. v. AT&T Mobility, LLC, No. 5:07-CV-00023 (E.D. Tex. filed Feb. 6, 2007).

252. *800 Adept, Inc.*, 505 F. Supp. 2d at 1337. The injunction was later vacated on appeal by the Federal Circuit because the defendants' services were found to not infringe under the correct claim construction. 800 Adept, Inc. v. Murex Sec., Ltd., 539 F.3d 1354, 1367 (Fed. Cir. 2008).

253. Reporter's Transcript of Hearing on Post-Trial Motions, *supra* note 244, at 124–25.

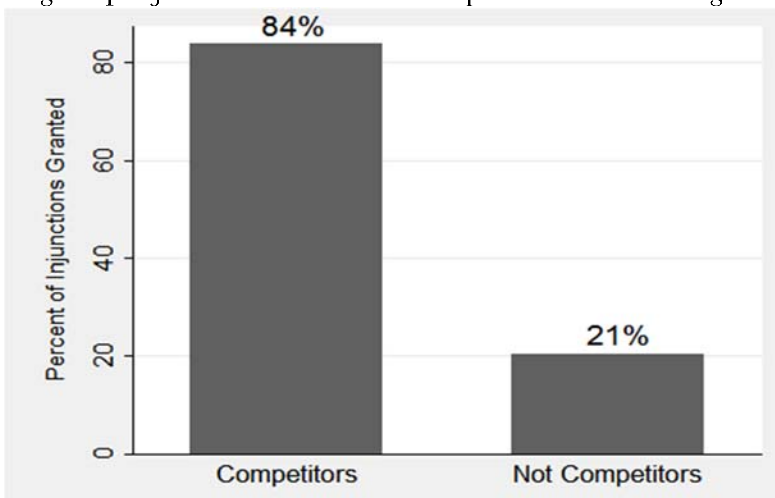
254. i4i Ltd. P'ship v. Microsoft Corp., 670 F. Supp. 2d 568, 599 (E.D. Tex. 2009).

255. For example, i4i Limited Partnership's website is almost exclusively devoted to its litigation with Microsoft, which culminated in a $240 million award that was affirmed on appeal. *See i4i v. Microsoft*, I4I, http://www.i4ilp.com (last visited Mar. 12, 2016); *see also* i4i Ltd. P'ship v. Microsoft Corp., 598 F.3d 831 (Fed. Cir. 2010), *aff'd*, 131 S. Ct. 2238 (2011).

5. Grant Rate and Competition Between Litigants

Whether the litigants were competitors is another relevant consideration identified in the literature.[256] This issue was studied as well. The different grant rates for competitors and non-competitors are depicted in Figure 4.

Figure 4. Injunction Grant Rates: Competition Between Litigants



Again, there was a large disparity in injunction grant rates between these two categories of patentees. Patent holders who competed with an infringer were granted a permanent injunction in the overwhelming majority of cases (84%; 150 of 179 cases), while patentees who were not market competitors rarely succeeded in obtaining injunctive relief (21%; 8 of 39 cases).[257] This difference was statistically significant as well.[258] Thus, as one district court explained, "*eBay* has changed little where a prevailing plaintiff seeks an injunction to keep an infringing competitor out of the market."[259]

Medical device manufacturers represented one notable group of competitors who were commonly denied injunctions post-*eBay*, as nearly a third of medical device firms who sued a competitor were denied an injunction (31%; 10 of 32 cases). In many of these cases, the district court found that the patentee failed to satisfy one or both of the final two *eBay* factors, balance of hardships and public interest.[260] In other words, although

256. *See supra* notes 139–44, 189 and accompanying text.

257. For district court opinions in the Decisions Dataset, 179 were found to involve competitors, while 39 cases did not involve competitors.

258. $p < 0.001$ using Pearson's chi-square (χ^2). This difference remains statistically significant if Hatch–Waxman (pharmaceutical) litigation is excluded.

259. Amgen, Inc. v. F. Hoffman–La Roche Ltd., 581 F. Supp. 2d 160, 210 (D. Mass. 2008), *aff'd in part, vacated in part, and remanded by* 580 F.3d 1340 (Fed. Cir. 2009).

260. *See, e.g.*, Smith & Nephew, Inc. v. Interlace Med., Inc., 955 F. Supp. 2d 69, 79–80 (D. Mass. 2013) (holding that "the balance of hardships weighs against a permanent injunction"

these patentees usually could demonstrate irreparable harm, the district court nonetheless denied an injunction because removing the infringing product from the market might adversely affect patients' health and safety.[261]

In several other cases involving competitors, the district court declined to grant an injunction because the patented technology was only a "small component" of the infringing product, thus following the reasoning of Justice Kennedy's concurrence that injunctions in such cases might result in holdup.[262] And one case denied an injunction between competitors because the patented technology was not causally connected to the alleged irreparable harm, which has been referred to by some courts as the "causal nexus" requirement.[263]

6. Irreparable Harm Findings

This study also sought to determine the basis for the district courts' conclusion regarding irreparable harm, which is the first factor of the *eBay* test. Prior to *eBay*, prevailing patentees were presumed to suffer irreparable

because it would cause the loss of over $250 million in investment and over 150 employees would lose their jobs and that "the public interest weighs against granting a permanent injunction" because "at least some doctors and their patients will suffer a negative impact if [the infringer] is enjoined from selling its medical device"); Conceptus, Inc. v. Hologic, Inc., No. C 09-02280 WHA, 2012 WL 44064, at *3 (N.D. Cal. Jan. 9, 2012) (denying an injunction because the infringer demonstrated "substantial hardship . . . would occur if a permanent injunction is imposed" and "[t]he public interest would undoubtedly be harmed by an injunction" because it "would leave only one product" on the market and thus "would have eliminated an important alternative for patients"); Respironics, Inc. v. Invacare Corp., No. 04-0336, 2008 WL 111983, at *6 (W.D. Pa. Jan. 8, 2008) (holding that the patentee failed to show that either "the balance of hardships" or "the public interest" weighed in favor of granting an injunction).

261. *See, e.g.*, Tyco Healthcare Grp. LP v. Ethicon Endo-Surgery, Inc., 936 F. Supp. 2d 30, 86 (D. Conn. 2013) (holding that granting an injunction was contrary to the public interest because it "would pull many devices that are presently used in surgery off the market"); Johnson & Johnson Vision Care, Inc. v. CIBA Vision Corp., 712 F. Supp. 2d 1285, 1292 (M.D. Fla. 2010) (concluding that "an injunction will create consequential medical, practical and economic issues" for users' of defendants' product, and "[t]he deleterious effects of the injunction on the general public would simply be too great to permit"); Bard Peripheral Vascular, Inc. v. W.L. Gore & Assocs., Inc., No. CV-03-0597-PHX-MHM, 2009 WL 920300, at *9 (D. Ariz. Mar. 31, 2009) ("Given . . . the important role that [the defendant's] products play in aiding vascular surgeons who perform life-saving medical treatments, sound public policy does not favor removing [them] from the market.").

262. *See* Douglas Dynamics, LLC v. Buyers Prods. Co., 717 F. 3d 1336 (Fed. Cir. 2013); Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901 (N.D. Ill. 2012); Humanscale Corp. v CompX Int'l Inc., No. 3:09-CV-86, 2010 WL 3222411 (E.D. Va. Aug. 16, 2010).

263. *See* Apple, Inc. v. Samsung Elecs. Co., 909 F. Supp. 2d 1147, 1153–57 (N.D. Cal. 2012), *aff'd in part, vacated in part by* 735 F.3d 1352, 1359–68 (Fed. Cir. 2013). Injunctions were also denied in several other decisions after the time period of this study based on lack of evidence of a "causal nexus." *See* Power Integrations, Inc. v. Fairchild Semiconductor Int'l, Inc., No. C 09-5235 MMC, 2015 WL 604582, at *4 (N.D. Cal. Feb. 12, 2015); Riverbed Tech., Inc. v. Silver Peak Sys., Inc., No. 11–484–RGA, 2014 WL 4695765, at *12 (D. Del. Sept. 12, 2014).

harm,[264] and this presumption was rarely rebutted.[265] After the Supreme Court's decision, however, patentees must demonstrate irreparable harm before an injunction can issue.[266] As a result, the issue of what harm qualifies as "irreparable" has taken on new significance since *eBay*.

In most cases where an injunction issued, the district court made an explicit finding regarding the harm(s) that it found irreparable.[267] Figure 5 depicts the percentage of cases where one of the following types of irreparable harm was found: (1) loss of market share (including lost customers and lost sales) due to infringement;[268] (2) price erosion for the patentee's product or services that practiced the patent;[269] (3) loss of goodwill or damage to the patentee's brand or reputation;[270] (4) loss of future business opportunities;[271] (5) the infringer's potential inability to pay a monetary judgment;[272] and (6) any other type of irreparable harm that does not fall into one of the previous five categories.[273]

264. *See* Smith Int'l, Inc. v. Hughes Tool Co., 718 F.2d 1573, 1581 (Fed. Cir. 1983) ("[W]here validity and continuing infringement have been clearly established, as in this case, immediate irreparable harm is presumed." (citations omitted)).

265. One situation where this presumption could be rebutted was when the infringing party voluntarily terminated the allegedly infringing activities with no reasonable prospect of resumption. *See* Polymer Techs., Inc. v. Bridwell, 103 F.3d 970, 974 (Fed. Cir. 1996) (affirming the denial of injunctive relief when the accused infringer "has or will soon cease the allegedly infringing activities").

266. *See supra* note 117 and accompanying text.

267. Injunctions issued in 158 decisions in the dataset. Of these, 112 decisions (71%) included an express finding regarding the type(s) of irreparable harm.

268. This was coded as a binary variable [MKTSHARE].

269. This was coded as a binary variable [PRICE].

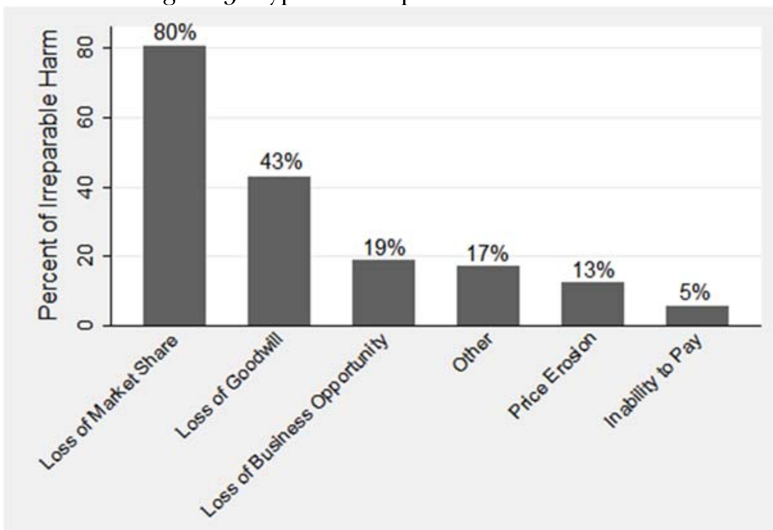
270. This was coded as a binary variable [GOODWILL].

271. This was coded as a binary variable [FUTUREBUS].

272. This was coded as a binary variable [INABILITY].

273. This was coded as a binary variable [OTHER]. A narrative description of the nature of the irreparable harm was also included [COMMENTS_HARM].

Figure 5. Types of Irreparable Harm Found



As illustrated in the farthest left column in Figure 5, the most common reason by far for finding irreparable harm was loss of market share (80%). This is perhaps unsurprising in light of district courts' willingness to grant an injunction when the parties are competitors.[274] When a competitor infringes by introducing a new product with the patented feature, the infringer will likely capture some of the patentee's market share. This is especially true since the infringer, unlike the patentee, can often charge a lower price and still turn a profit, as it does not have to recoup the cost of developing the patented technology.[275] Similarly, price erosion (13%) and loss of future business opportunities (19%) are competition-related harms.

Another significant source of irreparable harm was loss of goodwill or reputation (43%) due to the infringement. This type of loss may be irreparable because goodwill is "often difficult to quantify" and thus may be difficult or impossible to compensate with money damages.[276] A less common basis for finding irreparable harm is the infringer's potential inability to pay damages (5%), which typically occurs when a sizable monetary judgment would render the infringer insolvent.[277] Finally, other types of irreparable

274. *See supra* Figure 4.

275. *See, e.g.*, Douglas Dynamics, LLC v. Buyers Prods. Co., 717 F.3d 1336, 1344–46 (Fed. Cir. 2013) (infringing product gained 5% market share because the infringer was "competing in the marketplace using [plaintiff's] patented technology" and was able to "undercut[ ] prices").

276. *Id.* at 1344; *see also* MicroAire Surgical Instruments, LLC v. Arthrex, Inc., 726 F. Supp. 2d 604, 635 (W.D. Va. 2010) ("The loss of goodwill is a well-recognized basis for finding irreparable harm. . . .").

277. *See* Coloplast A/S v. Generic Med. Devices, Inc., No. C10–227BHS, 2012 WL 3262756, at *2 (W.D. Wash. Aug. 9, 2012) (finding that irreparable harm exists because, *inter alia*, the infringer "will

harm due to the infringer's conduct—such as loss of qualified employees,[278] diversion of funds from research and development opportunities,[279] loss of revenue from other licensees,[280] and impairment of a patent's market value[281]—were infrequently found as well (17%).

7. Other *eBay* Factors

This study also revealed a very strong relationship between the first and second *eBay* factors—irreparable harm and absence of an adequate remedy at law. Scholars have previously noted these two factors often collapse into a single inquiry.[282] Indeed, the district court in *eBay* recognized in its decision denying injunctive relief after remand from the Supreme Court that the adequate remedy at law factor "inevitably overlaps" with the irreparable harm requirement.[283]

The data collected for this study reveal that in 136 decisions where the district court made an express finding that irreparable harm would occur absent an injunction (the first *eBay* factor), it also found in all but one of these cases that there was no adequate remedy of law as well (the second *eBay* factor).[284] Similarly, in the 42 cases in the dataset where the district court found no irreparable injury, it also found that an adequate remedy at law existed in all but one case.[285]

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be unable to satisfy any judgment entered against it"); Symbol Techs., Inc. v. Janam Techs., LLC, 729 F. Supp. 2d 646, 665 (D. Del. 2010) ("In some instances, a defendant's inability to satisfy a money judgment has been deemed sufficient to establish irreparable injury." (citations omitted)).

278. *See* Research Found. of State Univ. of N.Y. v. Mylan Pharm., Inc., Nos. 09-184-LPS, 10-892-LPS, 2012 WL 1901267, at * 2 (D. Del. May 25, 2012).

279. *See* ePlus, Inc. v. Lawson Software, Inc., No. 3:09CV620, 2011 WL 2119410, at * 12 (E.D. Va. May 23, 2011).

280. *See* Smith & Nephew, Inc. v. Arthrex, Inc., 629 F. Supp. 2d 1176, 1181 (D. Or. 2008).

281. *See* Joyal Prods., Inc. v. Johnson Elec. N. Am., Inc., No. 04–5172 (JAP), 2009 WL 512156, at *11 (D. N.J. Feb. 27, 2009).

282. *See* Gergen et al., *supra* note 4, at 209 (noting that *eBay*'s "requirements of (1) irreparable injury and (2) inadequacy of legal remedies are redundant as these are, traditionally speaking, one and the same"); Jeremy Mulder, Note, *The Aftermath of* eBay*: Predicting When District Courts Will Grant Permanent Injunctions in Patent Cases*, 22 BERKELEY TECH. L.J. 67, 80 (2007) ("Courts collapse the first two factors [of the *eBay* test], apparently viewing irreparable harm, if an injunction is not granted, and inadequate remedy at law, in the form of damages, as opposite sides of the same coin.").

283. *MercExchange III*, 500 F. Supp. 2d 556, 582 (E.D. Va. 2007).

284. The lone exception is *Conceptus, Inc. v. Hologic, Inc.* where the district court found irreparable harm because the infringer took market share away from the patentee in a two-supplier market, thus causing loss of customers and potential customers, but it also found that the patentee had an adequate remedy at law because "it will be reasonable and practical to estimate the extent of damages." Conceptus, Inc. v. Hologic, Inc., No. C 09-02280 WHA, 2012 WL 44064 at *2–3 (N.D. Cal. Jan. 9, 2012) (quoting ECF No. 131 at 10).

285. *See* Accentra Inc. v. Staples, Inc., 851 F. Supp. 2d 1205, 1238 (C.D. Cal. 2011) (finding that the infringer did not challenge patentee's showing that its legal remedies are inadequate, but the district court concluded the patentee had failed to show irreparable harm and denied an injunction). The remaining district court decisions did not make an express finding on both *eBay* factors.

In addition, in cases where the district court denied an injunction, it also commonly found that the third and fourth *eBay* factors—the balance of hardships and the public interest—weighed against injunctive relief. Specifically, of the 60 cases in the dataset where an injunction was denied, the district court found that the balance of hardships weighed against an injunction half of the time (50%; 30 cases), and that the public interest weighed against an injunction slightly over half of the time (52%; 31 cases).[286]

8. Regression Analysis

Finally, this study sought to evaluate the potential impact of several additional factors on injunction decisions following *eBay* using multiple regression analysis. Factors included in this analysis were whether the patent holder licensed or offered to license the patent(s)-in-suit,[287] whether the patent(s)-in-suit claimed a business method,[288] and whether the patent(s)-in-suit covered a "small component" of an infringing product,[289] all of which were anticipated to be negatively correlated with an injunction. In contrast, a finding of willful infringement was anticipated to be positively correlated with injunctive relief.[290] The previously discussed factors of patentee type (i.e., PAE status) and competition between the litigants were anticipated to be statistically significant as well.

Three different regression models were created to assess the impact of these factors. The first model (Model #1) included only the factors described above. The second model (Model #2) controlled for field of technology.[291] The third model (Model #3) controlled for both field of technology and the six district courts with the most injunction decisions.[292] A statistical test called logistic (logit) regression[293] was used to assess the relationship between these factors and the court's ultimate decision on injunctive relief. The results in

286. Not all decisions made an express finding on all four *eBay* factors. Cases where a district court failed to expressly state that these factors weighed against an injunction or was otherwise silent regarding them are not included in this tally.

287. *See supra* notes 145–47 and accompanying text.

288. *See supra* note 114 and accompanying text.

289. *See supra* notes 148–49 and accompanying text.

290. *See supra* notes 150–53 and accompanying text.

291. It is particularly important to control for technology when evaluating the significance of patentee type, as PAEs commonly assert software and computer-related patents in litigation. In contrast, PAEs rarely assert patents in the chemical and pharmaceutical fields. *See* Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457, 477–78 (2012). Biotechnology [BIOTECH] was omitted from Models #2 and #3 because it has a perfect predictive rate on injunction decisions (i.e., injunctions were granted in all 4 cases in the dataset involving biotechnology patents).

292. *See supra* Table 2.

293. Logistic (logit) regression is "an estimation technique . . . commonly used by legal scholars and others to analyze judicial decisions. . . . Like other regression models, logit analyses simultaneously measure the individual relationships between several independent variables and a single dependent variable." David B. Spence & Paula Murray, *The Law, Economics, and Politics of Federal Preemption Jurisprudence: A Quantitative Analysis*, 87 CALIF. L. REV. 1125, 1179, 1200 (1999).

Table 3 report the odds ratio—which is a measure of the strength of association between the independent variable and the dependent variable (here, whether an injunction was granted)—for each factor, with standard errors in parentheses.[294] One or more asterisks indicate statistical significance for an independent variable.[295] The pseudo-R^2 value reported in the final row (in italics) is a measure of the predictive power of the independent variables included in each model.[296]

Table 3. Logistic Regression Models: Permanent Injunction Decisions

Variable[297]	**Odds Ratio**		
	Model #1	**Model #2**	**Model #3**
PAE	.28 (.22)	.18 (.16)	.12* (.12)
COMPETE	13.49*** (8.04)	18.65*** (12.40)	27.68*** (20.2)
LICENSE	1.64 (.74)	1.66 (.80)	2.28 (1.23)
BUSMETHOD	.60 (.42)	.36 (.31)	.41 (.41)

294. Odds ratios of greater than 1 indicate that the variable has a positive association with entry of a permanent injunction, while odds ratios of less than 1 indicate the variable has a negative relationship with entry of a permanent injunction. The amount by which the odds ratio is more or less than 1 reveals the magnitude of the association between the independent variable and the injunction decision. All odds ratios are reported to two decimal places. For a useful primer on odds ratios in logistic regression, see UCLA Institute for Digital Research and Education, *FAQ: How Do I Interpret Odds Ratios in Logistic Regression?*, http://www.ats.ucla.edu/stat/mult_pkg/faq/general/odds_ratio.htm (last visited Mar. 12, 2016).

295. For all results, * indicates $p < 0.05$, ** indicates p < 0.01, and *** indicates $p < 0.001$.

296. Pseudo R^2 values range between 0 and 1, with higher values indicating better model fit. *See* UCLA Institute for Digital Research and Education, *FAQ: What are Pseudo R-squareds?*, http://www.ats.ucla.edu/stat/mult_pkg/faq/general/Psuedo_RSquareds.htm (last visited Mar. 12, 2016).

297. From top to bottom in this column, the first six variables [PAE, COMPETE, LICENSE, BUSMETHOD, COMPONENT, and WILLFUL] have been previously described. *See supra* notes 184, 186, 189–92. The next seven variables [SOFTWARE, ELECTRONICS, ELECTRICAL, MECHANICAL, CHEMISTRY, DRUGS, and MEDICALDEVICE] involve the field of technology for the patent(s)-in-suit. *See supra* note 185. The final six variables correspond to the top six district courts for injunction decisions: Central District of California [CDCAL]; Northern District of California [NDCAL]; District of Delaware [DDEL]; District of Massachusetts [DMASS]; District of New Jersey [DNJ]; and Eastern District of Texas [EDTEX]. *See supra* Table 2.

COMPONENT	.06** (.05)	.04** (.04)	.02*** (.02)
WILLFUL	1.89 (.83)	1.76 (.84)	1.46 (.76)
SOFTWARE	-	.65 (.63)	.37 (.41)
ELECTRONICS	-	.92 (.93)	.60 (.66)
ELECTRICAL	-	2.91 (4.52)	1.88 (3.11)
MECHANICAL	-	.29 (.28)	.20 (.22)
CHEMISTRY	-	.28 (.36)	.17 (.23)
DRUGS	-	.84 (.97)	1.18 (1.55)
MEDICALDEVICE	-	.13* (.12)	.06* (.07)
CDCAL	-	-	.69 (.77)
NDCAL	-	-	.61 (.60)
DDEL	-	-	.07*** (.05)
DMASS	-	-	1.03 (.97)
DNJ	-	-	1.39 (1.94)
EDTEX	-	-	1.76 (1.33)

Pseudo R^2	.31	.37	.45

Not surprisingly, whether the patentee and infringer were competitors is the single most significant factor related to injunctive relief in all three models. This variable is highly statistically significant,[298] and its predictive power increases as control variables are added.[299] Whether the patentee was a PAE is also statistically significant in the expected direction (i.e., fewer permanent injunctions were granted to PAEs) in the final model, which has the highest degree of predictive power.[300] However, the models probably tend to underestimate the strength of the relationship between PAE status and injunctive relief, as there is a high degree of collinearity between the PAE and COMPETE variables[301]—by definition, a PAE cannot currently compete in a product market against an infringer.[302]

In addition, whether a patent claims a "small component" of an infringing product is statistically significant for injunctive relief.[303] When a patent is found to cover a small component, district courts rarely grant an injunction, as reflected by the low odds ratio for this variable.[304] Thus, it appears that district courts are heeding Justice Kennedy's advice to avoid injunctive relief "[w]hen the patented invention is but a small component of the product the [infringer] seek[s] to produce."[305]

However, several other factors identified in the existing literature as relevant to the injunction calculus appear not to be statistically significant and/or do not have the anticipated impact. For instance, a patentee's willingness to license the patent(s)-in-suit is actually *positively* correlated with injunctive relief after controlling for all other factors, although this finding is not statistically significant.[306] Similarly, a finding of willful infringement does

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298. $p < 0.001$ in all three models.

299. The odds ratio for COMPETE increased from 13.49 in Model #1 to 27.68 in Model #3. Similarly, the 95% confidence interval (not reported in Table 3) for the variable increased from 4.20–43.38 in Model #1 to 6.62–115.68 in Model #3.

300. $p = 0.035$ in Model #3.

301. $p < 0.001$ using Pearson's chi-square (χ^2) test.

302. In two cases, PAEs were found to have competed in the past with the infringer. *See* i4i Ltd. P'ship v. Microsoft Corp., 670 F. Supp. 2d 568, 599 (E.D. Tex. 2009) (finding that there was evidence of direct competition between patentee and defendant within the custom XML marketplace, but at the time of decision patentee's primary business appeared to be patent licensing and litigation); 800 Adept, Inc. v. Murex Sec., Ltd., 505 F. Supp. 2d 1327, 1337 (M.D. Fla. 2007) (finding that "800 Adept and the Murex–Targus Parties are competitors in the market for telephone call routing services"). Both patentees appeared to be engaged primarily in patent litigation by filing multiple lawsuits in the Eastern District of Texas against at least twenty other defendants.

303. $p < 0.01$ in Models #1 and #2, and $p < 0.001$ in Model #3.

304. District courts only granted injunctions 14% of the time (2 of 14 cases) where the district court found that the patent covered a "small component."

305. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006) (Kennedy, J., concurring).

306. $p = 0.125$ in Model #3. Overall, patentees who have engaged in licensing efforts are

not have a statistically significant correlation with permanent injunction decisions.[307] Perhaps most notably, business method patents do not have a statistically significant relationship with injunction denials,[308] despite Justice Kennedy's concurring opinion expressing skepticism about the quality of such patents.[309]

Two other variables have a statistically significant relationship with injunction decisions in the second and third models. First, injunctions are granted at a significantly lower rate in cases involving medical device technology, even after controlling for the litigants' status as competitors.[310] This higher-than-anticipated injunction denial rate may be at least partly due to the final *eBay* factor; several district court decisions have declined to award injunctive relief on the basis that it would disserve the public interest to restrict doctors' and patients' access to the infringing devices.[311] Second, one forum—the District of Delaware—was found to have a statistically significant negative correlation with injunctive relief.[312] This may be related to the fact that Delaware is currently a preferred forum for PAE litigants, who rarely obtain injunctive relief.[313]

slightly less likely to obtain a permanent injunction (64% of the time) than patentees who are not (77% of the time).

307. $p = 0.470$ in Model #3. Overall, patentees have a slightly higher injunction grant rate against willful infringers (77% of the time) than against non-willful infringers (70%).

308. $p = 0.375$ in Model #3. Prevailing patentees in business method cases win injunctions slightly over half the time (53%), compared to almost three-quarters of the time in all other cases (74%), but the small number of decisions involving business method patents (N = 17) renders this difference statistically insignificant.

309. *eBay*, 547 U.S. at 397 (Kennedy, J., concurring).

310. $p = 0.011$ in Model #3.

311. *See, e.g.*, Tyco Healthcare Grp. LP v. Ethicon Endo–Surgery, Inc., 936 F. Supp. 2d 30, 86 (D. Conn. 2013) (finding it "an important consideration that a permanent injunction would pull many devices that are presently used in surgery off the market"); Conceptus, Inc. v. Hologic, Inc., No. C 09-02280 WHA, 2012 WL 44064, at *4 (N.D. Cal. Jan. 9, 2012) (finding that "the public benefit of having two products with different qualities in the transcervical hysteroscopic sterilization market militates strongly against an injunction"); Johnson & Johnson Vision Care, Inc. v. CIBA Vision Corp., 712 F. Supp. 2d 1285, 1292–93 (M.D. Fla. 2010) (concluding "that the public interest would be disserved if an injunction were to be entered" because "millions of innocent contact lens wearers will suffer real adverse consequences if sale of [the infringing contact lenses] is enjoined"); Bard Peripheral Vascular, Inc. v. W.L. Gore & Assocs. Inc., No. CV-03-0597-PHX-MHM, 2009 WL 920300, at *5–6 (D. Ariz. Mar. 31, 2009) (finding the public interest "weigh[s] heavily against imposing an injunction" because of "the public health consequences of enjoining Gore from producing or selling its infringing products"); Reporter's Transcript of Proceedings at 7, Medtronic Sofamor Danek USA v. Nuvasive, Inc., No. 08-CV-01512 (S.D. Cal. Jan. 26, 2012), ECF No. 461 ("[I]t appears to the Court that the potential risk to patient health and safety is too great to justify enjoining NuVasive from continuing to sell its infringing products.").

312. $p < 0.001$ in Model #3.

313. *See supra* notes 234–35 and accompanying text.

B. PATENTS DATASET

Multiple regression analysis also was performed on numerous variables in the Patents Dataset to assess whether they had a statistically significant relationship with injunctive relief. For example, prior studies have found that patents with more claims,[314] higher citations to prior art,[315] more related predecessor (parent) applications,[316] and greater citations by subsequently-issued patents (i.e., forward citations)[317] are more likely to be asserted in litigation and thus more likely to be considered valuable by their owners.[318] Similarly, the length of time a patent is in prosecution has been correlated in past studies with increased patent value.[319] As a result, these variables were anticipated to be positively correlated with injunctive relief, on the theory that infringement of a valuable patent is more likely to result in irreparable harm.

In contrast, several other variables were anticipated to be negatively correlated with an injunction. For instance, prior studies have found that small entity status is negatively correlated with patent value,[320] and small entities are less likely to prevail in patent litigation.[321] Moreover, since one asserted justification for PAEs is that they assist small inventors in monetizing their innovation, patents obtained by small entities may be more likely to be acquired and asserted by PAEs,[322] which rarely obtain injunctions. Similarly, patents closer to expiration are less likely to be valuable than newly-acquired patents,[323] and so the time period between the patent's issuance and the

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314. *See* Allison et al., *supra* note 160, at 451–53 (finding "that litigated patents include significantly more claims than [non-litigated] patents," and suggesting "that a larger number of claims suggests the owners knew at the time of prosecution that these patents would turn out to be important"); Chien, *supra* note 160, at 326 fig.6, 329 app. A (finding a statistically significant relationship between the number of claims and whether a patent is litigated).

315. *See* Allison et al., *supra* note 160, at 453 (finding that "[l]itigated patents . . . also cite significantly more prior art than [non-litigated] patents").

316. *See id.* at 457 ("Litigated patents also tended to be part of 'families' of issued patents.").

317. *See id.* at 455 ("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. . . . Indeed, the number of citations received has a particularly strong association with litigation."); *see also supra* note 201.

318. *See* James Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, 37 RES. POL'Y 932, 939 (2008) ("A litigated patent is, all else equal, nearly six times more valuable"); *see also* Allison et al., *supra* note 160, at 437 (assuming "that litigated patents are at least a subset of the most valuable patents . . . .").

319. *See* Allison et al., *supra* note 160, at 459 ("Litigated patents also spent significantly longer in prosecution than issued patents.").

320. *See* Bessen, *supra* note 318, at 937 (finding that "patents owned by small entities are dramatically less valuable than patents owned by large entities").

321. *See* John R. Allison et al., *Patent Quality and Settlement Among Repeat Patent Litigants*, 99 GEO. L.J. 677, 690 (2011) (finding that "large patent plaintiffs are significantly more likely than small ones to win" in patent litigation).

322. *See* Shrestha, *supra* note 239, at 127–28.

323. *See* Allison et al., *supra* note 160, at 460 ("Litigation is more likely to occur when patents are young . . . . Given the connection between litigation and value, it follows that the potential value of a patent is known early on; it is rare for a patent to become valuable and be litigated late in its life.")

injunction decision was expected to be negatively correlated with injunction grants.

A regression model incorporating these variables was created. In addition, the NBER technology categories[324] for each patent-in-suit were added as controls,[325] with one modification—the "Drugs and Medical" category was divided into two separate categories because of the differences in injunction rates observed in the Decisions Dataset.[326] The odds ratios, standard errors, statistical significance, and pseudo R^2 are reported in Table 4.

Table 4. Logistic Regression: Patent Characteristics

Variable	**Odds Ratio**
CLAIMS	.998 (.004)
PRIORART	.998 (.002)
PARENT	.982 (.058)
FWDCITEPERYEAR	.997 (.018)
PROSECUTIONYEAR	1.032 (.060)
SMALL	1.591 (.509)
ISSUE2INJUNCTION	.965 (.027)
Pseudo R^2	*.071*

In sum, none of the measured patent characteristics had a statistically significant relationship with injunction outcomes. This was surprising in light

324. *See supra* note 200 and accompanying text.

325. Each of these technology categories was included in the regression model as dummy variables. The odds ratios and standard errors for these variables are omitted from Table 4, but they are included in the reported pseudo R^2 statistic for goodness-of-fit.

326. *See supra* Table 1 (showing permanent injunction grant rate is 92% for drugs and 65% for medical devices).

of the existing literature, which suggested these characteristics could have predictive value.[327] Indeed, the only variable in this model that had a statistically significant relationship was one of the control variables, the NBER technology category of Computers and Communications, which was negatively correlated with injunctive relief.[328]

C. Implications

This study's findings have several implications for both participants and policy makers in the patent system. First, district courts have applied *eBay* in a manner that awards permanent injunctions to operating companies who compete with the infringer in the vast majority of cases, while simultaneously denying them to most PAEs and non-competitors.[329] This result holds even after controlling for other potentially confounding factors, such as the field of patented technology and courts where PAEs commonly file infringement claims.[330] In particular, the first factor of the *eBay* test appears to be the main stumbling block for PAEs and other non-competing entities, as they rarely can demonstrate the type of competition-related harm that qualifies as an irreparable injury under existing precedent.[331]

Denying injunctive relief to PAEs may be normatively desirable in many cases, such as patentees who engage in rent-seeking behavior by exploiting the high transaction costs of patent litigation to extract nuisance-value settlements without any corresponding public benefit.[332] *eBay*'s four-factor test apparently has helped mitigate holdup by such patentees,[333] even if PAE litigation remains widespread.[334]

327. *See supra* note 160. *But cf.* Allison et al., *supra* note 170, at 1798–99 (finding that "the observable characteristics of the patents[-in-suit] don't seem to have much, if any, bearing on the outcome of the cases involving those patents").

328. Odds ratio 0.448, standard error 0.169, $p = 0.033$.

329. *See supra* notes 243–44 and accompanying text; *see also* Golden, *Patent Trolls*, *supra* note 4, at 2113–14 (asserting that "district courts' post-*eBay* practice may be in some tension with the Supreme Court's warning against the 'categorical denial of injunctive relief' to broad classes of patent holders"); Sandrik, *supra* note 4, at 97 ("Case law in the last five years has established a near categorical rule that [non-practicing entities] cannot obtain injunctive relief.").

330. *See supra* note 301 and accompanying text.

331. *See supra* Figure 5.

332. *See* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2126 (2013) (referring to "bottom-feeder trolls" as patent owners that "rely on the high cost of patent litigation" to induce alleged infringers to enter into "quick, low-value settlements").

333. *See* Chien & Lemley, *supra* note 2, at 2 ("By requiring federal courts to consider the equities of a particular case before granting an injunction, *eBay* solved much of the patent system's holdup problem."); Robert P. Merges, *Foundations and Principles Redux: A Reply to Professor Blankfein-Tabachnick*, 101 CALIF. L. REV. 1361, 1373 (2013) (same).

334. *See* Colleen V. Chien, *Patent Trolls by the Numbers* (Santa Clara Univ. Legal Studies, Research Paper No. 08-13, 2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2233041 (finding that PAEs initiated 62% of all patent litigation filed in 2012 based on data provided by RPX); *cf.* Cotropia et al., *supra* note 184, at 676 fig.2 (finding that operating companies represented 68.9% of unique patentees in patent cases filed in 2012).

However, the near-categorical denial of injunctive relief to non-practicing entities seemingly conflicts with the Supreme Court's admonition in *eBay* that lower courts should avoid "categorical rule[s]" prohibiting injunctive relief "in a broad swath of cases," including when the patentee does not commercially practice its patents.[335] As the Court's unanimous opinion explained, such "broad classifications" are not permitted by "traditional equitable principles."[336] Furthermore, the routine denial of injunctive relief to non-practicing entities is in tension with the Court's century-old holding in *Continental Paper Bag*—which was cited in *eBay*[337]—that a patentee's failure to practice the patented invention does not, standing alone, preclude equitable relief.[338]

The imposition of a liability rule for most non-practicing patentees may adversely affect entities that engage in innovation and utilize a business model that relies heavily on the right to exclude others, such as startups that have developed a new technology but have not yet brought a product to market.[339] For many startups, the process of commercializing an invention is costly and complex, with uncertain prospects for success.[340] Empirical researchers have found that many startup companies seek patents to secure rights to their inventions, particularly in the biotechnology and medical device industries,[341]

335. eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 393 (2006); *see also* Sandrik, *supra* note 4, at 111 (contending that "[t]he denial of injunctive relief . . . to patentees that practice their technology but do not compete in the same market as their infringers . . . is in conflict with the Supreme Courts warning against the 'categorical denial of injunctive relief'" (citations omitted)).

336. *eBay*, 547 U.S. at 393.

337. *See id.* ("The [district] court's categorical rule is also in tension with [*Continental Paper Bag*], which rejected the contention that a court of equity has no jurisdiction to grant injunctive relief to a patent holder who has unreasonably declined to use the patent." (citation omitted)).

338. *See supra* notes 60–68 and accompanying text; *see also* Holte, *Misinterpretation of* eBay, *supra* note 4, at 727 (noting "the Supreme Court affirmed the *Continental Paper Bag* case" in *eBay*).

339. *See* Andrew Beckerman-Rodau, *The Supreme Court Engages in Judicial Activism in Interpreting the Patent Law in* eBay, Inc. v. MercExchange, L.L.C., 10 TUL. J. TECH. & INTELL. PROP. 165, 198 (2007) ("Nonpracticing entities can be small enterprises that have developed innovative technology but have been unable to generate the necessary capital or marketing expertise to compete successfully [in] the marketplace."); *see also* Stuart J.H. Graham, Robert P. Merges, Pam Samuelson & Ted Sichelman, *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1297 (2009) (finding that among surveyed startups who apply for patent protection, "the most important reason for patenting is to prevent others from copying the startup's products and services").

340. *See* F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 707–08 (2001) (explaining the activities associated with commercializing an invention, including developing a commercial embodiment, raising capital, securing production facilities and labor, creating distribution channels, and informing potential consumers about the product's availability and benefits); Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 343 (2010) ("[T]he inventor must undertake costly and risky development and testing to transform the invention into a commercially viable product.").

341. *See* Graham et al., *supra* note 339, at 1277 tbl. 1 (showing that 39% of all surveyed startups, and 75% of biotechnology and 76% of medical device startups, hold U.S. patents or patent applications).

and the vast majority of startups that successfully secure venture capital financing have applied for patent protection.[342] The effective loss of the right to exclude post-*eBay* may hinder these firms' ability to subsequently commercialize their inventions.[343]

In addition, a liability rule may decrease the value of patents owned by PAEs and other non-practicing entities. By removing the threat of a permanent injunction, and thus the ability to potentially force infringing products off the market, *eBay* has "decrease[d] the incentives for potential licensees to seek a license rather than practice patents without permission."[344] The loss of the right to exclude erodes the patentee's bargaining power and consequently may result in lower licensing rates.[345] Indeed, this second-order effect is likely to have a much wider impact than injunction denials in litigation, as only a small fraction of patents are ever litigated, while many more are licensed.[346]

Third, district courts exhibit a technology-specific bias in applying the facially-neutral four-factor test in *eBay*. This phenomenon is not uncommon in patent law. As Dan Burk and Mark Lemley have explained, although

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342. *See id.* (showing that 82% of surveyed venture-backed companies either have at least one U.S. patent or have applied for a U.S. patent, and that venture-backed firms hold an average of 18.7 U.S. patents and patent applications); David H. Hsu & Rosemarie H. Ziedonis, *Resources as Dual Sources of Advantage: Implications for Valuing Entrepreneurial-Firm Patents*, 34 STRATEGIC MGMT. J. 761, 762 (2013) (finding "that successful patent filings are . . . influential determinants of financing outcomes for new ventures" for semiconductor startups); *see also* Beckerman-Rodau, *supra* note 338, at 199 ("Strong patent rights provide an incentive for enterprises, such as venture capitalists, to provide capital to smaller enterprises . . . ."); Samuel Kortum & Josh Lerner, *Assessing the Contribution of Venture Capital to Innovation*, 31 RAND J. ECON. 674, 674–75 (2000) (finding that "venture capital is associated with a substantial increase in patenting" and suggesting several models to explain this relationship); Celia Lerman, Patent Strategies of Technology Startups: An Empirical Study 26-27 (May 25, 2015) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2610433 (finding in empirical study of startups listed in CruchBase that "patents have a positive effect on funding" from investors and that "the number of patents matters").

343. *See* Golden, *Patent Trolls*, *supra* note 4, at 2117 ("By discouraging innovation, and the ownership of rights in innovation, by independent inventors, universities, technology start-ups, research-oriented spin-offs, and patent holding companies, a categorically discriminatory market for patent rights may slow, rather than promote, progress."); Kieff, *supra* note 340, at 703 ("[T]he treatment of patents as property rights is necessary to facilitate investment in the complex, costly, and risky commercialization activities required to turn nascent inventions into new goods and services."); *see also* Ted Sichelman & Stuart J.H. Graham, *Patenting by Entrepreneurs: An Empirical Study*, 17 MICH. TELECOMM. & TECH. L. REV. 111, 112 (2010) (explaining that "patents provide substantial *ex post* incentives to commercialize inventions").

344. Ellis et al., *supra* note 4, at 459; *see also* Tang, *supra* note 135, at 250 (contending that "[s]ince eBay drastically reduced the threat of permanent injunctions over large corporations' core products or services, these corporations now have even less financial incentive to license from non-practicing patent owners").

345. Ellis et al., *supra* note 4, at 460.

346. *See, e.g.*, Mark A. Lemley, Essay, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1507 (2001) (asserting that "only about 1.5% of patents are litigated at all," but estimating that "the total number of patents litigated or licensed for a royalty (as opposed to a cross-license) is on the order of [5%] of issued patents").

"patent law is technology-neutral in theory, it is technology-specific in application."[347] In particular, Burk and Lemley point to how federal courts apply various doctrines, such as nonobviousness, enablement, written description, and best mode, differently in fields like biotechnology and computer software.[348] Injunctive relief appears to be another doctrine that fits this description. In particular, it appears that industries which depend on strong patent rights to encourage innovation—most notably biotechnology and pharmaceuticals[349]—are the most likely to obtain injunctive relief.[350] Notably, these industries also have extremely high research and development costs, running into the hundreds of millions of dollars in some cases.[351] In contrast, injunctions are granted at lower rates for industries where patent protection is viewed as less vital, such as computer software.[352]

Finally, differences in injunction rates by district open the possibility to forum shopping by litigants who are concerned about their prospects for injunctive relief.[353] For example, although PAEs rarely receive injunctions, three of the four decisions where they were able to do so were from the Eastern District of Texas,[354] which is a favored venue of non-practicing entities.[355] This finding may weigh in favor of adopting venue-limiting

347. Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1156 (2002).

348. *Id.*; *see also* DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 59–62 (2009) (advancing a similar argument).

349. *See* BURK & LEMLEY, *supra* note 348, at 50 (discussing prior empirical work finding "that patents play a major role in supporting innovation in only a few industries, most notably in chemistry and pharmaceuticals"); Graham et al., *supra* note 339, at 1278 (finding that "biotechnology and medical device companies are much more likely to hold patents and applications than are software and Internet firms"); *see also* Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 MGMT. SCI. 173, 175 tbl.1 (1986) (finding in a cross-section survey of firms that 65% percent of pharmaceutical innovations would not have been introduced without patent protection).

350. *See supra* Table 3 (finding pharmaceutical and biotechnology patents received injunctions over 90% of the time).

351. *See* Joseph A. DiMasi et al., *The Price of Innovation: New Estimates of Drug Development Costs*, 22 J. HEALTH ECON. 151, 166–67, 167 fig.2 (2003) (finding that the total cost per FDA approved new drug exceeds $800 million); *see also* JOSEPH A. DIMASI, TUFTS CTR. FOR THE STUDY OF DRUG DEV., INNOVATION IN THE PHARMACEUTICAL INDUSTRY: NEW ESTIMATES OF R&D COSTS (2014), http://csdd.tufts.edu/files/uploads/Tufts_CSDD_briefing_on_RD_cost_study_-_Nov_18,_2014..pdf (finding in updated study that estimated average pre-tax industry costs per new prescription drug approval exceeds $2.5 billion).

352. *See* Graham et al., *supra* note 339, at 1278 (finding that most startup software firms hold no patents).

353. *See supra* Table 2 (describing differential grant rates by district).

354. *See, e.g.*, i4i Ltd. P'ship v. Microsoft Corp., 670 F. Supp. 2d 568, 608 (E.D. Tex. 2009); Final Judgment and Permanent Injunction, Anascape Ltd. v. Nintendo of Am., Inc., No. 9:06-CV-158 (E.D. Tex. July 23, 2008), ECF No. 384; Commonwealth Sci. & Indus. Research Organisation v. Buffalo Tech. Inc., 492 F. Supp. 2d 600, 607–08 (E.D. Tex. 2007).

355. *See supra* note 235.

provisions for patent cases in district courts, as currently proposed in some versions of patent reform legislation.[356]

VI. Conclusion

The Supreme Court decision in *eBay* has ushered in a new era in patent remedies by creating a bifurcated system of property rules and liability rules for different categories of patentees. Little has changed for prevailing patentees who compete in a product market against an infringer, as they still obtain permanent injunctions in the vast majority of cases. In contrast, PAEs are generally subject to a liability rule because they rarely can obtain an injunction at the trial court level. This dichotomy may have a negative impact on certain types of non-practicing entities by effectively eliminating their right to exclude others from practicing the patented technology. Moreover, it appears to conflict with the Court's own conclusion in *eBay* that such a "categorical rule" is inappropriate in determining entitlement to equitable relief.

Appendix A:
List of Injunction Decisions

Plaintiff	**Defendant**	**Court**	**Docket**	**Cite**	**Date**

356. *See* Venue Equity and Non-Uniformity Elimination (VENUE) Act of 2016, S. 2733, 114th Cong. § 2(a) (proposed amendment to 35 U.S.C. § 1400(b)); Amendment in the Nature of a Substitute to H.R. 9, 114th Cong. § 281B(g) (2015) (proposed amendment to 35 U.S.C. § 1400(b)), https://www.congress.gov/bill/114th-congress/house-bill/9/text.

Briese Lichttechnik Verttriebs GmbH	Langton	NYSD	1:09-CV-09890	ECF No. 477	12-18-2013
XpertUniverse, Inc.	Cisco Sys., Inc.	DED	1:09-CV-00157	2013 WL 6118447	11-20-2013
TransPerfect Global, Inc.	MotionPoint Corp.	CAND	4:10-CV-02590	ECF No. 468	11-15-2013
Global Traffic Techs., LLC	Emtrac Sys, Inc.	MND	0:10-CV-04110	2013 WL 5964454	11-08-2013
Bristol-Myers Squibb Co.	Mylan Pharms., Inc.	DED	1:09-CV-00651	ECF Nos. 242, 243	11-05-2013
CardSoft, Inc.	VeriFone Holdings, Inc.	TXED	2:08-CV-00098	2013 WL 5862762	10-30-2013
WBIP, LLC	Kohler Co.	MAD	1:11-CV-10374	ECF No. 257	08-12-2013
Stryker Corp.	Zimmer Inc.	MIWD	1:10-CV-01223	2013 WL 6231533	08-07-2013
Smith & Nephew, Inc.	Interlace Med., Inc.	MAD	1:10-CV-10951	955 F. Supp. 2d 69	06-27-2013
WesternGeco L.L.C.	ION Geophysical Corp.	TXSD	4:09-CV-01827	953 F. Supp. 2d 731	06-19-2013
Halo Elecs., Inc.	Pulse Elecs., Inc.	NVD	2:07-CV-00331	2013 WL 3043668	06-17-2013
Alps South, LLC	The Ohio Willow Wood Co.	FLMD	8:08-CV-01893	ECF No. 418	05-09-2013
Allergan, Inc.	Apotex Inc. et al.	NCMD	1:10-CV-00681	2013 WL 1750757	04-23-2013
Unicom Monitoring, LLC	Cencom, Inc.	NJD	3:06-CV-01166	2013 WL 1704300	04-19-2013
In re Armodafinil Patent Litigation (‘722 Patent Litigation)		DED	1:10-MD-02200	939 F. Supp. 2d 456	03-30-2013
Tyco Healthcare Group LP	Ethicon Endo-Surgery Inc.	CTD	3:10-CV-00060	936 F. Supp. 2d 30	03-28-2013
VirnetX Inc.	Apple Inc.	TXED	6:10-CV-00417	925 F. Supp. 2d 816	02-26-2013
Brocade Commc’ns Sys. Inc.	A10 Networks, Inc.	CAND	5:10-CV-03428	2013 WL 140039	01-10-2013

Apple, Inc.	Samsung Elecs. Co., Ltd.	CAND	5:11-CV-01846	909 F. Supp. 2d 1147	12-17-2012
E2Interactive, Inc.	Blackhawk Network, LLC	WIWD	3:09-CV-00629	ECF No. 536	12-06-2012
Graphic Packaging Intern., Inc.	C.W. Zumbiel Co.	FLMD	3:10-CV-00891	2012 WL 3536983	08-15-2012
Coloplast A/S	Generic Med. Devices, Inc.	WAWD	2:10-CV-00227	2012 WL 3262756	08-09-2012
Carl Zeiss Vision Int'l GmbH	Signet Armorlite, Inc.	CASD	3:07-CV-00894	ECF No. 1561	08-06-2012
Teva Pharms. USA	Sandoz, Inc.	NYSD	1:08-CV-07611	ECF No. 338	07-24-2012
Integrated Tech. Corp.	Rudolph Techs., Inc.	AZD	2:06-CV-02182	ECF No. 546	07-23-2012
Pfizer Inc.	Teva Pharms. U.S.A., Inc.	DED	1:09-CV-00307	882 F. Supp. 2d 643	07-19-2012
Gen. Elec. Co.	Mitsubishi Heavy Indus. Ltd.	TXND	3:10-CV-00276	ECF No. 640	07-09-2012
Valeant Int'l	Watson Pharms., Inc.	FLSD	1:10-CV-20526	ECF No. 198	07-09-2012
Fractus, S.A.	Samsung Elecs. Co.	TXED	6:09-CV-00203	876 F. Supp. 2d 802	06-28-2012
Apple, Inc.	Motorola, Inc.	ILND	1:11-CV-08540	869 F. Supp. 2d 901	06-22-2012
Motorola, Inc.	Apple, Inc.	ILND	1:11-CV-08540	869 F. Supp. 2d 901	06-22-2012
St. Jude Med. Inc.	Access Closure Inc.	ARWD	4:08-CV-04101	ECF No. 359	06-04-2012
Research Found. of State Univ. of NY	Mylan Pharm.	NJD	1:09-CV-00184	2012 WL 1901267	05-25-2012
Schering Corp.	Mylan Pharm.	NJD	2:09-CV-06383	ECF No. 455	05-17-2012
Layne Christensen Co.	Bro-Tech Corp. d/b/a The Purolite Co.	KSD	2:09-CV-02381	871 F. Supp. 2d 1104	05-16-2012
Hospira, Inc.	Sandoz Int'l GmbH	NJD	3:09-CV-04591	2012 WL 1587688	05-04-2012
Meadwestvaco Corp.	Rexam PLC	VAED	1:10-CV-00511	ECF No. 597	04-12-2012

Broadcom Corp.	Emulex Corp.	CACD	8:09-CV-01058	ECF No. 1090	03-16-2012
Medtronic Sofamor Danek USA, Inc.,	Nuvasive, Inc.	CASD	3:08-CV-01512	ECF Nos. 460, 461	01-26-2012
Conceptus, Inc.	Hologic, Inc.	CAND	3:09-CV-02280	2012 WL 44064	01-09-2012
Accentra, Inc.	Staples, Inc.	CACD	2:07-CV-05862	851 F. Supp. 2d 1205	12-19-2011
Eli Lilly and Company	Actavis	NJD	2:07-CV-03770	ECF No. 748	12-06-2011
ActiveVideo Networks, Inc.	Verizon Communications, Inc.	VAED	2:10-CV-00248	827 F. Supp. 2d 641	11-23-2011
Hurricane Shooters, LLC	EMI Yoshi Inc.	FLMD	8:10-CV-00762	ECF No.. 144	11-18-2011
The Paw Wash LLC	Paw Plunger LLC	MOWD	4:08-CV-00113	ECF No. 44	11-15-2011
Sanofi-Aventis Deutschland GmbH	Glenmark Pharms., Inc. USA	NJD	2:07-CV-05855	821 F. Supp. 2d 681	09-30-2011
Versata Software Inc.	SAP Am., Inc.	TXED	2:07-CV-00153	2011 WL 4017944	09-09-2011
Lighting Ballast Control LLC	Philips Elecs. N. Am. Corp.	TXND	7:09-CV-00029	814 F. Supp. 2d 665	08-26-2011
Belden Tech. Inc.	Superior Essex Communications LP	DED	1:08-CV-00063	802 F. Supp. 2d 555	08-12-2011
Peach State Labs, Inc.	Envtl. Mfg. Solutions, LLC	FLMD	6:09-CV-00395	ECF No. 276	08-12-2011
Pozen Inc.	Par Pharma. Inc.	TXED	6:08-CV-00437	800 F. Supp. 2d 789	08-05-2011
Inventio AG	Otis Elevator Co.	NYSD	1:06-CV-05377	2011 WL 3480946	08-04-2011
Midtronics Inc.	Aurora Performance	ILND	1:06-CV-03917	800 F. Supp. 2d 970; ECF No. 196	08-03-2011
Soitec	MEMC Elec. Materials, Inc.	DED	1:08-CV-00292	2011 WL 2748725	07-13-2011
LG Elecs. USA Inc.	Whirlpool Corp.	DED	1:08-CV-00234	798 F. Supp. 2d 541	07-01-2011
Metso Minerals Inc.	Powerscreen Int'l Distrib. Ltd.	NYED	2:06-CV-01446	788 F. Supp. 2d 71	05-26-2011

ePlus, Inc.	Lawson Software, Inc.	VAED	3:09-CV-00620	2011 WL 2119410	05-23-2011
3D Sys., Inc.	Envisiontec, Inc.	MIED	2:05-CV-74891	ECF Nos. 307, 309	04-25-2011
B. Braun Melsungen AG	Terumo Corp.	DED	1:09-CV-00347	778 F. Supp. 2d 506	04-21-2011
WhitServe LLC	Computer Packages, Inc.	CTD	3:06-CV-01935	ECF No. 481	03-30-2011
Douglas Dynamics, LLC	Buyers Prods. Co.	WIWD	3:09-CV-00261	ECF No. 530	02-28-2011
Harris Corp.	Fed. Express Corp.	FLMD	6:07-CV-01819	ECF No. 302; 2011 WL 3627379	02-28-2011
Affinity Labs of Texas LLC	BMW N. Am., LLC	TXED	9:08-CV-00164	ECF No. 551	01-26-2011
K-Tec	Vita-Mix	UTD	2:06-CV-00108	765 F. Supp. 2d 1304	01-26-2011
Ernie Ball Inc.	Earvana	CACD	5:06-CV-00384	2011 WL 201816	01-21-2011
Brigham and Women's Hospital, Inc.	Teva Pharms.	DED	1:08-CV-00464	ECF No. 262	01-07-2011
Bendix Comm. Veh. Sys. Inc.	Haldex Brake Prods. Corp.	OHND	1:09-CV-00176	2011 WL 14372	01-03-2011
Otsuka Pharm.	Sandoz, Inc.	NJD	3:07-CV-01000	2010 WL 4596324	11-15-2010
Robert Bosch, LLC	Pylon Mfg. Co.	DED	1:08-CV-00542	748 F. Supp. 2d 383	11-03-2010
Stone Strong, LLC	Delzotto Prods. of Fla., Inc.	FLMD	5:08-CV-00503	2010 WL 4259371	10-25-2010
Streck, Inc.	Research & Diagnostic Sys., Inc.	NED	8:06-CV-00458	ECF No. 386	09-30-2010
O2 Micro Int'l Ltd.	Beyond Innovation Tech. Co.	TXED	2:04-CV-00032	2010 WL 8753254; ECF No. 424	09-27-2010
Input/Output, Inc. (ION)	Sercel, Inc.	TXED	5:06-CV-00236	2010 WL 3911378	09-16-2010
Marine Polymer Techs., Inc.	HemCon Inc.	NHD	1:06-CV-00100	ECF No. 439	09-16-2010
ReedHycalog UK, Ltd.	Diamond Innovations Inc.	TXED	6:08-CV-00325	2010 WL 3238312	08-12-2010

ClearValue, Inc.	Pearl River Polymers, Inc.	TXED	6:06-CV-00197	735 F. Supp. 2d 560	08-12-2010
Soverain Software LLC	Newegg, Inc.	TXED	6:07-CV-00511	836 F. Supp. 2d 462	08-11-2010
Retractable Techs., Inc.	Occupational & Med. Innovations, Ltd. (OMI)	TXED	6:08-CV-00120	2010 WL 3199624	08-11-2010
Alcon, Inc.	Teva Pharms. USA, Inc.	DED	1:06-CV-00234	2010 WL 3081327	08-05-2010
In re Alfuzosin Hydrochloride Patent Litig.		DED	1:08-MD-01941	ECF No. 176	08-03-2010
Dow Chem. Corp.	Nova Chems. Corp.	DED	1:05-CV-00737	2010 WL 3083023	07-30-2010
Custom Designs of Nashville Inc.	Alsa Corp.	TNMD	3:08-CV-00665	727 F. Supp. 2d 719	07-27-2010
Cordance Corp.	Amazon.com, Inc.	DED	1:06-CV-00491	730 F. Supp. 2d 333	07-22-2010
Woods	Deangelo Marine Exhaust, Inc.	FLSD	9:08-CV-81569	ECF No. 260	06-30-2010
Mitsubushi Chem. Corp.	Barr Laboratories	NYSD	1:07-CV-11614	ECF No. 118	06-30-2010
LaserDynamics Inc.	Quanta Computer, Inc.	TXED	2:06-CV-00348	2010 WL 2574059	06-22-2010
Smith & Nephew Inc.	Arthrex, Inc.	TXED	2:07-CV-00335	2010 WL 2522428	06-18-2010
Richter	Supa Tech.	NVD	2:08-CV-00005	ECF No. 145	05-28-2010
Retractable Techs., Inc.	Becton, Dickinson & Co.	TXED	2:07-CV-00250	2010 WL 9034911	05-19-2010
Tyco Healthcare Group LP et al	Applied Medical Resources Group	TXED	9:09-CV-00176	ECF No. 138	05-17-2010
Parker-Hannifin Corp.	Wix Filtration Corp.	OHND	1:07-CV-01374	ECF No. 236	05-03-2010
Humanscale Corp.	CompX Int'l Inc.	VAED	3:09-CV-00086	2010 WL 1779963	04-29-2010
Johnson & Johnson Vision Care	CIBA Vision Corp.	FLMD	3:05-CV-00135	712 F. Supp. 2d 1285	04-27-2010

Ricoh Co.	Quanta Computer Inc.	WIWD	3:06-CV-00462	2010 WL 1607908	04-19-2010
Presidio Components	Amer. Tech. Ceramics	CASD	3:08-CV-00335	723 F. Supp. 2d 1284	04-13-2010
Judkins	HT Window Fashions Corp.	PAWD	2:07-CV-00251	704 F. Supp. 2d 470	03-31-2010
Eli Lilly & Co.	Sicor Pharms, Inc.	INSD	1:06-CV-00238	705 F. Supp. 2d 971	03-31-2010
Arlington Indus. Inc.	Bridgeport Fittings, Inc.	PAMD	3:01-CV-00485	2010 WL 817519	03-09-2010
Mytee Prods., Inc.	Harris Research, Inc.	CASD	3:06-CV-01854	ECF No. 277	01-20-2010
Emcore Corp.	Optium Corp.	PAWD	2:07-CV-00326	2010 WL 235126	01-15-2010
Innovention Toys, LLC	MGA Entm't, Inc.	LAED	2:07-CV-06510	ECF No. 220	01-13-2010
I-Flow Corp.	Apex Med. Tech., Inc	CASD	3:07-CV-01200	2010 WL 141402	01-08-2010
IGT	Bally Gaming Int'l Inc.	DED	1:06-CV-00282	675 F. Supp. 2d 487	12-22-2009
Creative Internet Advertising Corp.	Yahoo Inc.	TXED	6:07-CV-00354	674 F. Supp. 2d 847	12-09-2009
Japan Cash Machine Co.	MEI, Inc.	NVD	2:05-CV-01433	ECF No. 374	11-03-2009
Cummins-Allison Corp	SBM Co., Ltd.	TXED	9:07-CV-00196	ECF Nos. 219, 221	10-30-2009
Monsanto Co.	Bowman	INSD	2:07-CV-00283	686 F. Supp. 2d 834	09-30-2009
The Western Union Co.	Moneygram International	TXWD	1:07-CV-00372	2009 WL 8660103	09-30-2009
Eli Lilly & Co.	Teva Pharms. USA, Inc.	INSD	1:06-CV-01017	657 F. Supp. 2d 967	09-23-2009
Flexiteek Ams., Inc.	PlasTEAK, Inc.	FLSD	0:08-CV-60996	2009 WL 2957310	09-15-2009
Spectralytics Inc.	Cordis Corp.	MND	0:05-CV-01464	650 F. Supp. 2d 900	09-04-2009
Unigene Labs., Inc.	Apotex Inc. et al.	NYSD	1:06-CV-05571	2009 WL 2762706	08-31-2009

August Tech. Corp.	Camtek Ltd.	MND	0:05-CV-01396	ECF No. 547	08-28-2009
Merck Sharp & Dohme Pharm. SRL	Teva Pharm. USA, Inc.	NJD	3:07-CV-01596	2009 WL 3153316	08-19-2009
Finjan Software Ltd.	Secure Computing Corp.	DED	1:06-CV-00369	2009 WL 2524495	08-17-2009
i4i LP	Microsoft Corp.	TXED	6:07-CV-00113	670 F. Supp. 2d 568	08-11-2009
Daiichi Sankyo Co., Ltd.	Mylan Pharms.	NJD	2:06-CV-03462	ECF No. 143	08-06-2009
Medtronic Sofamor Danek USA, Inc.,	Globus Med., Inc.	PAED	2:06-CV-04248	637 F. Supp. 2d 290	07-17-2009
iLight Techs., Inc.	Fallon Luminous Prods. Corp.	TNMD	2:06-CV-00025	ECF No. 314	07-02-2009
Transamerica Life Ins. Co.	Lincoln Nat'l Life Ins. Co.	IAND	1:06-CV-00110	625 F. Supp. 2d 702	06-08-2009
Haemonetics Corp.	Baxter Healthcare Corp.	MAD	1:05-CV-12572	ECF No. 328	06-01-2009
Hypoxico Inc.	Colorado Altitude Training	NYSD	1:02-CV-06191	630 F. Supp. 2d 319	05-29-2009
Koninklijke Philips Elecs. NV	Power Media CD Tek, Inc.	CACD	2:07-CV-04788	ECF No. 176	05-21-2009
Mass Eng'd Design	Ergotron, Inc.	TXED	2:06-CV-00272	633 F. Supp. 2d 361	04-17-2009
Bard Peripheral Vascular	W.L. Gore & Assocs., Inc.	AZD	2:03-CV-00597	2009 WL 920300	03-31-2009
Kowalski	Mommy Gina Tuna Resources	HID	1:06-CV-00182	2009 WL 856006	03-30-2009
Joyal Prods., Inc.	Johnson Elec. N. Am., Inc.	NJD	3:04-CV-05172	2009 WL 512156	02-27-2009
Hynix Semiconductor, Inc.	Rambus Inc.	CAND	5:00-CV-20905	609 F. Supp. 2d 951	02-23-2009
Global Traffic Techs. LLC	Tomar Elecs., Inc.	MND	0:05-CV-00756	ECF No. 374	01-23-2009
U.S. Philips Corp.	Iwasaki Elec. Co	NYSD	1:03-CV-00172	607 F. Supp. 2d 470	01-13-2009

Ariba Inc.	Emptoris Inc.	TXED	9:07-CV-00090	ECF No. 329	01-07-2009
Telcordia Techs., Inc.	Cisco Sys., Inc.	DED	1:04-CV-00876	592 F. Supp. 2d 727	01-06-2009
Funai Elec. Co., Ltd.	Daewoo Elecs. Corp.	CAND	3:04-CV-01830	593 F. Supp. 2d 1088	01-05-2009
Sensormatic Elec. Corp.	The Tag Co.	FLSD	9:06-CV-81105	632 F. Supp. 2d 1147	12-19-2008
Vertical Doors Inc.	J.T. Bonn Inc.	CACD	8:05-CV-00905	ECF No. 468	12-15-2008
Power Integrations, Inc.	Fairchild Semiconductor Intern.	DED	1:04-CV-01371	2008 WL 5210843	12-12-2008
Smith & Nephew Inc.	Arthrex Inc.	ORD	3:04-CV-00029	629 F. Supp. 2d 1176	12-03-2008
American Calcar Inc.	American Honda Motor Co.	CASD	3:06-CV-02433	ECF No. 548	11-18-2008
Callaway Golf Co.	Acushnet Co.	DED	1:06-CV-00091	585 F. Supp. 2d 600	11-10-2008
Cam Guard Sys., Inc.	Smart Sys. Techs, Inc.	CACD	8:07-CV-01051	ECF No. 226	11-10-2008
Becton Dickinson Co.	Tyco Healthcare	DED	1:02-CV-01694	2008 WL 4745882	10-31-2008
Extreme Networks, Inc.	Enterasys Networks, Inc.	WIWD	3:07-CV-00229	2008 WL 4756498	10-29-2008
Advanced Cardiovascular Sys., Inc.	Medtronic Vascular, Inc.	DED	1:98-CV-00080	579 F. Supp. 2d 554	09-26-2008
Gemtron Corp.	Saint-Gobain Corp.	MIWD	1:04-CV-00387	ECF No. 831	09-23-2008
Pressure Prods. Med. Supplies Inc.	Quan Emerteq Corp.	TXED	9:06-CV-00121	ECF Nos. 247, 248	08-20-2008
TruePosition, Inc.	Andrew Corp.	DED	1:05-CV-00747	568 F. Supp. 2d 500	07-31-2008
Emory Univ.	Nova Biogentics	GAND	1:06-CV-00141	2008 WL 2945476	07-25-2008
Anascape, Ltd.	Nintendo of Am.	TXED	9:06-CV-00158	ECF Nos. 384, 395	07-23-2008
Grantley Patent Holding, Ltd.	Clear Channel Communications, Inc.	TXED	9:06-CV-00259	ECF Nos. 244, 245	06-10-2008

Trading Tech. Int'l	eSpeed	ILND	1:04-CV-05312	2008 WL 4531371	05-22-2008
Kowalski	Ocean Duke Corp.	HID	1:04-CV-00055	ECF No. 270	04-30-2008
Power-One, Inc.	Artesyn Techs., Inc. (Emerson)	TXED	2:05-CV-00463	2008 WL 1746636	04-11-2008
Fresenius USA, Inc.	Baxter Int'l Inc.	CAND	4:03-CV-01431	2008 WL 928496	04-04-2008
Chase Med., L.P.	CHF Techs., Inc.	TXND	3:04-CV-02570	ECF No. 311	04-02-2008
Ecolab, Inc.	FMC Corp.	MND	0:05-CV-00831	ECF No. 529	04-02-2008
Orion IP, LLC	Mercedes-Benz USA	TXED	6:05-CV-00322	2008 WL 8856865	03-28-2008
Avid Identification Sys.	Philips Elecs. N. Am. Corp.	TXED	2:04-CV-00183	2008 WL 819962	03-25-2008
Blackboard Inc.	Desire2Learn Inc.	TXED	9:06-CV-00155	ECF No. 363	03-11-2008
Amgen	F. Hoffman-LaRoche Ltd.	MAD	1:05-CV-12237	ECF No. 1675; 581 F. Supp. 2d 160	02-28-2008
Cygnus Telecommunications Tech., LLC	WorldPort Communications	CAND	5:02-CV-00144	2008 WL 506182	02-22-2008
ResQNet.com, Inc.	Lansa, Inc.	NYSD	1:01-CV-03578	533 F. Supp. 2d 397	02-01-2008
Respironics, Inc.	Invacare Corp.	PAWD	2:04-CV-00336	2008 WL 111983	01-07-2008
Broadcom Corp.	Qualcomm, Inc.	CACD	8:05-CV-00467	ECF No. 996	12-31-2007
DePuy Spine, Inc.	Medtronic Sofamor Danek, Inc.	MAD	1:01-CV-10165	ECF Nos. 581, 585	12-21-2007
Celerity, Inc.	Ultra Clean Holding Inc.	CAND	3:05-CV-04374	ECF No. 551	11-30-2007
Acumed, LLC	Stryker Corp.	ORD	3:04-CV-00513	2007 WL 4180682	11-20-2007
Martek Biosciences Corp.	Nutrinova, Inc.	DED	1:03-CV-00896	520 F. Supp. 2d 537	10-30-2007
Sundance, Inc.	DeMonte Fabricating Ltd.	MIED	2:02-CV-73543	2007 WL 3053662	10-19-2007

Koninklijke Philips Elecs. NV	Int'l Disc Mfrs.	CACD	2:06-CV-02468	ECF No. 302	10-10-2007
Baden Sports, Inc.	Kabushiki Kaisha Molten	WAWD	2:06-CV-00210	2007 WL 2790777	09-25-2007
Telecomm. Sys, Inc.	Mobile 365, Inc.	EDVA	3:06-CV-00485	ECF No. 224	09-04-2007
Allan Block Corp.	E. Dillon & Co.	MND	0:04-CV-03511	509 F. Supp. 2d 795	08-20-2007
Johns Hopkins Univ.	Datascope Corp.	MDD	1:05-CV-00759	513 F. Supp. 2d 578	08-09-2007
Muniauction, Inc.	Thomson Corp.	PAWD	2:01-CV-01003	502 F. Supp. 2d 477	07-31-2007
MercExchange, LLC	eBay, Inc.	VAED	2:01-CV-00736	500 F. Supp. 2d 556	07-27-2007
Diomed, Inc.	Angiodynamics, Inc.	MAD	1:04-CV-10019	ECF No. 287	07-02-2007
Sanofi-Synthelabo	Apotex, Inc.	NYSD	1:02-CV-02255	492 F. Supp. 2d 353	06-19-2007
Commonwealth Sci. & Indus. Res. Org. (CSIRO)	Buffalo Tech. (USA), Inc.	TXED	6:06-CV-00324	492 F. Supp. 2d 600	06-15-2007
Brooktrout, Inc.	Eicon Networks Corp.	TXED	2:03-CV-00059	2007 WL 1730112	06-14-2007
Heuft Systemtechnik GmbH	Indus. Dynamics Co.	CACD	2:05-CV-06299	ECF No. 314	06-08-2007
Lexion Med Inc.	Northgate Techs. Inc.	ILND	1:04-CV-05705	ECF No. 236	05-29-2007
Informatica Corp.	Business Objects Data Integration, Inc.	CAND	3:02-CV-03378	ECF No. 694	05-16-2007
Proveris Scientific Corp.	Innovasystems, Inc.	MAD	1:05-CV-12424	ECF No. 150	05-11-2007
MGM Well Servs., Inc.	Mega Lift Sys., LLC	TXSD	4:05-CV-01634	505 F. Supp. 2d 359	04-25-2007
800 Adept, Inc.	Murex Securities, Ltd.	FLMD	6:02-CV-01354	505 F. Supp. 2d 1327	04-12-2007
Praxair, Inc.	ATMI, Inc.	DED	1:03-CV-01158	479 F. Supp. 2d 440	03-27-2007

O2 Micro Int'l, Ltd.	Beyond Innovation Tech. Co., Ltd.	TXED	2:04-CV-00032	2007 WL 869576	03-21-2007
Ortho-McNeil Pharm., Inc.	Mylan Labs Inc.	NJD	2:04-CV-01689	2007 WL 869545	03-20-2007
Amado	Microsoft Corp.	CACD	8:03-CV-00242	ECF No. 661	03-13-2007
Verizon Servs. Corp.	Vonage Holdings Corp.	VAED	1:06-CV-00682	ECF No. 549	03-08-2007
Atlanta Attachment Co.	Leggett & Platt, Inc.	GAND	1:05-CV-01071	2007 WL 5011980	02-23-2007
Momentus Golf, Inc.	Swingrite Golf Corp.	IASD	4:02-CV-40252	ECF No. 224	02-16-2007
Novozymes A/S	Genencor Int'l, Inc.	DED	1:05-CV-00160	474 F. Supp. 2d 592	02-16-2007
Genlyte Thomas Group LLC	Arch. Lighting Group	MAD	1:05-CV-10945	ECF No. 80	02-05-2007
MPT, Inc.	Marathon Labels, Inc.	OHND	1:04-CV-02357	505 F. Supp. 2d 401	01-19-2007
Exergen Corp.	CVS Corp.	MAD	1:01-CV-11306	ECF No. 256	01-12-2007
Innogenetics, N.V.	Abbott Labs.	WIWD	3:05-CV-00575	578 F. Supp. 2d 1079; 2007 WL 5431017	01-12-2007
IMX, Inc.	LendingTree, Inc.	DED	1:03-CV-01067	469 F. Supp. 2d 203	01-10-2007
Transocean Offshore Deepwater Drilling, Inc.	GlobalSantaFe Corp.	TXSD	4:03-CV-02910	2006 WL 3813778	12-27-2006
Visto Corp.	Seven Networks, Inc.	TXED	2:03-CV-00333	2006 WL 3741891	12-19-2006
Cybersettle, Inc.	Nat'l Arbitration Forum, Inc.	NJD	3:04-CV-04744	ECF No. 73; 2006 WL 3256824	12-18-2006
Black & Decker Inc.	Robert Bosch Tool Corp.	ILND	1:04-CV-07955	2006 WL 3446144	11-20-2006
Color Kinetics, Inc.	Super Vision Int'l, Inc.	MAD	1:02-CV-11137	ECF No. 266	11-08-2006
Omegaflex, Inc.	Parker Hannifin Corp.	MAD	3:02-CV-30022	ECF No. 142	10-19-2006
Janssen Pharm.	Dr. Reddy's Laboratories	NJD	2:03-CV-06185	ECF No. 92	10-13-2006

Rosco, Inc.	Mirror Lite Co.	NYED	1:96-CV-05658	2006 WL 2844400	09-29-2006
Smith & Nephew, Inc.	Synthes (U.S.A.)	TNWD	2:02-CV-02873	466 F. Supp. 2d 978	09-28-2006
3M Innovative Properties Co.	Avery Dennison Corp.	MND	0:01-CV-01781	2006 WL 2735499	09-25-2006
Int'l Rectifier	IXYS Corp.	CACD	2:00-CV-06756	ECF Nos. 689, 690	09-14-2006
Voda	Cordis Corp.	OKWD	5:03-CV-01512	2006 WL 2570614	09-05-2006
Finisar Corp.	DirecTV Group Inc.	TXED	1:05-CV-00264	2006 WL 2037617	09-01-2006
Pods, Inc.	Porta Stor, Inc.	FLMD	8:04-CV-02101	ECF No. 209	08-25-2006
Litecubes, LLC	Northern Light Prods., Inc.	MOED	4:04-CV-00485	2006 WL 5700252	08-25-2006
TiVo	Echostar (Dish Network)	TXED	2:04-CV-00001	446 F. Supp. 2d 664	08-17-2006
Paice LLC	Toyota Motor Corp.	TXED	2:04-CV-00211	2006 WL 2385139	08-16-2006
Brinton	Loggans	TNMD	3:04-CV-00177	ECF Nos. 153, 154, 160	08-06-2006
Wald	Mudhopper Oilfield Servs., Inc.	OKWD	5:04-CV-01693	2006 WL 2128851	07-27-2006
z4	Microsoft Corp.	TXED	6:06-CV-00142	434 F. Supp. 2d 437	06-14-2006