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Pushing Patent Boundaries

An Empirical Assessment of How Patent Trolls and Other Litigants Use Patent Scope

Janet Freilich
Harvard Law School

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PUSHING PATENT BOUNDARIES: AN EMPIRICAL ASSESSMENT OF HOW PATENT TROLLS AND OTHER LITIGANTS USE PATENT SCOPE

Janet Freilich[*]

Patent scope is a fundamental dimension of the patent system. Because scope is so foundational, scholars have worked for decades to build an extensive and well-developed theoretical literature on the topic. There is, however, a glaring absence of empirical work on patent scope. This Article conducts the first empirical assessment of how patent owners enforce the scope of their patents. Specifically, this Article exploits a feature of patent procedure that requires plaintiffs to state whether they are asserting a narrow segment of their patent (dependent claims) or the broadest portions of their patent (independent claims) in litigation. The results are counterintuitive, particularly with respect to non-practicing entities ("NPEs", known colloquially as patent trolls). NPEs are thought to litigate aggressively and indiscriminately – pushing the boundaries of their patents and suing every likely defendant falling even arguably within the scope of the patent. Unexpectedly, I find that NPEs are *less* likely to litigate at the boundaries of their patents than practicing entities. This Article suggests that NPEs are litigating predominantly in the core of their patents because they acquire patents *after* the infringing activity has begun, meaning that they can select a patent that squarely encloses their target. NPEs can do so because they are able to select patents *ex post* to fit their needs, whereas small players with only one patent must predict patent requirements *ex ante*. This Article concludes with cautions that proposals to reduce the harms caused by NPEs may have little effect on the litigation practices of NPEs and may instead disproportionately affect practicing entities and small innovators.

[*] Academic Fellow in Private Law and Intellectual Property, Harvard Law School.

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INTRODUCTION

There are two fundamental dimensions to a patent reward: the length of the patent's term and the breadth of the patent's scope (the intellectual space within the boundaries of the patent).[1] Because scope is such a foundational aspect of the patent system, scholars have worked for decades to build an extensive and well-developed theoretical literature on the topic.[2] There is, however, a glaring absence of empirical work on patent scope.[3] Patent scope is defined by words, and is therefore challenging to gauge and evaluate. Courts have recognized that even for individual patents, "the scope of [a] patent [cannot] be determined in a definite sense…[t]he scope of a patent is not a mathematical measurement."[4] Because there are no units for measuring or discussing patent scope, scope does not lend itself to quantitative or even qualitative assessment.

This Article presents the first empirical strategy for understanding how plaintiffs use the scope of their patents in litigation. Specifically, this Article exploits a feature of patent procedure that obliges plaintiffs to state whether they are asserting a narrow segment of their patent or the broadest portions of their patent (or both) in litigation. I sought to determine whether different types of plaintiffs used portions of their patents differently. The most salient – and surprising – difference is between non-practicing entities ("NPEs", known colloquially as patent trolls) and practicing entities.

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[1] Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1606 (2003)

[2] *See, e.g.*, J. Bessen & E. Maskin, *Sequential Innovation, Patents, and Imitation*, 40 RAND J. ECON. 611 (2009); Vincenzo Denicolo, *Patent Races and Optimal Patent Breadth and Length*, 44 J. INDUSTRIAL ECON. 249 (1996); Nancy Gallini, *Patent Policy and Costly Imitation*, 23 RAND J. ECON. 52 (1992); Richard Gilbert & Carl Shapiro, *Optimal Patent Length and Breadth*, 21 RAND J. ECON. 106 (1990); Ai-Ting Goh & Jacques Olivier, *Optimal Patent Protection in a Two-Sector Economy*, 43 INT'L ECON. REV. 1191 (2002); Jerry R. Green & Suzanne Scotchmer, *One the Division of Profit in Sequential Innovation*, 26 RAND J. ECON 20 (1995); Hugo A. Hopenhayn & Matthew F. Mitchell, *Innovation Variety and Patent Breadth*, 32 RAND J. ECON. 152 (2001); Paul Klemperer, *How Broad Should the Scope of Patent Protection Be?*, 21 RAND J. ECON. 113 (1990); T. O'Donoghue, S. Scotchmer, & J. Thisse, *Patent Breadth, Patent Life, and the Pace of Technological Progress*, 7 J. ECON. & MGMT. STRATEGY 1 (1998); Frank Scherer, *Nordhaus' Theory of Optimal Patent Life: A Geometric Reinterpretation*, 62 AM. ECON. REV. 422 (1972); Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29 (1991); D. Wright, *Optimal Patent Breadth and Length with Costly Imitation*, 17 INT'L J. INDUS. ORG. 419 (1999).

[3] Adam B. Jaffe, *The US Patent System in Transition: Policy Innovation and Innovation Process*, 29 RESEARCH POLICY 531, 548 (2000) ("Overall, there is a noticeable gap between the highly developed theoretical literature on patent scope and the limited empirical literature.").

[4] General Motors Corp. v. Kesling, 164 F.2d 824, 832 (1947).

NPEs may be "the most significant problem facing the patent system today."[5] In their worst form, NPEs hold up innovation by demanding unwarranted rent.[6] NPEs filed upwards of 60% of patent suits in 2012.[7] In 2014, there were over a dozen bills before Congress designed to improve legal and institutional systems to prevent NPE behaviors perceived as harmful.[8] One widespread belief that both underlies negative opinions about NPEs and shapes proposals for patent reform is the understanding that NPEs litigate aggressively, indiscriminately, and perhaps improperly – pushing the boundaries of their patents and suing every likely defendant falling even arguably within those boundaries.[9]

The findings of this Article call this belief into question. If the conventional wisdom is correct, we would expect NPEs to push the boundaries of their patents by asserting the broadest portions of the patents, or at least be indifferent to whether narrow or broad portions of the patents are used. Strikingly, I find that NPEs are *less* likely than practicing entities to rely on the broadest portions of their patents to win litigation, a counterintuitive result facially at odds with the business practices of both NPEs and practicing entities.

What does it mean to litigate in narrow or broad portions of a patent? When a patent is drafted, it begins with a detailed description of the invention. This is then generalized and broadened to encompass variations on the idea in order to protect

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[5] Mark A. Lemley, *Should Patent Infringement Require Proof of Copying?*, 105 MICH. L. REV. 1525, 1542 (2007). *See also*, James Bessen & Michael J. Meurer, *The Direct Cost from NPE Disputes*, 99 CORNELL L. REV. 387, 394 (2014); John M. Golden, *'Patent Trolls' and Patent Remedies*, 85 TEX. L. REV. 2111, 2310 (2007).

[6] Christopher Cotropia, Jay Kesan, & David Schwartz, *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649, 656 (2014).

[7] *Id*.

[8] Innovation Act (H.R. 3309); Patent Quality and Improvements Act (S. 1720), Patent Quality Improvement Act (S. 866); Patent Abuse Reduction Act (S. 1013); Patent Litigation Integrity Act (S. 1612); Transparency in Assertion of Patents Act (S. 2049); Patent Fee Integrity Act (S. 2146); Trade Protection Not Troll Protection Act (H.R. 4763); Demand Letter Transparency Act (H.R. 3540); Innovation Protection Act (H.R. 3309); Patent Litigation and Innovation Act (H.R. 2639); SHIELD Act (H.R. 845); Stopping the Offensive Use of Patents Act (H.R. 2766); End Anonymous Patents Act (H.R. 2024).

[9] *See, e.g.*, GERALD B. HALT, JOHN C. DONCH, ROBERT FESNAK, AMBER STILES, INTELLECTUAL PROPERTY IN CONSUMER ELECTRONICS, SOFTWARE AND TECHNOLOGY STARTUPS 218 (2014) ("a broad patent can be asserted against a wider swath of potential infringers than a patent that is narrow in scope. NPEs specifically look to purchase patents that cover broad ideas or concepts because the pool of potential infringers is larger…The broader the scope of the patent, the easier it is to assert the patent against infringers and prevail."); Timo Fischer & Joachim Henkel, *Patent Trolls on Markets for Technology – An Empirical Analysis of NPEs' Patent Acquisitions*, 41 Research Policy 1519, 1527 (2012) ("the broader the scope of a patent, the larger the number of products and processes that, *ceteris paribus*, will infringe upon it. A broader scope thus entails a larger potential for licensing revenues…which should increase the patent's attractiveness for an NPE.").

the invention against infringement by products that are similar, but not exactly the same. For example, a detailed description of an invention might be an oval-shaped dining room table with four legs. If the patent were restricted to those details, it would be very easy for competitors to design around the patent, for example, by changing the shape of the table. Therefore the patent drafter will generalize the invention, perhaps claiming more broadly a "horizontal surface having at least one vertical leg." The patent drafter has the opportunity to include details of the invention in narrow "dependent claims,"[10] while the generalized, broadest scope of a patent is contained in a broader "independent claim."[11] Dependent claims must always encompass narrower subject matter than the independent claim from which they depend.[12] During litigation, plaintiffs must specify whether they are asserting infringement using independent claims, dependent claims, or both.[13] In the hypothetical above, plaintiffs litigating against a maker of an oval-shaped dining room table with four legs could assert a narrow segment of the patent's scope (a dependent claim), while plaintiffs litigating against, for example, a maker of a rectangular coffee table with six legs would need to assert the whole patent (an independent claim).

If the infringing behavior falls into a dependent claim, it likely incorporates more features and details that the patent drafter had specifically in mind during prosecution. [14] If the infringing behavior falls only into an independent claim, the broadest claim of the patent, it is likely a more generalized version of the invention of the patent. Plaintiffs winning only on independent claims are more likely to be stretching their patents in some way to cover the infringing behavior.

I used the Lex Machina database to collect all cases asserting patents 4,500,000 through 6,000,000, and, for cases where infringement was found, hand-

[10] 35 U.S.C. § 112. ("A claim may be written in independent, or, if the nature of the case admits, in dependent or multiple dependent form.").

[11] *Id*.

[12] *Id*.

[13] *See, e.g.*, N.J. Local Patent Rule 3.1.

[14] The overlap between dependent claims and the "core" of an invention is a matter of debate. *Compare* Jeanne Fromer, *Claiming Intellectual Property*, 76 CHI. L. REV. 720, 740 (2009) ("A dependent claim typically describes a subset of the inventions communicated by the associated independent claim – prototypical instantiations – providing unique insight into the patentee's conception of central examples or characteristics of his invention") *with* Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction*, 157 U. PENN. L. REV. 1780, n. 148 (2009) ("Certainly because dependent claims are usually narrowed claims, perhaps even reading on a single embodiment of the invention, their legal boundaries may tend to coincide more nearly with the physical boundary of a given embodiment of the invention. But under current practice they are clearly peripherally construed.") However, even if not every dependent claim covers the core of an invention, dependent claims are always narrower than independent claims, thus they are useful in distinguishing whether a plaintiff requires the broadest portions of the patent.

coded whether the infringing behavior fell into a dependent claim of the patent-in-suit or only into an independent claim.[15] The final data set contains 433 cases. I additionally collected data on many variables about the cases, patents, and litigants (including whether the plaintiff was an NPE), and sought to determine which variables correlated with the use of independent or dependent claims.

This Article finds that different types of plaintiffs use patent claims of different breadths differently.[16] As previewed, NPEs are, unexpectedly, less likely to need the independent claims of their patent than practicing entities. Instead, they overwhelmingly restrict themselves to litigation that falls within narrower segments of their patents. Thus, for a patent of a given scope, a practicing entity is more likely to litigate close to the boundary than an NPE. This is a surprising result. The business model of many NPEs is to monetize their patents[17] through assertion and litigation, so why are NPEs restricting themselves to only a portion of their patents?

The data do not provide a causal account; however, I conducted a closer analysis of all NPE cases in the sample in order to suggest possible explanations. The most compelling explanation arises from the finding that NPEs frequently acquire their patents *after* the infringing activity has begun, and often right before the NPE brings suit, suggesting that the NPE is acquiring the patent specifically for litigation.[18] Breadth, in patent litigation, comes at a cost: broader patents and broader portions of a patent are more likely to inadvertently cover previously discovered inventions, and consequently to be found invalid at trial.[19] Thus, I argue that NPEs are less likely to use the broadest portions of their patents because

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[15] The sample had to be restricted to cases where infringement was found because the type of claim asserted is not always publicly available unless there has been a judgment of infringement. *See* Section II, *infra*.

[16] Aside from differences between NPEs and practicing entities, I find interesting patterns of claim use for several other major types of litigants. For example, there are differences in claim use for owners of patents covering technologies in different industries. Owners of patents in the pharmaceutical industry are less likely to need the broadest claim of the patent as compared to other industries. This is likely a function of how patenting and infringement proceed in the pharmaceutical industry, where the changes that generic companies can make to get around a brand name patent are constrained by FDA requirements. Size also matters. Litigation using only independent claims is more likely for plaintiffs with a small patent portfolio or for patents belonging to small patent families. *See* Section VI.B, *infra*.

[17] Patent trolls who seek to monetize their patents are more correctly known as "Patent Assertion Entities" (PAEs) or "Patent Monetizers". Colleen Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 328 (2010); Sara Jeruss, Robin Feldman, & Joshua Walker, *The America Invents Act 500: Effects of Patent Monetization Entities on US Litigation*, 11 DUKE L. & TECH. REV. 357 (2013). For further discussion of terminology, see Section V, *infra*.

[18] Or licensing, although this study only relates to litigation.

[19] Michael Risch, *A Generation of Patent Litigation*, 52 SAN DIEGO L. REV. 67, 129 (2015).

NPEs – knowing the infringing behavior before acquiring the patent – select a patent squarely covering the infringement, thereby increasing the likelihood that the NPE will win on both infringement and validity.[20]

While my findings are counterintuitive relative to the conventional wisdom on NPE litigation strategy, they fit with several recent studies that suggest that certain types of NPEs bring valid, high-value lawsuits, as compared to the broader archetype of NPE lawsuits as generally invalid, nuisance suits.[21] This distinction is important because many policy changes seek to tighten the rules of the patent system to eliminate low-quality nuisance suits.[22] If these are not in fact the type of suits that NPEs bring, then these policy changes will have little effect on NPE behavior.

Building on the collected data about the litigation strategy of NPEs and other plaintiffs, this Article presents a new theoretical model of patent use. The foundations of a patent's boundaries are traditionally viewed as being set *ex ante*, before the patent is granted. Infringement then occurs, falling into (or out of) a portion of the patent in a manner beyond the control of the patentee. The behavior noted by this Article flips the traditional model for particular categories of litigants who I posit practice *ex post* patent selection – making the choice of where and whether the infringing behavior falls within the patent after the infringement occurs. This is an important distinction because while the scope of an individual patent might be malleable *ex post*,[23] the potential scope is still constrained by the document written *ex ante*, whereas NPEs who acquire patents *ex post* may have considerably more freedom to select a patent that fits their needs.

The Article proceeds as follows. In Part I, I introduce the concept of patent claims, explain how they segment the breadth of the patent, and discuss litigation strategies relating to use of patent claims. In Part II, I review literature relating to how patent claims of different breadths might be used by different players, and different strategic considerations relating to claim use. In Part III, I set out the methodology and limitations of this study and present the results in Part IV. Part V.A presents new data on NPEs, and seeks to explain why NPEs use patent claims in unexpected ways. Part V.B explores a variety of other characteristics correlating (or not) with use of independent or dependent claims with particular emphasis on how patent claims are used by plaintiffs of different sizes and plaintiffs in different industries. Part VI suggests a new theoretical framework for

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[20] Section II, *infra*.

[21] *See, e.g.*, Jonathan H. Ashtor, Michael J. Mazzeo, and Samantha Zyontz, *Patents at Issue: The Data Behind the Patent Troll Debate*, 21 GEO. MASON L. REV. 957, 960 (2014).

[22] *See* note 17, *supra*.

[23] Jason Rantanen, *The Malleability of Patent Rights* (2015), *available at* http://ssrn.com/abstract=2540356.

how patents are used and explains why the results are consistent with related empirical work.

I. PATENT CLAIMS

A. The Nuts and Bolts of Patent Claims

The boundaries of a patent are defined by the patent's claims.[24] Claims are governed by strict rules set by statute and regulation. One such rule allows two types of claims: independent claims and dependent claims.[25] Independent claims stand alone and do not reference any other claims. Dependent claims must refer back to another claim.[26] Moreover, dependent claims must be narrower in scope than the claim from which they depend. To illustrate, consider the example below of a patent claiming a chair:

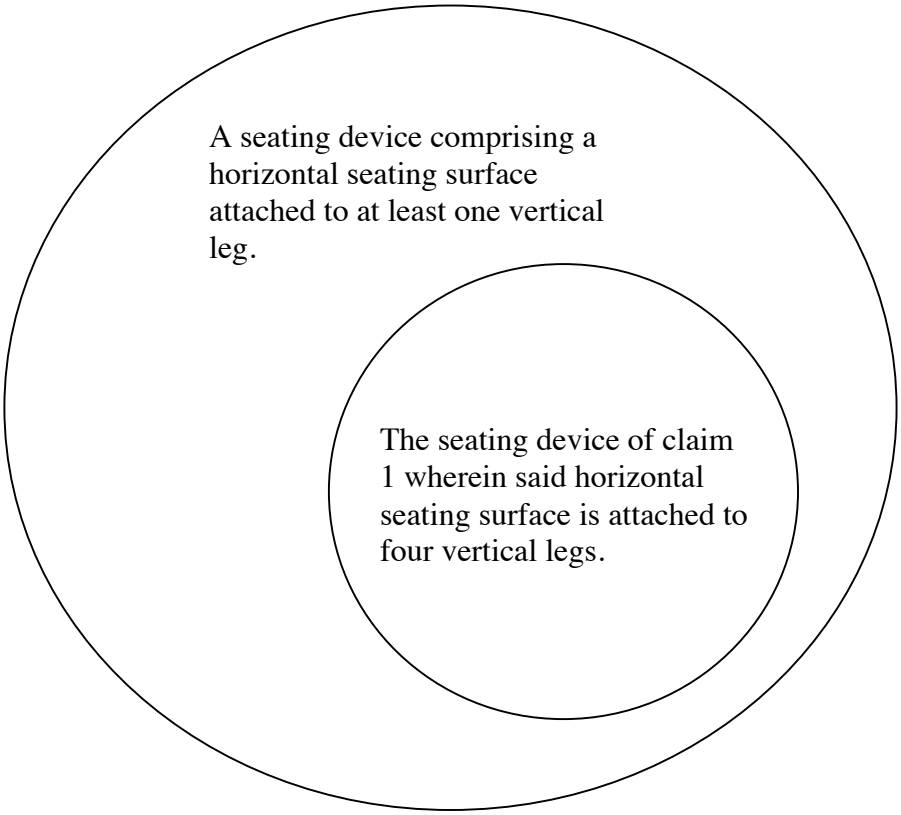
1. A seating device comprising a horizontal seating surface attached to at least one vertical leg.
2. The seating device of claim 1 wherein said horizontal seating surface is attached to four vertical legs.

Represented pictorially, the scope of the two claims is as follows:

[24] *See, e.g.*, London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538 (Fed. Cir. 1991) ("claims…constitute the metes and bounds of the claimed invention."); Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 868 F.2d 1251, 1257 (Fed. Cir. 1989) ("A claim in a patent provides the metes and bounds of the right which the patent confers on the patentee to exclude others from making, using or selling the protected invention.").

[25] 35 U.S.C. § 112(c) ("A claim may be written in independent, or…dependent form.").

[26] 35 U.S.C. § 112(d) ("a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.").



Claim 1 is an independent claim and claim 2, depending from claim 1, is a dependent claim. Claim 2 has a narrower scope than claim 1 because claim 1 covers, for example, bar stools with only one leg, kitchen chairs with four legs, or benches with eight legs. Claim 2, conversely, only covers chairs with four legs.

Dependent claims cover a more detailed (and therefore narrower) version of the invention, while independent claims cover a more generalized (and therefore broader) version of the invention.[27] The details attached to dependent claims reflect particular features important to the inventor or drafting patent attorney. Dependent claims may be very detailed, and cover an "embodiment"[28] of the invention, which is an example of the actual product or method.

[27] *See, e.g.*, RF Delaware Inc. v. Pacific Keystone Tech., Inc., 326 F.3d 1255, 1264 (Fed. Cir. 2003) ("An independent claim usually covers a scope broader than the preferred embodiment, especially if the dependent claim recites the precise scope of the preferred embodiment.").

[28] *E.g.*, Metso Minerals Industries, Inc. v. Johnson Crushers Intern., Inc., 866 F.Supp.2d 1024, 1040 (E.D. Wisc. 2011) ("Essentially, the dependent claim claims the preferred embodiment of the invention…"); Joy MM Delaware, Inc. v. Sandvik Mining and Const. USA LLC, 2007 WL 1653730, *3 (W.D.Pa. June 5, 2007) ("While the dependent claims reflect the inventor's preferred embodiment…the independent claim is not so limited.").

How big is the gap between the scope covered by an independent claim and the scope covered by a dependent claim? It varies vastly, and is not generally quantifiable. However, claims occasionally contain numbers, which provides some insight into this question. One patent in the studied sample, U.S. Patent No. 5,527,814, claims the drug Riluzole, a treatment for amyotrophic lateral sclerosis (ALS). The broadest claim with dosage information covers Riluzole in amounts of at least 25 to 200 mg.[29] A narrower claim covers Riluzole in an amount of 50 mg, which is also the amount in which the product is administered to patients.[30] Other patents have significantly larger gaps between the scope of independent and dependent claims. In one striking example, the broadest claim of U.S. Patent No. 4,767,708 (later found to be invalid) covered a technology that could be used in "thousands, and potentially millions, of unidentified [bacterial] species."[31] The narrowest claim covered only one bacterial species.[32]

Studying use of a patent's independent and dependent claims provides some insight into how patentees use the area of their patents. For any given patent, use of dependent claims means use of an area of the patent closer to a more detailed version of the invention than use of independent claims. Similarly, use of independent claims means use of an area of the patent that is broader and closer to the patent's border than use of dependent claims.

B. Patent Claims and Litigation

When a patent is asserted in litigation, the plaintiff must, prior to trial, specify which claims of the patent are asserted against the defendant.[33] At trial, the judge or jury will assess infringement and invalidity of each claim individually.[34] If an

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[29] Claim 4.

[30] Claim 5. *See* Judgment in a Civil Case (Dkt. No. 230) at 1, Impax Labs. v. Aventis Pharma Inc., 1:02-cv-00581 (D.Del. March 16, 2005).

[31] Carnegie Mellon University v. Hoffman-La Roche, 541 F.3d 1115, 1125 (Fed. Cir. 2008).

[32] Claim 11.

[33] The timing of this assertion varies by jurisdiction. *See, e.g.*, Northern District of California Patent Rule 3-1 (requiring disclosure of asserted claims no later than 10 days after the Initial Case Management Conference); Utah Patent Rule 2.3 (requiring disclosure of asserted claims within 35 days after the defendant's Initial Disclosure). The Federal Circuit permits the use of local rules to set the timing of disclosure of asserted claims as long as the local rules are not inconsistent with or contradictory to a Federal Rule of Civil Procedure. O2 Micro Intern. Ltd. v. Monolithic Power Systems, 467 F.3d 1355, 1365-66 (Fed. Cir. 2006).

[34] 35 U.S.C. § 282(a) ("Each claim of a patent (whether in independent, dependent, or multiple dependent form) shall be presumed valid independently of the validity of other claims; dependent or multiple dependent claims shall be presumed valid even though dependent upon an invalid claim."). *See also* Dayco Prods., Inc. v. Total Containment, Inc., 329 F.3d 1358, 1370-71 (Fed. Cir. 2003) (holding that the lower court's "grouping of claims [to evaluate invalidity] is contrary to law. . . it is permissible to group claims together for disposition [only] where resolution involves the same issues of validity; however, the justification for such grouping is possible only where

independent claim is infringed, the dependent claim is not necessarily infringed.[35] Similarly, if an independent claim is found to be invalid, the dependent claim is not necessarily invalid.[36]

Because the validity and infringement of each claim is assessed separately, the rational plaintiff will always assert the narrowest claim(s) that the plaintiff believes covers the defendant's product.[37] This is because the defendant will almost certainly respond with a counterclaim that the plaintiff's asserted claim(s) is invalid,[38] and narrower claims are less likely to be invalid.[39] While claims granted by the Patent and Trademark Office have a presumption of validity,[40] this presumption can be challenged during litigation. Courts find claims to be invalid in approximately half of cases where validity is at issue,[41] and many (if not most)

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those issues are substantially materially identical. Where claims differ in scope in an aspect material to the analysis, those claims must be addressed individually.").

[35] However, if a dependent claim is infringed, the independent claim is necessarily infringed.

[36] As with infringement, if a dependent claim is invalid for anticipation or obviousness, the independent claim is necessarily invalid.

[37] *See, e.g.*, FABER ON CLAIM DRAFTING § 7.1-7.2 ("wherever possible, it is desirable to assert a narrow claim against an alleged infringer, because such a claim is harder to invalidate either on newly discovered prior art or on formal grounds (too broad, etc.)."); PATENT LITIGATION WORKSHOP: HOW TO WIN IN COURT FOR THE PATENTEE, 241 (1973) ("The tactic is then to select the narrowest claim as to which he has a cinch case of infringement…"); US INTELLECTUAL PROPERTY LAW AND POLICY, 161 (ed. Hugh C. Hansen, 2006) ("As those schooled in the patent law will recognize, U.S. claims drafters typically craft a series of claims in each application, forming a reverse pyramid of successively narrower claims. The first claim of the patent is very broad and abstract…By drafting claims in this manner, the patentee wishes to enforce the narrowest possible claim against an accused infringer: the narrower the claim, the greater the likelihood that such a claim will withstand a defense of invalidity. The greater the number of limitations in a claim, the more unlikely it is that prior art will render that claim anticipated or obvious. Importantly, experienced claim drafters recognize that not all the pertinent prior art may be before them, and that they must speculate as to the sorts of references that may bear upon the claimed invention. Also, the narrower the claim, the greater the difficulty an accused infringer will have in making an attack based upon enablement."). In the context of claim construction, courts recognize "the truism that patentees who seek broad claim constructions to argue for infringement may see their claims invalidated in view of the prior art." Fresenius Medical Care Holdings, Inc. v. Baxter Intern. Inc., No. C03-01431SBA(EDL), 2005 WL 2043047, at *2 (N.D. Cal. Aug. 24, 2005). *See also* Mobil Oil Corp. v. Filtrol Corp., 501 F.2d 282, 284 (9th Cir. 1974) ("It is a "well-known principle of patent law that where claims are close to the prior art, often they cannot be construed broadly enough to be infringed without also being so broad as to be invalid.").

[38] *See* Morton Intern., Inc. v. Cardinal Chemical Co., 967 F.2d 1571, 1573 (Fed. Cir. 1992) *rev'd on other grounds* 508 U.S. 83 (1993) ("It is arguable that a counterclaim for invalidity of asserted claims is even mandatory under Fed.R.Civ.P. 13(a).").

[39] In re Brimonidine Patent Litigation, 643 F.3d 1366, 1371 (Fed. Cir. 2011) ("the narrowest claims…are the least vulnerable to [the Defendant's] validity challenge.").

[40] Doug Lichtman & Mark A. Lemley, *Rethinking Patent Law's Presumption of Validity*, 60 STAN. L. REV. 45, 48 (2007).

[41] John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 205 (1998) (studying a sample of 300 final validity decisions and finding that

unlitigated patents are also thought to be invalid,[42] making a finding of invalidity a significant risk for patent holders.

Thus, to the extent that certain claims in a patent are more likely to be valid, patentees are strongly incentivized to use those claims in litigation.[43] The following example demonstrates why narrower claims are stronger:

1. A pharmaceutical composition comprising between 1 mg and 30 mg of drug X.
2. The pharmaceutical composition of claim 1 comprising about 15 mg of drug X.

A patent claim is invalid if the defendant can present evidence that the invention was known or would have been obvious prior to the effective filing date of the patent.[44] This evidence is called "prior art."[45] In order to invalidate claim 1, a defendant need only find a prior art reference disclosing a dose of the drug between 1 mg and 30 mg.[46] In order to invalidate claim 2, the defendant must find a prior art reference disclosing a dose of close to 15 mg. The latter is likely to be more difficult, therefore it is harder to invalidate a narrower claim. Other requirements of patentability also favor narrow claims and increase the likelihood that broader claims will be invalidated.[47] Case law provides many examples of

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46% found the patent invalid).

[42] *See, e.g.*, Joachim Henkel, *Why Most Patents Are Invalid* (2014), *available at* https://www.law.berkeley.edu/files/Henkel_Joachim.pdf.

[43] Other strategic considerations may also favor the assertion of "stronger" dependent claims, for example, building credibility with the court or increasing the chances of a clear victory that could result in the award of costs or attorney fees.

[44] 35 U.S.C. §§ 102(a), 103. Invalidity can be argued during litigation based on the above conditions for patentability. 35 U.S.C. § 282(b)(2).

[45] Life Technologies Corp. v. Biosearch Technologies, Inc., No. C 12-00852 WHA, 2012 WL 4097740, at *2 (N.D. Cal. Sept. 17, 2012) ("It is a basic principle of patent law, subject to minor exceptions, that prior art is technology already available to the public. It is available, in legal theory at least, when it is described in the world's accessible literature, including patents, or has been publicly known or in…public use or on sale."). *See also* OddzOn Products, Inc. v. Just Toys, Inc., 122 F.3d 1396, 1402 (9th Cir. 1997) ("the real meaning of "prior art" in legal theory…is knowledge that is available, including what would be obvious from it, at a given time, to a person of ordinary skill in the art.").

[46] *See* Atlas Powder Co. v. Ireco Inc., 190 F.3d 1342, 1346 (Fed. Cir. 1999) ("[W]hen a patent claims a chemical composition in terms of ranges of elements, any single prior art reference that falls within each of the ranges anticipates the claim.").

[47] For example, the enablement requirement. 35 U.S.C. § 112 ("The specification shall contain a written description of the invention, and the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same."). *See also*, MagSil Corp. v. Hitachi Global Storage Technologies, Inc., 687 F.3d 1377, 1381 (2012) ("a patentee choose broad claim language at the peril of losing any claim that cannot be enabled across its full scope of

instances where courts have found broad claims to be invalid but narrower claims to be valid.[48]

Because plaintiffs will assert the narrowest claims possible, they will assert dependent claims where feasible.[49] Thus, when the trier of fact finds that a defendant infringes a dependent claim of the plaintiff's patent, it is possible to conclude that the plaintiff is not litigating in the outer portion of his patent because there is some unenforced scope in the broader, independent, claim that is not present in the dependent claim and was not needed by the plaintiff during litigation. By looking at all infringement wins from a given patent, it is possible to assess whether some plaintiffs are litigating using dependent or independent claims of their patent and whether or not some portion of the patent's scope is left unenforced.

II. LITERATURE REVIEW

Although there is no empirical research on when plaintiffs would be expected to push patent boundaries, there is a great deal of theoretical work. The following sections summarize that work for different types of plaintiffs, providing a theoretical basis for the expectations that are tested by the experiments presented in this Article.

A. NPE Theory

NPEs are entities that do not develop or commercialize technology themselves, but instead make money by acquiring patents and asserting them against innovators, possibly in socially detrimental ways.[50] Policy makers are concerned about NPEs because they engage in hold-up behavior by waiting until a product has been developed and put on the market and then suing the product's maker for patent infringement.[51] In the words of President Obama, NPEs "don't actually produce anything themselves. . . . They are essentially trying to leverage and hijack somebody else's idea and see if they can extort some money out of them."[52]

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coverage.").

[48] *See, e.g.*, Martek Biosciences Corp. v. Nutrinova, Inc. 579 F.3d 1363 (Fed. Cir. 2009) (reversing the district court's finding of invalidity as to the narrower dependent claim but not as to the broader independent claim); Alcon Research, Ltd. v. Apotex, Inc., 687 F.3d 1362, 1367 (2012) (finding a broad claim invalid for obviousness while a narrower claim was not invalid).

[49] Note that plaintiffs are likely to also assert independent claims to provide security against unpredictable claim construction rulings or insufficient knowledge about the accused product.

[50] Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP., MEDIA AND ENT. L.J. 611, 613 (2008).

[51] J.P. Mello, *Technology Licensing and Patent Trolls*, 12 B.U. J. SCI. & TECH. L. 388, 391 (2006).

[52] Gene Sperling, *Taking on Patent Trolls to Protect American Innovation*, THE WHITE HOUSE

In the game of patent litigation, NPEs have several advantages over practicing entities. First, NPEs are not susceptible to traditional deterrents to patent litigation. When a practicing entity considers suing a competitor for patent infringement, it must consider whether the competitor has a patent portfolio that it could deploy against the practicing entity's own products.[53] Firms in patent-dense technology areas often amass patent portfolios for just this purpose.[54] Thus, practicing entities fear that suing a competitor for infringement of one patent will lead the competitor to countersue for infringement of another patent.[55] NPEs, because they produce no products of their own, do not fear this type of countersuit.[56]

Second, NPEs can obscure ownership of patents by creating shell companies.[57] It is difficult to find patents through keyword searches;[58] thus, companies planning to commercialize a technology might attempt to avoid patent risks in part by reviewing the patent portfolios of known competitors.[59] The NPE practice of creating new companies to hold patents makes this harder, increasing the likelihood that a company will invest substantial amounts of money commercializing a technology only to face a patent lawsuit brought by an NPE.[60]

Third, NPEs have different motivations for patent litigation. NPEs litigate to monetize, that is, they bring patent infringement lawsuits in order to make money. Practicing entities, by contrast, have more complicated motivations for patent litigation. While some practicing entities may also litigate to monetize their patent portfolio (and this may be an increasingly common practice),[61] others litigate to protect their own business and products. For example, a manufacturer of a brand name pharmaceutical product will sue a generic competitor because, if the generic

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BLOG (June 4, 2013), *available at* http://www.whitehouse.gov/blog/2013/06/04/taking-patent-trolls-protect-american -innovation.

[53] Deborah Platt Majoras, *A Government Perspective on IP and Antitrust Law*, 38 RUTGERS L.J. 493, 498 (2006).

[54] *Id*.

[55] *Id*.

[56] Although they are vulnerable to countersuits claiming that the asserted patent is invalid.

[57] Jason M. Schultz & Brian J. Love, *Brief of Amici Curiae Law, Business, and Economics Scholars in Support of Respondents in Alice Corp. Pty. Ltd., v. CLS Bank International*, 4 NYU J. INTELL. PROP. & ENT. L. 358, 372 (2014).

[58] Janet Freilich, *Are There Too Many Patents To Search*, NEW PRIVATE LAW BLOG (July 2, 2015), *available at* http://blogs.law.harvard.edu/nplblog/2015/07/02/are-there-too-many-patents-to-search-a-response-janet-freilich/.

[59] *Id*.

[60] *Id*. Note that some practicing entities also assign patents to holding companies for purposes of licensing and/or litigation.

[61] Colleen Chien, *From Arms Race to Marketplace: The New Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 322 (2010).

enters the market, the brand name company will lose up to 80% of its market share.[62]

All of these factors add up to a perception that NPEs will push the boundaries of their patents, particularly when contrasted with practicing entities. Practicing entities are expected to draft dependent claims covering their product or process and then litigate primarily against direct competitors with similar products or processes.[63] Thus, one would expect them to litigate predominantly using dependent claims. NPEs, by contrast, are not restricted by any similar considerations – that is, NPEs will litigate against more than merely direct competitors[64] – and should litigate whenever they find a good case. NPEs, being opportunistic with respect to patent litigation, will litigate using broad portions of the patent if that is where infringement occurs.[65]

While much of the rhetoric around NPEs is negative, it should not be assumed that NPEs are necessarily harmful. There is a well-developed literature on the benefits of NPEs, primarily their function in creating a market for patents, which allows small innovators to monetize their patents.[66] In addition, NPEs serve as a form of contingency-fee lawyer by financing patent infringement lawsuits. If a patent owner is "unable or uninterested in filing a lawsuit to recover money," he can "instead sell and assign the patents and related causes of action to" another

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[62] Ernst R. Berndt & Murray L. Aitken, *Brand Loyalty, Generic Entry and Price Competition in Pharmaceuticals in the Quarter Century After the 1984 Waxman-Hatch Legislation*, NBER Working Paper Series 16431, 5 (2014) *available at* http://www.nber.org/papers/w16431.

[63] *See, e.g.*, M. HENRY HEINES, PATENT FOR BUSINESS: THE MANAGER'S GUIDE TO SCOPE, STRATEGY, AND DUE DILIGENCE, 48 (2007) ("Coverage is stronger…when the device or product line also falls within one or more dependent claims…"). The Supreme Court of Canada relied on the logic that dependent claims contain the practicing entity's core product in Teva Canada Ltd. v. Pfizer Canada Inc., 2012 SCC 60 [2012]. Pfizer's patent contained seven "cascading" dependent claims for increasingly narrower ranges of compounds, with the last claim directed specifically to sildenafil, the active ingredient in Viagra. The court criticized Pfizer for failing to disclose the utility of sildenafil specifically (as opposed to the broader range of compounds) in the patent's specification, noting that the presence of sildenafil in the narrowest dependent claim was evidence that "Pfizer had the information needed to disclose the useful compound and chose not to release it." *Id*. at para. 79.

[64] To the extent that this concept has any meaning in the context of NPE patents.

[65] *See, e.g.*, Adam Smith, *Patent Trolls – An Overview of Proposed Legislation and a Solution that Benefits Small Business and Entrepreneurs*, 9 OHIO ST. ENTREPREN. BUS. L.J. 201, 205-206 (2015). ("broad scope allows the holder to sue a larger number of individuals or entities…").

[66] *See, e.g.*, Christopher A. Cotropia, Jay Kesan, & David Schwartz, *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649, 653 (2014); Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457, 459 (2012); Tim Pohlmann & Marieke Opitz, *The Patent Troll Business: An Efficient Model to Enforce IPR?*, 43 R&D MANAGEMENT 103 (2013); Sannu K. Shrestha, *Trolls or Market-Makers? An Empirical Analysis of Nonpracticing Entities*, 10 COLUM. L. REV. 114, 115-16 (2010).

entity, often an NPE.[67] Under this model of NPE behavior, NPEs incentivize innovation by enabling some types of innovators to enforce and profit from their innovation.

Part of the debate about the NPEs is definitional. NPEs are alternately called patent trolls, patent assertion entities ("PAEs"),[68] or patent monetization entities ("PMEs"),[69] each of which covers a somewhat different class of entities. This Article uses the term "NPE" with recognition that it covers a large and sometimes vague set of entities. Unless otherwise specified, I define "NPE" to mean any entity that asserts patents but does not commercialize products. However, the findings of this paper apply to more narrow definitions of NPEs as well, as discussed in more detail in Section IV, *infra*.

Although scholars and policy makers have a variety of views on the definition, impact, and behavior of NPEs, most agree that more high quality empirical studies are needed.[70] NPE policy is too often shaped by anecdotes and pejorative language, much to the chagrin of patent scholars.[71] While empirical studies are

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[67] David L. Schwartz, *The Rise of Contingent Fee Representation in Patent Litigation*, 64 ALA. L. REV. 336, 339 (2012).

[68] 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, 300 (2010).

[69] Sara Jeruss, Robin Feldman, & Joshua Walker, *The America Invents Act 500: Effects of Patent Monetization Entities on US Litigation*, 11 DUKE L. & TECH. REV. 357 (2013).

[70] For example, in 2011, Congress asked the Government Accountability Office to study the impact of NPEs on patent litigation. The results are reported in Jeruss, et. al, *supra* note 69. *See also* David S. Olson, *On NPEs, Holdups, and Underlying Faults in the Patent* System, 99 CORNELL L. REV. 140, 148 (2014) (suggesting many potential empirical projects that would benefit the creation of NPE policy); Erin Mershon, *Obama Backs Patent Reform Efforts in State of the Union*, POLITICO (Jan. 28, 2014), http://www.politico.com/blogs/politico-live/2014/01/obama-backs-patent-reform-effort-in-state-of-the-union-182139.html.

[71] *See, e.g.*, 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, 1571 (2009) ("These stories [of NPEs], routinely invoked by the press, advocates, and academics, shape public understanding of the patent system."). *See also*, John R. Allison, Mark A. Lemley, & Joshua Walker, *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U. PENN. L. REV. 1, 2 (2009) ("Patent reform has become, perhaps improbably, one of the most contentious issues facing Congress and the courts…Advocates on both sides paint seemingly irreconcilable pictures of the patent system, either as a stable system with clearly defined legal rights essential to innovation or a system rampant with litigation abuse by 'patent trolls'…Far too much of this debate is based on anecdote and assumption, not real data."); Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2118 (2013) ("Complaints that trolls are perverting the patent system or interfering with innovation are legion. NPR has run feature stories on the problems with trolls. The New York Times and the Wall Street Journal have run front-page articles about them. The Federal Trade Commission has issued reports recommending action against trolls. Congress passed patent reform legislation that was designed in part to deal with the problem of trolls…"); Michael Risch, *Framing the Patent Troll Debate*, 24 EXPERT OPIN. THER. PATENTS 126, 127 (2014) ("This definitional morass is a symptom of a bigger

increasingly available, they remain insufficient, and we are constantly "remind[ed] of how little we currently know about [issues such as] the selection of [patent] disputes for litigation…"[72]

B. Industry Theory

Patents, patenting strategy, and litigation tactics look different in different industries. This is well recognized in the patent literature.[73] There may, therefore, be differences in whether plaintiffs in different industries win litigation using independent or dependent claims of their patents. Two dynamics in particular may motivate differences in how claims are used, although the directionality of the differences is difficult to predict.

The first dynamic relates to patents in the high-tech space. These patents, particularly patents on software, are thought to be "broad" and often "too broad."[74]

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problem in the patent troll debate: a lack of analytical rigor that leads interested parties to talk past each other.").

[72] John M. Golden, *Litigation in the Middle: The Context of Patent-Infringement Injunctions*, 92 TEX. L. REV. 2076, 2078 (2014).

[73] *See generally* Burk & Lemley, *supra* note 1 (arguing that innovation, patent theory, and the patent system differ across industries); Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific*, 17 BERKELEY TECH. L.J. 1155 (2002) (assessing whether patent law is applied differently across industries). Many studies on specific aspects of patents have also found industry differences. *See, e.g.*, John R. Allison & Mark A. Lemley, *The Growing Complexity of the United States Patent System*, 82 BU L. REV. 77, 114-25 (2002) (comparing prosecution and examination of patents in different industries); G. Dosi, L. Marengo, & C. Pasquali, *How Much Should Society Fuel the Greed of Innovators? On the Relations Between Appropriability, Opportunities, and Rates of Innovation*, 35 RESEARCH POLICY 1110, 1111 (2006) ("the evidence suggests that the patents/innovation relation depends on the very nature of industry-specific knowledge bases, on industry stages in their life-cycles and on the forms of corporate organizations."); John Hagedoorn, *Sharing Intellectual Property Rights – An Exploratory Study of Joint Patenting Amongst Companies*, 12 INDUSTRIAL AND CORPORATE CHANGE 1035, 1042 (2003) (finding that the number of co-owned patents varies by industry); Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?* 58 EMORY L.J. 181, 196 (2008) (comparing patent grant rates in different industries); Arti K. Rai, *Fostering Cumulative Innovation in the Biopharmaceutical Industry: The Role of Patents and Antitrust*, 16 BERKELEY TECH. L.J. 813, 823 (2001); (arguing that "broad patent rights provide the primary mechanism by which an anticompetitive situation might arise" and that this is an "industry-specific reality."); Deepak Somaya & Ian O. Williamson, *Combining Patent Law Expertise with R&D for Patenting Performance*, 18 ORGANIZATION SCIENCE 922, 925 (2007) (exploring industry-specific effects of patent law expertise on firm patenting).

[74] *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology Specific?* 17 BERKELEY TECH. L.J. 1155, 1170 (2002) ("The Federal Circuit's treatment of software validity issues suggests that while the court will find relatively few software patents nonobvious, those that it does approve will be entitled to broad protection. The evidence on software patent claim scope so far is mixed, though there is some evidence tending to support this hypothesis."); Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 CAL. L. REV. 1, 5

The methodology of this Article does not measure the overall breadth of the patent, so the results will not bear on this criticism. However, breadth might impact claim use strategy, and therefore, if high-tech patents are too broad, some difference in claim use might be seen. For example, the type of patent applicant who seeks a very broad patent might later be the type of plaintiff who seeks to enforce it broadly. Alternatively, a very broad patent may be attractive to a buyer who wishes to enforce it broadly. However, the effect could also go the other way. The owner of a very broad patent may not need to use the broadest claims of the patent because the narrower claims of a broad patent cover as much intellectual space as the broadest claims of a narrow patent.

The second dynamic relates to patents in the pharmaceutical space. Patent infringement and litigation in the pharmaceutical space operate under a strict framework set out by statute and FDA regulation, constraining how and whether breadth is used in pharmaceutical patent litigation. It is conventional, in pharmaceutical patenting, for the commercial embodiment to be covered by at least one dependent claim, if the commercial embodiment is known (which, for many pharmaceutical patents, it is).[75] Patent litigation in the pharmaceutical industry is commonly between brand name and generic drug companies. Contrary to popular perception, generic drugs often seek to enter the market before the patents covering their brand name counterparts have expired.[76] In these cases, the generic company has generally made some change as compared to the brand name product, usually in an attempt to avoid infringement of the patent that covers the brand name product. This sparks litigation on the question of infringement.

However, the amount of change the generic company is able to make is minimal. The FDA strictly regulates differences between brand name and generic drugs. In order to be eligible to be a generic drug, the drug must be the "same as"

(2001) (noting a "convergence between the Patent and Trademark Office's [PTO] relatively unconstrained practice of issuing software patents and a strand of the theoretical literature which suggests that the optimal patent scope is broad."); B. KLEMENS, MATH YOU CAN'T USE: PATENTS, COPYRIGHT, AND SOFTWARE 4 (2005) ("in software…most patents cover ideas like the pop-up window, regardless of implementation, so they tend to be too broad."). Arti Rai & James Boyle, *Synthetic Biology: Caught Between Property Rights, the Public Domain, and the Commons*, 5 PLOS BIOLOGY 0389, 0390 (2007) ("many scholars have argued that the Federal Circuit allows unduly broad patents to issue in the area of software.").

[75] *Id*. at 12 (statement by Paul Ginsburg, Assistant General Patent Counsel at Pfizer: "even if one's broad claim would be held invalid, even if perhaps it covers things that are not operative or because it is so broad that it inadvertently reads on the prior art, the remedy for that is to have a whole series of dependent claims. That is why patent applications generally have a number of claims of decreasing scope. A good patent attorney will always [also] put in a claim that covers the commercial embodiment, if it is known, quite specifically.").

[76] Janet M. Freilich, *The Paradox of Legal Equivalents and Scientific Equivalence: Reconciling Patent Law's Doctrine of Equivalents with the FDA's Bioequivalence Requirement*, 66 SMU L. REV. 59, 59 (2013).

the brand name drug,[77] meaning that it is "identical in active ingredient(s), dosage form, strength, route of administration, and conditions of use."[78] Moreover, the generic drug cannot "show a significant difference from the rate and extent of absorption of the [brand name] drug."[79] The only allowable major differences are in inactive ingredients, although the FDA still closely regulates these changes.[80] Thus, differences between infringing products and patents in the pharmaceutical industry are both minor and predictable.[81] Assuming that most pharmaceutical patents can be drafted such that the commercial product is covered by a dependent claim, then most litigation should occur in dependent claims.

C. Portfolio Theory

The value of patents sometimes lies not in ownership of individual patents, but in ownership of a patent portfolio.[82] A decade ago, Gideon Parchomovsky and Polk Wagner pioneered this "portfolio" approach to patent law by proffering portfolio theory as a resolution for the puzzling observation that individual patents are likely worth less than the cost of filing the patent, and yet firms continue to patent on a large scale.[83] They suggest that portfolios operate as a "super-patent," providing the ability to exclude over a broad range. Portfolio scale-effects create more value than would be suggested by merely adding together the value of individual patents.[84]

Portfolio theory relates to how plaintiffs use the broader and narrower claims of their patents because it has the potential to affect players' incentives and ability to use breadth. Ideally, "the breadth of the right to exclude conferred by a patent portfolio is essentially the sum of the individual patent rights"[85] and each patent seamlessly abuts or slightly overlaps with its neighbor to create a broad area of

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[77] Applications for FDA Approval to Market a New Drug, 21 C.F.R. § 314(a)(1).

[78] *Id*.

[79] 21 U.S.C. § 355(j)(8)(B). The FDA has interpreted this requirement to mean the "absence of a significant difference in the rate and extent to which the active ingredient…becomes available at the site of drug action." 21 C.F.R. § 320.1(e).

[80] The FDA allows certain substitutes within stated parameters, and requires the generic drug to be bioequivalent to the brand name drug. CTR. FOR DRUG EVALUATION & RESEARCH GUIDANCE FOR INDUSTRY: SUBMISSION OF SUMMARY BIOEQUIVALENCE DATA FOR ANDAS 3-9 (2011), *available at* www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatorylnformationGuidances/UCM134846.pdf.

[81] *See* Freilich, *supra* note 76, at 78-82.

[82] *See*, Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PENN. L. REV. 1 (2005).

[83] *Id*. at 12.

[84] *Id*. at 7.

[85] *Id*. at 33.

protection[86] (picture the scales on a turtle's shell). The broader aggregate scope of the portfolio increases the chance that the portfolio owner will be able to prove infringement of any one patent in the portfolio.[87] We might, therefore, expect to see some effect from portfolio size, although precisely what effect is less obvious.

One possibility is that firms or individuals with small portfolios seek to obtain broader patents, which would fit with previous observations that small firms obtain an outsized number of patents on important technology.[88] While my experiment does not directly measure patent breadth, it is possible that small firms with broader patents would be able to litigate in narrower internal claims. Alternatively, small portfolios might indicate that the plaintiff is unable to expend significant resources on patenting, and therefore that their patent is narrow or of low quality, necessitating stretching the patent in litigation by using broad claims. A further factor is infringer behavior. Perhaps infringers will be more willing to tread far past the boundaries of a patent if the patentee is small and presumptively less able to enforce the patent. Risk aversion plays a role as well. The owner of a small portfolio may fear losing the patent to a judgment of invalidity, and might therefore avoid litigating close to the border of the patent, where invalidity is more likely. The owner of a large portfolio may not fear the loss of any one patent because he would still retain a large mass of other patents.

Another possibility is that "holders of strong patent portfolios have an inherent advantage over competitors that hold a small number of individual patents," as predicted by prior work.[89] Plaintiffs who have a large patent portfolio might be able to select a "rifle shot" patent to assert against an infringer because they have many patents to select from. Portfolios may provide advantages not only by increasing the effective scope covered by the company's patents, but also by allowing for more targeted litigation strategy.

III. METHODOLOGY

This study measures whether plaintiffs win infringement suits using independent claims or dependent claims. If the plaintiff wins using only an independent claim, it is presumably because she could not win using a narrower claim, and therefore she is litigating at the periphery of the patent. If the plaintiff wins using a dependent claim, he is likely litigating closer to a more detailed version of the patented invention and is also not using the broadest portion of the patent's scope.

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[86] *Id*. at 41.

[87] *Id*. at 34.

[88] *See, e.g.*, CHI RESEARCH, INC., SMALL SERIAL INNOVATORS: THE SMALL FIRM CONTRIBUTION TO TECHNICAL CHANGE 10 (2003).

[89] Parchomovsky & Wagner, *supra* note 82, at 65.

A. Study Sample

My sample for this study is all patents with numbers between 4,500,000 and 6,000,000. I chose the lower limit of the study because the litigation database used does not have data for cases before 2000 and few patents with numbers below 4,500,000 were litigated after 2000. I chose the upper limit of the study because I wanted to obtain data on all litigation in which a patent was involved during its lifetime, and most patents with numbers above 6,000,000 have not yet expired.

To determine whether a patent was litigated, each patent number in the sample range was entered into the Lex Machina database, which is a collection of litigation documents from PACER, with a focus on intellectual property.[90] For patent numbers entered into the database, Lex Machina provides information on, *inter alia*, whether the patent has been asserted in litigation, how many times the patent has been asserted, and the outcome of the litigation.

Using this data, I identified patents that had been asserted in litigation and had a judgment of infringement in their favor. I excluded cases where the judgment of infringement was a consent judgment[91] or a default judgment,[92] because these categories often do not report specific claims that were infringed. I additionally excluded 43 other cases where I was unable to determine which claims had been infringed.[93] 433 cases remained.

To determine which claims were found to be infringed, I reviewed docket entries for each case. Information on which claims where infringed was generally available on the jury verdict form or judge's opinion or findings of fact. In order to be consistent, I recorded only the first finding on infringement for each case.[94]

Once infringed claims had been identified, I reviewed the patent to determine if the infringed claims were independent or dependent.[95] Where only independent claim(s) were infringed, I classified the plaintiff as needing the broadest claims of the patent. Where dependent claims were infringed, I classified the plaintiff as not

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[90] http://law.lexmachina.com

[91] *See, e.g.*, Foster v. Hallco Mfg. Co., Inc., 947 F.2d 469, 474-75 (Fed. Cir. 1991) (explaining the public policy considerations for consent judgments in patent cases).

[92] *See, e.g.*, HF Livermore Corp. v. Aktiengesellschaft Gebruder Loepfe, 432 F.2d 689 (D.D.C. 1970) (discussing default judgments in the context of patent cases).

[93] This occurred, for example, in cases where the defendant admitted infringement of "one or more claims" or where the jury verdict form only asked the jury to indicate whether the defendant had infringed "any of the claims of the patent."

[94] Because more recent cases may still have pending appeals.

[95] This is evident from reading the patent claims because dependent claims indicate that they depend from another claim, by language such as "the [invention] of claim 1, further comprising…"

needing the broadest claims of the patent (even if independent claims were also found to be infringed, as occurred in 86% of cases[96]). For patents that were litigated more than once, I classified the plaintiff as needing the broadest claims of the patent if only independent claim(s) were infringed in any litigation.[97] Note that I was unable to explore how claims were used for asserted patents in cases with no judgment because the plaintiff does not have to specify which claims are asserted in the complaint.[98]

Validity

49 patents in the sample (11%) were at least partially invalidated in one or more cases.[99] Of these patents, 41 were invalidated at the same trial where infringement was found and 8 were invalidated at a later date. Of the 41 patents invalidated at the same trial where infringement was found, the trier of fact invalidated all asserted claims for 34 patents.[100] Of the 8 patents invalidated at a later date, 7 were invalidated in their entirety, and one was partially invalidated.

I did not find any correlation between validity and any of the variables listed in Section II.B, *infra*, including no correlation between validity and the likelihood that a plaintiff was an NPE. However, this may reflect the small number of invalid patents in my sample, rather than lack of relationship.

B. Characterizing Factors Associated With Use of Dependent Claims

I sought to identify differences between plaintiffs who needed independent claims and plaintiffs who won using dependent claims. To do this, I collected data

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[96] Among the other 14% of cases, where dependent claims were found infringed but independent claims were not asserted, pharmaceutical patents and invalid patents were overrepresented as compared to the overall sample (43% versus 20% and 21% versus 11%, respectively), while the percent of NPE plaintiffs was very similar (14% versus 13%).

[97] Note that very few patents were litigated to a judgment of infringement more than once. This is likely because one finding of infringement encouraged settlement of other pending or potential cases.

[98] In re Bill of Lading Transmission, 681 F.3d 1323,1335 (Fed. Cir. 2012) (A patentee does not have to "identify which claims it asserts are being infringed."). Note that the leniency of this pleading standard is widely criticized as opening the door for frivolous lawsuits by patent trolls seeking quick settlement. In 2013, Congress passed a bill that requires identification of asserted claims in the complaint. H.R. 3309.

[99] Thus, most cases resolved favorably for the plaintiff with respect to infringement were also resolved favorably for the plaintiff with respect to validity. This is consistent with previous research. Kimberly Moore noted that resolutions of patent cases tend to be "all or nothing", meaning that all issues are resolved favorably for one party, rather than finding a patent infringed and invalid, or non-infringed and valid. Kimberly A. Moore, *Judges, Juries, and Patent Cases – An Empirical Peek Inside the Black Box*, 99 MICH. L. REV. 365, 378 (2000).

[100] The remaining 7 patents had some claims found infringed but not invalid.

on the following factors for each patent in the study:

Industry. Each patent was classified as one of high-tech, mechanical, chemical, or pharmaceutical.[101] Different industries are known to use patents differently;[102] therefore some industries may be more likely to use certain types of claims.

Status as a practicing or non-practicing entity. Questions about the behavior of NPEs are extremely relevant to a multitude of prominent debates about design of the patent system;[103] therefore I sought to understand how NPEs use patent claims, and whether that differs from practicing entities.

Forward citations. Forward citations are the number of references citing the patent. The number of forward citations received by a patent is widely used as a proxy for patent value.[104] However, forward citations are recognized to be a noisy measure of value with limited predictive usefulness.[105]

Backward citations. Backward citations are the number of references cited by the patent. Some scholars speculate that backward citations are a measure of the patent's validity because, if the examiner reviews a larger number of citations during prosecution, the examiner's decision to grant the patent may be of better quality, and therefore the patent is more likely to be valid,[106] although other research has found that backward citations increase the likelihood of invalidity.[107]

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[101] Industry classifications were adapted from Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could A Patent Term Reduction Decimate Trolls Without Harming Innovators?*, 161 U. PENN. L. REV. 1309, 1344 (2013).

[102] Note 73, *supra*.

[103] Section IV, *infra*.

[104] *E.g.*, Bronwyn H. Hall et al., *Market Value and Patent Citations: A First Look*, 13-20 (Nat'l Bureau of Econ. Research Working Paper No. 7741, 2000); Dietmar Harhoff et al., *Citations Frequency and the Value of Patented Inventions*, 81 REV. ECON. & STAT. 511 (1999); Jean O. Lanjouw & Mark Schankerman, *The Quality of Ideas: Measuring Innovation with Multiple Indicators* (Nat'l Bureau of Econ. Research, Working Paper No. 6297, 1999); Manuel Trajtenberg, *A Penny for your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. ECON. 172 (1990).

[105] David S. Abrams, Ufuk Akcigit, & Jillian Popadak, *Patent Value and Citations: Creative Destruction or Strategic Disruption?* 3 (2014), *available at* http://ssrn.com/abstract=2496598; John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1799 (2014); C. Gay & C. Le Bas, *Uses Without Too Many Abuses of Patent Citations or the Simple Economics of Patent Citations as Measure of Value and Flows of Knowledge*, 14 ECONOMICS OF INNOVATION AND NEW TECHNOLOGY 333, 335 (2005).

[106] John R. Allison, et al., *Valuable Patents*, 92 GEO. L. REV. 436, 448 (2004); Kimberly A. Moore, *Xenophobia in American Courts*, 97 NW. U. L. REV. 1497, 1538 (2003). *But see* Jean O. Lanjouw & Mark Schankerman, *Characteristics of Patent Litigation: A Window on Competition*, 32 RAND J. ECON. 129, 138 (2001)

[107] Michael Risch, *A Generation of Patent Litigation*, 52 SAN DIEGO L. REV. 67, 70 (2015).

Some studies have also found a correlation between the number of backward citations and patent value.[108]

Number of claims. The number of claims in a patent may be positively correlated with the breadth of a patent.[109] However, this correlation "makes little intuitive or logical sense" and there is "no reason to believe that the number of claims in a given patent varies in any consistent way with patent scope."[110] The number of claims may also correlate with patent value, because filing more claims is more expensive.[111] For purposes of this study, number of claims may affect whether independent or dependent claims are asserted during litigation. If a patent contains only a small number of claims, the difference in scope between the claims may be large; therefore any infringing inventions that change even small details as compared to the central invention of the patent may require asserting an independent claim. If the patent contains a large number of claims, the scope gradations may be very fine, allowing assertion of a dependent claim even for infringing products relatively different from the core invention of the patent.

Applicant Size. When a patent application is filed, the applicant must represent to the USPTO that it is either a large or small entity.[112] Small entities are individuals, small businesses, or nonprofits.[113] Care must be taken when interpreting this variable because it refers to the size of the patentee, who may not be the plaintiff enforcing the patent.[114]

Patent Priority Date. This metric was collected to determine if patterns of claim use are different for older patents. The patent priority date is the earliest filing date of the patent.

Breadth (IPC classes).[115] The International Patent Classification (IPC) is a set of categories into which patents are assigned based on the patent's relevant technology area.[116] Patents spanning a greater number of IPCs are more valuable,

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[108] John R. Allison & Emerson H. Tiller, *The Business Method Patent Myth*, 18 BERKELEY TECH. L.J. 987, 1037 (2003).

[109] Jean O. Lanjouw & Mark Shankerman, The Quality of Ideas: Measuring Innovation with Multiple Indicators (Nat'l Bureau Econ. Research, Working Paper No. 7345, 1999).

[110] Kimberly A. Moore, *Xenophobia in American Courts*, 97 NW. U.L. REV. 1497, 1544 (2003).

[111] *Id*.

[112] Small entities are eligible for discounted filing fees. 35 U.S.C. § 41(h)(1) (reducing fees for small entities by 50%).

[113] 37 C.F.R. § 1.27.

[114] Patent owners frequently sell patents to other entities.

[115] Joshua Lerner, *The Importance of Patent Scope: An Empirical Analysis*, 25 RAND J. ECON. 319, 321 (1994).

[116] International Patent Classification Guide.

which raises the possibility that the patent is broader.[117] However, there are many criticisms of this measure, and it does not logically follow that patents spanning two IPCs must be broader than a patent with only one IPC.[118]

Jury Trial or Bench Trial. A case was classified as a jury trial if a jury demand was made, even if the finding of infringement was made on summary judgment. This is because, as long as the parties expected the case to eventually go to a jury, they will take into account strategic considerations for trying the case in front of a jury.

Case Filing Date. The date on which the case was first filed, as assigned by PACER. This variable was included to determine if claim use changed over the studied period.

Number of Times Asserted. This variable counts how many times each patent has been asserted in litigation. Because the most litigated patents have different characteristics from the least litigated patents,[119] I sought to determine if claim use behavior was also a characteristic that varied between the most and least litigated patents.

Plaintiffs with Patent Portfolio Greater than 10. I determined how many patents were owned by a plaintiff by entering the plaintiff's name in the "assignee" portion of the USPTO's search database.[120] Note that this measure will not capture portfolios spread across multiple companies. This bias is particularly important for NPEs, who are notorious for scattering their patents among numerous shell companies.[121]

I was less interested in variations in patent portfolios at the extremes – for example, between portfolios of 5,000 or 10,000, therefore I collected this data as a binary variable with patent portfolios above 10 classified as "large" and patent portfolios equal to or smaller than 10 classified as "small." The choice of 10 is somewhat arbitrary - I experimented with shifting the "large" bucket to 5, 50, and 100, and the directionality and significance of the result did not change.[122]

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http://www.wipo.int/export/sites/www/classifications/ipc/en/guide/guide_ipc.pdf.

[117] Lerner, *supra* note 115, at 321.

[118] Dietmar Harhoff, Frederic M. Scherer, Katrin Vopel, *Citations, Family Size, Opposition and the Value of Patent Rights*, 1596 RES. POL'Y 1, 25-26 (2002).

[119] John R. Allison, Mark A. Lemley, & Joshua H. Walker, *Extreme Value or Trolls on Top? The Characteristics of the Most Litigated Patents*, 158 U. PENN. L. REV. 1 (2009).

[120] The USPTO's assignment database is widely recognized to be only roughly accurate.

[121] *See, e.g.*, Ryan Hauer, *Legislative Update: Another Attempt at Patent Reform*, 24 DEPAUL J. ART TECH. & INTELL. PROP. L. 367, 388 (2014) ("the largest NPEs may own over a thousand shell companies…").

[122] A point at which increasing portfolio size leads to diminishing returns has been predicted

Patent Family Size. Data on patent family size was obtained through the Derwent database. Derwent classifies patents as belonging to one family if they are related through priority claims.[123] Plaintiffs selecting from a large patent family might be able to better select a rifle shot patent claim to assert. Alternatively, a large family size indicates that the patentee spent considerable resources on protecting the technology, and may therefore be an indication of the *ex ante* importance of the technology to the patentee.

C. Limitations

Empirical studies of litigation data must always be conscious of the many selection effects that shape the studied sample.[124] One particular concern is that cases that are litigated, and in particular cases that are litigated to a final judgment, are not a representative sample of all disputes. Only 1 percent of issued patents are ever litigated.[125] Of these, even fewer reach final judgment and are found to be infringed.[126] The skew of this small sample is of longstanding concern to studies of litigation across areas of law.[127] Moreover, not all asserted claims reach final judgment. It is a common practice among litigators to assert a wide range of

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by the literature. *See, e.g.*, Parchomovsky & Wagner, *supra* note 82, at 31 ("there are likely to be diminishing returns from adding patents to a portfolio as its size increases beyond a certain point.").

[123] Thompson Reuters DWPI Classification System, *available at* http://ip-science.thomsonreuters.com/support/patents/dwpiref/reftools/classification/.

[124] *See, e.g.*, Jason Rantanen, *The Federal Circuit's New Obviousness Jurisprudence: An Empirical Study*, 15 STAN. TECH. L. REV. 709, 714 (2013).

[125] Mark A. Lemley, *Reconceiving Patents in the Age of Venture Capital*, 4 J. SMALL & EMERGING BUS. L. 137, 145 (2000) ("There are over 160,000 new patents issued every year. Where do they go? Well, some of them get litigated, but despite the dramatic increase in the numbers of litigation, we're talking there about maybe 1,000 to 2,000 lawsuits a year. We're talking about maybe one percent of all actual patents ever being litigated.").

[126] Note that this is less true in the pharmaceutical industry. Patent litigation in the pharmaceutical industry is governed by the Hatch-Waxman Act, which encourages lawsuits between generic and brand name drug companies. Drug Price Competition and Patent Term Restoration Act, Pub. L. No. 98-417, 98 Stat. 1585 (1984) (amended in 2003 by the Medicare Prescription Drug, Improvement, and Modernization Act, Pub. L. No. 108-173, Stat. 2066, 2448-64. Additionally, settlement of pharmaceutical lawsuits may be an antitrust violation; therefore these cases are less likely to settle. *See* Michael A. Carrier, *A Response to Chief Justice Roberts: Why Antitrust Must Play a Role in the Analysis of Drug Patent Settlements*, 15 MINN. J.L. SCI. & TECH. 31 (2014); David W. Opderbeck, *Rational Antitrust Policy and Reverse Payment Settlements in Hatch-Waxman Patent Litigation*, 98 GEO. L.J. 1303 (2010).

[127] George L. Priest & Benjamin Klein, *The Selection of Disputes for Litigation*, 13 J. LEGAL STUDIES 1, 2 (1984) ("Many legal scholars have expressed concern about the peculiar sample of cases that reach trial and appeal, but none has developed an accepted means to adjust analysis of appellate data in response to the problem.").

claims, and whittle down the number of asserted claims as trial progresses.[128]

Disputes that are litigated and reach trial will be disputes "closer to the decision standard" because there is "more uncertainty as to their outcome."[129] In this sample, disputes that are closer to the decision standard will be disputes where there is uncertainty over whether a patent is infringed. Disputes that settle should be disputes where the defendant's product is either clearly within or clearly outside the scope of the plaintiff's patent. This means that disputes that settle will likely fall either within dependent claims or entirely outside the patent. Note, however, that because patent cases frequently involve multiple issues, disputes that are clear as to infringement may still come before the court because there are disputes about other issues (commonly validity).[130]

A second limitation is that this study looks only at litigation wins – but what of cases that lose? In order to address this limitation, I gathered an additional population of cases that lose. These cases are not analyzed in depth in this Article because the Article focuses on where infringement falls within the scope of a patent, and, for cases where the plaintiffs lose on infringement; infringing behavior does not fall anywhere within the scope of the patent. Within the range of patents studied in this Article, there are 707 cases where the plaintiff loses on the question of patent infringement. It is sometimes possible to obtain information on the claims that are asserted when the plaintiff loses. I was able to obtain this information for 350 of the 707 losing cases. Note, however, that it is difficult to draw conclusions from these cases because there is a strong bias in which cases stated the claims that were asserted, with cases resolved early much less likely to state the claims that were asserted.[131]

One important set of players omitted by looking solely at litigation wins, or

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[128] This can be for a variety of reasons. For example, litigants may use claims as bargaining chips, dropping one claim from the suit in exchange for a concession from the other party. Alternatively, litigants may drop claims as discovery or claim construction progresses to a point where it becomes clear that the party is unlikely to win on that claim.

[129] *Id*. at 16. Disputes that are far from the decision standard are likely to settle or be resolved without litigation. The expected rate of plaintiff wins will vary based on information asymmetry in any given area. *See* Steven Shavell, *Any Frequency of Plaintiff Victory at Trial is Possible*, 25 J. LEGAL. STUD. 493, 500 (1996).

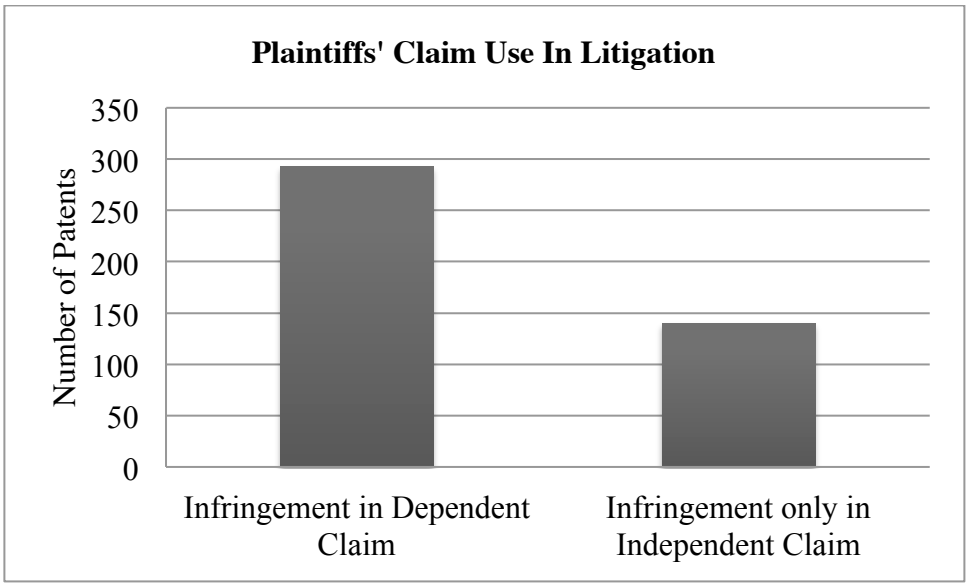
[130] *See, e.g.*, Jason Rantanen, *Why Priest-Klein Cannot Apply to Individual Issues in Patent Cases* (Univ. Iowa Legal Studies Research Paper No. 12-15, 2012), *available at* http://ssrn.com/abstract=2132810 ("the more issues the patentee needs to succeed on, the higher the average probability of success on each needs to be if the Priest-Klein hypothesis about the selection of disputes is correct.").

[131] I was able to find asserted claims for 71% of cases where infringement was decided at trial (41/143 cases) but only 47% of cases where infringement was decided on summary judgment (262/564 cases).

even by looking at all decisions on the merits, is NPEs who file nuisance suits.[132] These NPEs may use patent claims very differently from NPEs who win decisions on the merits. Thus, the conclusions of this Article are limited to those NPEs (and other litigants) who win cases. However, even with this limitation, the conclusions of this Article are important. NPEs who win cases are oftentimes the NPEs who make headlines and hobble businesses.[133]

IV. RESULTS

As shown in Fig. 1, below, *two-thirds of patent owners who litigate a patent to a successful decision on the merits win using at least one narrower dependent claim*. Of the 433 patents evaluated in the study, independent claims were needed to win in 140 cases and not needed in 293 cases (68%). Only a minority of plaintiffs are litigating using the full breadth of their patents.



The overall assertion of dependent and independent claims is strikingly similar for cases where the patent owner loses: of the 350 losing cases where asserted claims were available, only independent claims were asserted in 137 cases, while dependent claims were asserted in 213 cases (61%).

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[132] *See* Section V.A, *supra*.

[133] *See, e.g.*, Ian Austen, *Bye Bye Blackberry?*, NEW YORK TIMES (Dec. 3, 2005), *available at* http://www.nytimes.com/2005/12/03/technology/bye-bye-blackberry.html (describing a case in which NTP, an NPE, sued Research in Motion, the maker of the BlackBerry for patent infringement, ultimately obtaining $612.5 million from Research in Motion).

1. Summary Statistics

Summary statistics are below. For categorical variables, the tables below compare the proportion of cases having the specified characteristic in instances where the plaintiff wins using a dependent claim versus instances where the plaintiff wins using only an independent claim. For continuous variables, the tables below compare the mean value for the specified characteristic for instances where the plaintiff wins using a dependent claim versus instances where the plaintiff wins using only an independent claim. Asterisks beside the variable name indicate the level of statistical significance.

Characteristics of plaintiffs who need independent claims differed significantly ($p<0.05$)[134] along several dimensions:

- NPEs are *less* likely to need independent claims than practicing entities.
- Large entities, plaintiffs asserting patents from large families, and plaintiffs who own more patents are *less* likely to need independent claims than small entities, plaintiffs asserting patents from small families, and plaintiffs who own fewer patents.
- Plaintiffs asserting patents with *more* claims are *less* likely to need independent claims than plaintiffs asserting patents with fewer claims.
- Plaintiffs trying their cases before a jury are *more* likely to need independent claims than plaintiffs trying cases before a judge.
- Plaintiffs enforcing patents in the pharmaceutical industry are *less* likely to need independent claims than plaintiffs enforcing patents in the high-tech, chemical, or mechanical industries.

Other variables do not differ significantly between the two categories. These results are discussed more extensively in Section V, *infra*.

[134] Note that this study looks at the population of decisions during the studied time period, rather a sample. Tests for statistical significance are useful to draw inferences from samples to populations. They are performed here in order to facilitate extrapolation beyond the population, such as to other time periods. However, care must be taken if extrapolating to other time periods, because changes in patenting practices, litigation practices, and legal doctrine may limit the applicability of any such extrapolation.

A. Characteristics of Plaintiff

	Win with only independent claims	Win with dependent claims	*p*-value
Non-practicing Entity* **	7.2%	15.6%	0.006
Industry			
Pharmaceutical* **	7.1%	26.6%	< 0.001
Mechanical	43.6%	34.1%	0.062
Chemical	9.3%	4.1%	0.058
High-Tech	40.0%	35%	0.334
% of Plaintiffs with Patent Portfolio > 10* **	60.0%	77.9%	0.002

N=433 (140 independent; 293 dependent); *p<0.05; **p<0.01; ***p<0.001

B. Characteristics of Case

	Win with only independent claims	Win with dependent claims	*p*-value
% Jury Trial* **	90.0%	72.7%	< 0.001
Case Filing Date (Year)	2004	2004	0.921

N=433 (140 independent; 293 dependent); *p<0.05; **p<0.01; ***p<0.001

C. Characteristics of Patent

	Win with only independent claims	Win with dependent claims	p-value
Number of Claims*	18.7	24.2	0.012
Number of Forward Citations	94.6	105.1	0.488
Priority Date (Years)	1991	1990	0.104
Breadth (Number of IPC Classes)	2.22	2.19	0.835
Back Citations	30.7	39.2	0.197
Prosecution Length (Years)	2.16	2.23	0.587
% Large Entity***	67.1%	82.9%	0.001
Number of Times Asserted	3.78	4.77	0.239
Patent Family Size (Number of Patents)***	8.1	15.8	<0.001

N=433 (140 independent; 293 dependent); *p<0.05; **p<0.01; ***p<0.001

2. Regression

It is conventional to use a multiple logistic ("logit") regression to analyze a binary variable[135] such as whether or not a plaintiff wins using only an independent claim of a patent.[136] The variables in the summary statistics table above, as well as industry, were included in a logit regression to determine their impact on the dependent variable, whether the plaintiff wins using only an independent claim of a patent. The results are displayed in the table below as odds ratios,[137] with standard error in square brackets. As seen below, most of the independent variables do not have a significant relationship with the dependent variable. However, a plaintiff is *more* likely to win using only independent claims if: (1) it is owned by a practicing entity, (2) it is owned by a company that owns few patents, (3) it belongs to a small family, or (4) it is not in the pharmaceutical industry.

[135] A variable that comes in only two states, in this case "dependent claims were used" or "only independent claims were used." I also analyzed the results using OLS and probit regressions, and found that the same factors were significant and that the magnitudes of the effects were similar.

[136] *E.g.*, Christopher Seaman, *Willful Patent Infringement & Enhanced Damages*, 97 IOWA L. REV. 415, 452 (2012); David B. Spence & Paul Murray, *The Law, Economics, and Politics of Federal Preemption Jurisprudence: A Quantitative Analysis*, 87 CALIF. L. REV. 1125, 1179-87 (1999).

[137] Odds ratios are obtained by exponentiating regression coefficients from the logit regression. Damodar Gujarati, *ECONOMETRICS BY EXAMPLE* 180 (2014). Odds ratios greater than 1 indicate an increased association between the independent variable and the plaintiff winning with only an independent claim, while odds ratios less than 1 indicate a decreased association between the independent variable and the plaintiff winning with only an independent claim. *Id*.

Variable	Win with only independent claim (odds ratio)
Non-Practicing Entity	0.352** [0.523]
Number of Claims	0.988 [0.007]
Number of Forward Citations	1.000 [<0.001]
Patent Priority Date (Year)	0.947 [0.040]
Breadth (Number of IPC Classes)	1.205 [0.084]
Jury Trial (Dummy Variable[138])	1.701 [0.389]
Case Filing Date (Year)	1.102 [0.040]
Large Entity (Dummy Variable)	0.623 [0.291]
Number of Backward Citations	1.000 [0.002]
Number of Times Asserted	1.001 [0.012]
Patent Portfolio > 10 (Dummy Variable)	0.535* [0.280]
Patent Family Size	0.974* [0.023]
Industry Variables[139]	
High Tech	1.037 [0.261]
Chemical	1.243 [0.408]
Pharmaceutical	0.290** [0.047]

N=433; *p<0.05; **p<0.01; ***p<0.001; Pseudo R^2 = 0.135

[138] A "dummy variable" is a binary variable (a variable that comes in one of two states, such as whether a trial is a bench trial or a jury trial). Jeffrey Wooldridge, INTRODUCTORY ECONOMETRICS: A MODERN APPROACH 225 (2008).

[139] The mechanical industry was used as the reference sector.

V. DISCUSSION

In Part A, below, I discuss the implications of these results for NPEs. In Part B, I discuss other factors correlating with claim use behavior, with emphasis on industry and size factors. In Part C, I discuss the variables that do not significantly correlate with claim use, and possible implications. Part D looks at other factors such as venue and lead law firm.

A. A New Narrative of Patent Troll Behavior

There is intense debate about non-practicing entities (NPEs, also called patent trolls), often driven by narratives portraying popular views of their behavior.[140] Clarifying the story and providing a deeper understanding of NPE behavior is important because it "allows us to move beyond labels and the search for 'bad actors' and to focus instead on aspects of the patent system itself that give rise to the problems."[141] Moreover, better data on NPEs allows policy solutions tailored to problematic behavior. Thus, there is a push for more detailed and more empirical analyses of NPE behavior.[142]

Anecdotally, NPEs are thought to litigate aggressively and indiscriminately, suggesting that they would choose to push as far towards the boundaries of their patents as possible, or at least that they would be indifferent to which claims are used.[143] This Article tests the anecdotal understanding of NPE litigation behavior by measuring whether NPEs win litigation using dependent or independent claims. The data gathered in this Article call this assumption about NPE behavior into question. NPEs are, surprisingly, *more* likely to win using dependent claims than practicing entities.

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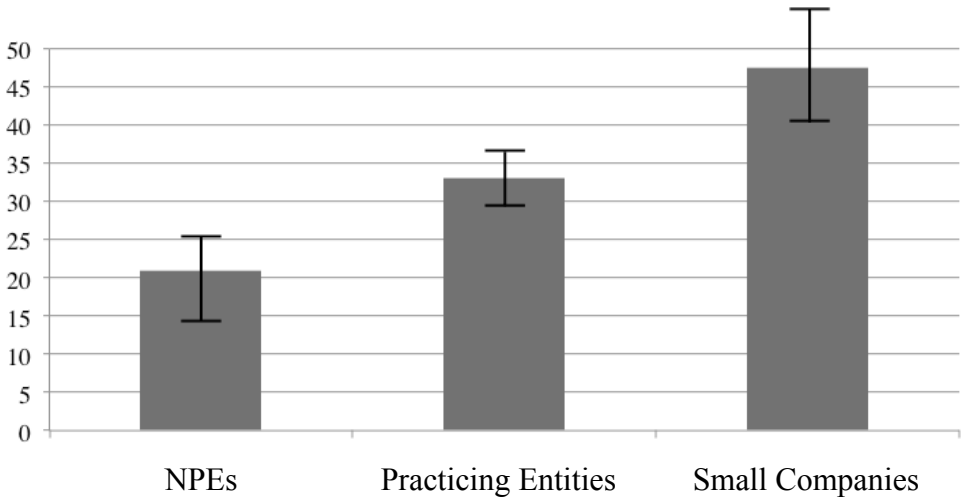
[140] *See* note 71, *supra*.

[141] Lemley & Melamed, *supra* note 71, at 2121.

[142] *See, e.g.*, Michael Risch, *The Layered Patent System*, 101 IOWA L. REV. 1, 4 (2015) (complaining that "Like the proverbial elephant, one commentator feels a leg and identifies a technology problem, another feels an ear and finds a litigant problem, and the third feels a trunk and discovers a patentee problem.").

[143] *See* note 9, *supra*.

% of Plaintiffs Winning Using Independent (Broadest) Claims



The graph above shows that NPEs are less likely than practicing entities – and much less likely than small companies – to need the broadest claims of their patents to win infringement litigation. Small companies, by contrast, are far more likely to need to resort to the broadest portions of their patents to win infringement litigation. All differences are significant at $p<0.05$, and error bars represent 95% confidence intervals.

I note here that, because this data derives from litigation judgments, it does not capture all NPE behavior. In particular, there are (at least) two types of NPEs. First, there are those who seek to "strike it big in court. These trolls think they have a patent that reads on a significant area of technology, and it is very important to them that their patent be held valid and infringed."[144] A second type of troll is the "bottom-feeder," who files large numbers of suits with no expectation of going to trial, and hopes to elicit relatively small settlements with high frequency.[145] Because my sample is restricted to cases with findings of infringement, it deals predominantly with the first category of NPE.

Even with respect to only one category of NPE, the results are counterintuitive. The business model of NPEs is to acquire patents and monetize them, through licensing or litigation, so why would they restrict themselves to litigation in internal, narrower, portions of their patents?

The data in this article does not show causation, thus, a definitive answer must

[144] Lemley & Melamed, *supra* note 71, at 2126.
[145] *Id*.

wait for future research. However, the evidence is consistent with certain compelling explanations. In the following sections, I present several possible explanations and discuss policy implications. These explanations are not meant to be an exclusive or exhaustive description of why NPEs win infringement litigation using dependent claims. Rather, because these data open a new field, the explanations are intended to spark discussion and suggest avenues for further research.

1. Selection by NPEs: Good Litigation Targets

One possible explanation for the data presented in this Article is that NPEs litigate predominantly using dependent claims because they are able to select patents where the infringement falls into dependent claims. As I will discuss further in this section, I see evidence in my sample that NPEs acquire patents *after* the infringing activity has begun, which is consistent with a model wherein NPEs specifically acquire patents that they know are being infringed. If NPEs strategically seek out patents where litigation opportunities exist, it stands to reason that they will acquire patents where the litigation opportunities are good ones: meaning, in many cases, that the infringement will occur within dependent claims. Litigation opportunities involving dependent claims are good from the NPE's perspective because the plaintiff is more likely to win on both infringement and validity if asserting a dependent claim.

NPEs come by their patents in two possible ways: development or acquisition.[146] The former category includes NPEs such as individuals, universities, failed technology companies, and research companies.[147] An example of a research company is Rambus Inc., a company that originated as a manufacturer of data storage chips[148] but now "secures intellectual property rights . . . and then licenses them to manufacturers in exchange for royalty payments."[149] Excluding individuals and universities, approximately half of the NPEs in the sample used in this Article developed their patents.

The other half acquired their patents.[150] This number may be increasing, as

[146] This is true for practicing entities as well, although in my data sample they are less likely to acquire patents other than through mergers or acquisitions of companies owning those patents.

[147] For a full taxonomy of NPEs, *see* Christopher Cotropia, Jay Kesan, & David Schwartz, *Patent Assertion Entities Under a Microscope*, 99 MINN. L. REV. 649, 658 (2014).

[148] Nicole Shanahan, *Deconstructing the Patent Bubble*, 11 (2013), *available at* http://ssrn.com/abstract=2359912.

[149] Rambus Inc. v. FTC, 522 F.3d 456, 459 (D.D.C. 2008).

[150] The proportion of NPEs who acquired their patents in my sample is consistent with other research, and may even be low, as studies on the proportion of NPE patents acquired from individuals and small companies alone find rates close to 50%. *See, e.g.*, Colleen Chien, *A Race to the Bottom*, 51 INTELLECTUAL ASSET MANAGEMENT 10, 12 (2012); Risch, *Patent Troll Myths*, 42

research focusing on more recent patent litigation has found that approximately two-thirds of NPE patents litigated in 2011-2012 were acquired.[151] The sources of acquisition vary: NPEs may purchase directly from the inventor, or from a practicing entity that is not using a patent, or through bankruptcy proceedings. Scholars have suggested that NPEs strategically acquire patents, but have had limited direct evidence of this.[152]

To study the relationship between acquisition and infringement, I sought to obtain data on when a patent was acquired and when the infringing activity began for patents in my sample. Because information on acquisition and infringement is hard to find, the overall numbers in my dataset are small, but the results are nevertheless suggestive. Of the acquired patents asserted in litigation by NPEs, I was able to find acquisition dates for 21.[153] Of these 21, I was able to find infringement dates for 17.[154] Of these 17, 13 patents were acquired by the NPE-plaintiff after the infringing activity began.

A closer analysis of the case files provides evidence that the NPE knew about the infringing activity before it acquired the patent, and that it acquired the patent specifically for litigation. An example of this strategic acquisition and assertion behavior is U.S. Patent No. 5,412,730. The '730 patent relates "to secure communication through the use of pseudo-random encryption keys" to enable the "transmitter and receiver…to generate the same sequence of keys without the security risk of transmitting keys from the transmitter to the receiver or vice-versa."[155] The inventor of the '730 patent was an employee at Telequip Corp., a

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SETON HALL L. REV. 457, 477 (2015).

[151] PatentFreedom, http://www.patentfreedom.com/about-PAEs/background.

[152] *See, e.g.*, Fiona M. Morton & Carl Shapiro, *Strategic Patent Acquisition*, 79 ANTITRUST L. J. 463, 467 (2014) ("PAEs seek to keep abreast of industry knowledge and trends so that they can locate valuable patents and purchase them inexpensively. Indeed, having good information about potential licensees and past licensing deals or settlement terms is critical to the PAE business model…"). *See also* Ted Sichelman, *Are Patent Trolls "Opportunistic"?* (2014) *available at* http://ssrn.com/abstract=2520125.

[153] Acquisition dates were obtained from both litigation filings (often the pleadings) and the USPTO's acquisition database (http://assignment.uspto.gov/). Acquisition dates were not available for all patents, in particular, when the transaction giving rights in the patent to the plaintiff was a license, rather than an assignment, dates are generally not available.

[154] To determine the date when the infringing activity began, I reviewed all case filings. Most often, the information was found in findings of fact or jury instructions. If a jury is instructed to calculate reasonable royalty damages, they must determine what a reasonable royalty would be based on a "hypothetical negotiation" occurring at "the date that the infringement began." LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 75 (Fed. Cir. 2012). Thus, jury instructions often contain the date when the infringing activity began. However, information on when infringement begins is frequently not available. Thus, I was not able to obtain the date when the infringing activity began for all patents.

[155] Memorandum Opinion and Order, Dkt. No. 454 at 2, TQP Development, LLC v. 1-800-

company that manufactures coin dispenser machines.[156] The work leading to the '730 patent caused Telequip to open a 'Secure Coprocessor Division' to commercialize the technology, but Telequip ultimately sold only thirty units of the product.[157] Telequip therefore shut down its Secure Coprocessor Division and sold the Division's assets, including the '730 patent.[158]

The plaintiff in this case, TQP Development, LLC, acquired the patent several years later.[159] The court found that, prior to acquiring the '730 patent, TQP "invested about $1.2 to 1.3 million in analyzing the '730 patent, which ultimately led [TQP] to make the purchase based on a belief that the '730 patent 'was greatly assisting or enabling Internet commerce.'"[160] TPQ was able to use "publicly available SSL and RC4 documentation and screen shots of an internet browser connected to [the Defendant's] website to identify the accused infringing use."[161]

After acquiring the patent, TQP asserted it hundreds of times against prominent targets including Apple, Google, Intel, Dell, Hewlett-Packard, and "practically anyone who encrypts pages of a web site to protect users' privacy."[162] Notably, in the case that was litigated through to final judgment, the infringing behavior began in 2004,[163] while the patent was acquired in 2008 (and the case filed in 2011).[164] TQP appears to have specifically sought out the '730 patent, identified infringing uses, and *then* acquired the patent. Perhaps unsurprisingly, TQP won the case using a dependent claim of the '730 patent.[165]

Another example of strategic acquisition is U.S. Patent No. 5,367,627. The '627 patent "describes a computerized system that assists a salesperson in training and with sales of parts corresponding to particular products. The system includes

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Flowers.com, Inc., 2:11-cv-00248 (E.D. Tex. Nov. 25, 2013)

[156] *Id*.

[157] *Id*.

[158] *Id*. at 3.

[159] *Id*. at 4.

[160] *Id*. citing Trial Tr. Nov. 19, 2013 at 55:10-18.

[161] *Id*. at 5, citing Trial Tr. Nov. 19, 2013 at 130:18-134:1. *See also*, *id*. at 4 ("TQP relied on 'marketing documents and white papers' it obtained from the internet, open source code, and scholarly papers to preliminarily identify alleged infringers.").

[162] Andy Greenberg, *Meet the Texas Lawyers Suing Hundreds of Companies for Using Basic Web Encryption*, FORBES (No. 9, 2012), *available at* http://www.forbes.com/sites/andygreenberg/2012/11/09/meet-the-texas-lawyer-suing-hundreds-of-companies-for-using-basic-web-encryption/.

[163] Proposed Jury Instructions, Dkt. No. 391 at 37, TQP Development, LLC v. 1-800-Flowers.com, Inc., 2:11-cv-00248 (E.D. Tex. Nov. 15, 2013).

[164] Original Complaint for Patent Infringement, Dkt. No. 1 at 1, TQP Development, LLC v. 1-800-Flowers.com, Inc., 2:11-cv-00248 (E.D.Tex. May 6, 2011).

[165] Jury Verdict Form, Dkt. No. 407 at 1, TQP Development, LLC v. 1-800-Flowers.com, Inc.., 2:11-cv-00248 (E.D.Tex. Nov. 25, 2013).

a data storage device that stores graphic and textual information…A display apparatus displays portions of this information…The invention is said to eliminate the need for salespeople to use more cumbersome paper-based methods of determining the most appropriate part for a customer."[166]

The inventor of the '627 patent "worked at a farm equipment dealership and developed a way to compile parts information into sales proposals using a computer." The inventor's company developed a software product that "was an embodiment of the general four-step method" claimed by the patent.[167]

In 2004, Orion IP, an NPE, acquired the patent for approximately $70,000.[168] In SEC filings, the selling company had valued the patent at approximately $35,000.[169] A year after acquiring the patent, Orion IP asserted it against twenty-one major car manufacturers, whom Orion IP alleged used sales software infringing the patent.[170] Twenty companies settled the lawsuit for an undisclosed sum, and the remaining defendant, Hyundai, lost the case and was found liable for $34 million dollars in damages.[171] As with the example above, the infringement began before the NPE acquired the patent, in this case in 1999,[172] 5 years before the patent was acquired and 6 years before suit was brought.[173] Thus, the NPE appears to have strategically identified a patent, and then brought suit against targeted defendants – a suit where enforcement was within the dependent claims of the patent. NPEs who acquire their patents after infringement, are, in a sense, like contingency fee lawyers.[174] The injury (infringement) has already occurred, and the NPE is able to do due diligence to determine whether litigation is worthwhile.

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[166] Orion IP, LLC v. Mercedes-Benz USA, LLC, 516 F.Supp. 2d 720, 723 (E.D. Tex. 2007).

[167] Orion IP, LLC v. Hyundai Motor America, 605 F.3d 967, 971 (Fed. Cir. 2010).

[168] Defendant Hyundai Motor America's Motion for Remittitur, Dkt No. 590 at 7, Orion IP, LLC v. Hyundai Motor America, 6:05-cv-00322 (E.D. Tex. June 15, 2007).

[169] *Id*.

[170] *Id*.

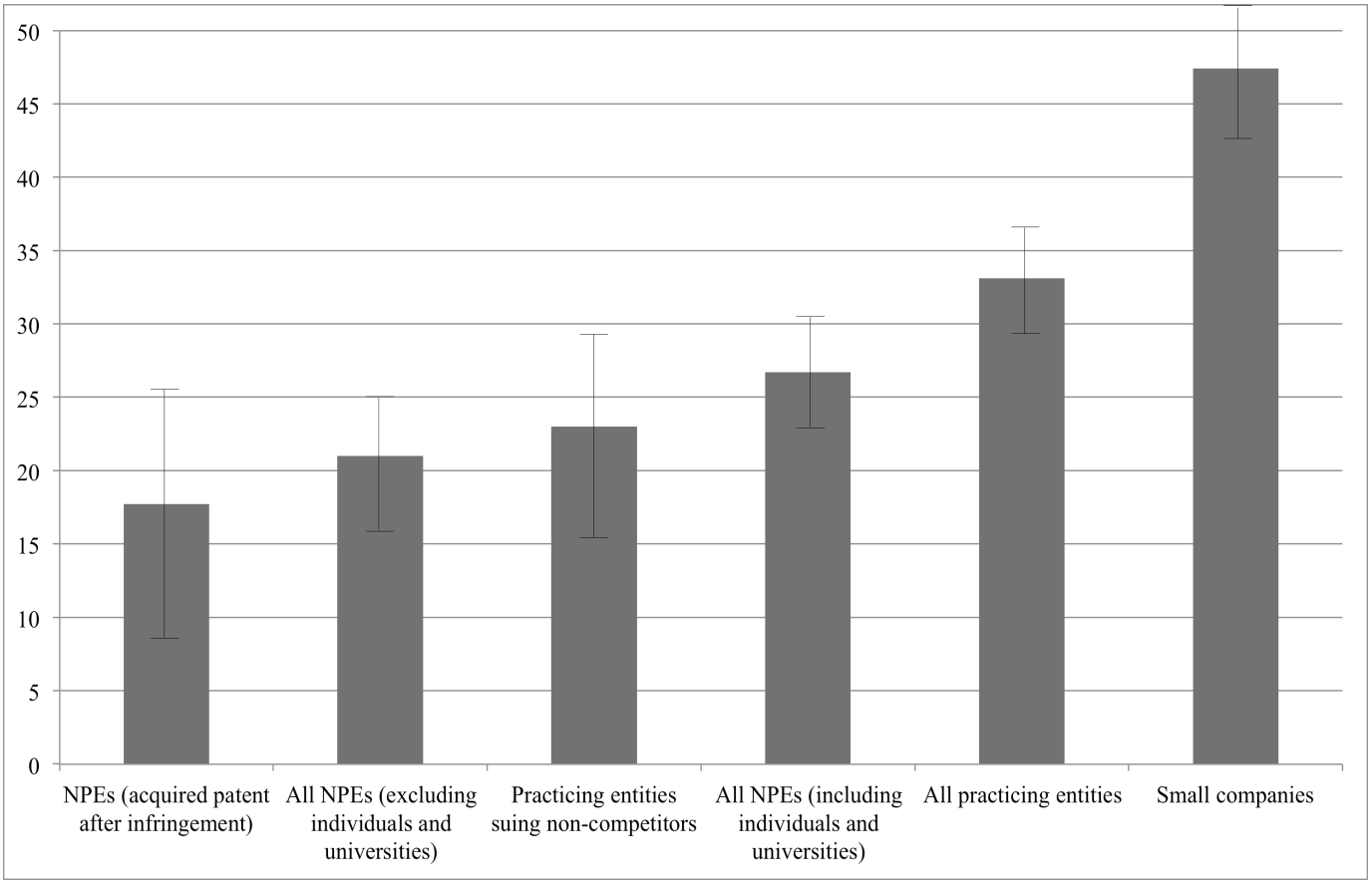
[171] Orion IP, LLC v. Hyundai Motor America, 605 F.3d 967, 972 (Fed. Cir. 2010) (the damages figure does not include pre-judgment interest, post-judgment interest, and an ongoing two-percent royalty on post-verdict sales).

[172] Defendant Hyundai Motor America's Motion for Remittitur, Dkt. No. 590 at 4, Orion IP, LLC v. Hyundai Motor America, 6:05-cv-00322 (E.D. Tex. June 15, 2007).

[173] Original Complaint for Patent Infringement, Dkt. No. 1 at 1, Orion IP, LLC v. Hyundai Motor America, 6:05-cv-00322 (E.D. Tex. Aug. 30, 2005).

[174] This comparison is developed in more detail in David L. Schwartz, *The Rise of Contingent Fee Representation in Patent Litigation*, 64 ALA. L. REV. 335, 380 (2012).

% of Plaintiffs Winning Using Independent (Broadest) Claims



As seen in the graph above, the explanation that NPEs strategically select patents where infringement falls into dependent claims fits with the data on NPE behavior. Categories of NPEs who are generally thought of as "strategic" actors are less likely to need independent claims. Moreover, the likelihood of needing independent claims decreases for NPEs who are best positioned to use patents strategically, with the smallest likelihood being found for NPEs who acquire patents after infringement and therefore have not only a motivation but also a clear opportunity to behave strategically.

Small companies, who may not have the resources to litigate strategically, are the most likely to need to stretch their patents by using independent claims. Practicing entities as a group are also likely to win using independent claims. The broadest definition of NPEs, all entities who do not commercialize products, a definition that includes universities and individuals,[175] is more likely than narrower

[175] If NPEs are companies that are engaged in patent use that is distinct from the manufacture

definitions of NPEs to use broader portions of their patents. This may be because individuals and universities, while technically NPEs under this definition, are less expected and able to behave strategically.

When individuals and universities are excluded from the definition of NPEs, the likelihood that NPEs litigate using the broadest portions of their patents decreases. This pattern suggests that NPEs are using breadth strategically, a conclusion that fits with evidence that NPEs behave strategically in other contexts.[176] Practicing entities that enforce patents against companies outside of their industries, which are considered NPEs under some definitions,[177] are also relatively unlikely to need to stretch their patents and use independent claims.

Because patent enforcement is the business model of NPEs, it stands to reason that NPEs would select strong cases to litigate to judgment.[178] Previous research has found that most NPEs seek strong patents that "can withstand invalidity challenges."[179] NPEs may also be particularly sensitive to the risk that a patent will be found invalid because the patent itself is the entity's product, its revenue source. Losing the patent means complete loss of revenue.

If the use of particular patent claims by NPEs who acquire their patents can be explained by strategic acquisition, what of NPEs who develop their patents? The NPEs in my dataset own a significantly ($p<0.05$) larger number of patents as compared to practicing entities[180] and the patents they enforce in litigation belong

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of products or services covered by a patent, then individual inventors and universities are, technically, NPEs. John R. Allison, et al., *Patent Litigation and the Internet*, 2012 STAN. TECH. L. REV. 3, 35 (2012). However, the socially concerning behavior that characterizes patent holding companies does not always have a parallel in individual inventors and universities, therefore many studies of NPEs exclude indiviuals and universities. *See* Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP., MEDIA & ENT. L.J. 611 (2008). *See also* Holly Forsberg, *Diminishing the Attractiveness of Trolling: The Impacts of Recent Judicial Activity on Non-Practicing Entities*, 12 U. PITT. J. TECH. L. & POL'Y 1, 5 (2011); Jennifer Kahaulelio Gregory, *The Troll Next Door*, 6 J. MARSHALL REV. INTELL. PROP. L. 292 (2007); Marc Morgan, *Stop Looking Under the Bridge for Imaginary Creatures: A Comment Examining Who Really Deserves the Title Patent Troll*, 17 FED. CIR. B.J. 165 (2008); David L. Schwartz and Jay P. Kesan, *Analyzing the Role of Non-Practicing Entities in the Patent System*, Illinois Public Law and Legal Theory Research Paper No. 13-01 (2013) *available at* http://www.reed.edu/economics/parker/f12/354/brown/Schwartz.pdf. Very few plaintiffs in my sample were individuals or universities (16 and 2, respectively).

[176] *Id*. at 311, 323.

[177] Colleen V. Chien, *From Arms Race to Marketplace*, 62 HASTINGS L.J. 297, 322 (2010).

[178] This is distinct from the category of NPEs that sends out vague demand letters based on weak patent claims.

[179] Colleen Chien, *Of Trolls, Davids, Goliaths, and Kings: Narratives and Evidence in the Litigation of High-Tech Patents*, 87 NC L. Rev. 1570, 1580 (2009).

[180] Note that the true number of patents owned by these NPEs is likely even larger than seen in the data because NPEs are notorious for hiding patent ownership in a series of shell companies, and

to significantly ($p<0.05$) larger families. Thus, as I develop further in Section VI.B.1, *infra*, NPEs may be able to select an appropriate patent from a large portfolio. As with patent acquisition, one criterion for this selection may be whether the patent squarely covers the infringing activity.

2. Selection by NPEs: Broad Patents

An alternative explanation for the finding that NPEs win using dependent patent claims is that NPEs select patents but, rather than (or in addition to) selecting patents that squarely cover infringement, NPEs select the broadest patents they can find. This has been suggested by prior literature.[181] If NPEs systematically acquire broader patents than practicing entities, this may be reflected in use of claims in litigation. Specifically, a broad NPE patent may have a dependent claim of the same breadth as the independent claim of a narrower patent owned by a practicing entity, thus, where a practicing entity might resort to an independent claim only, an NPE could use a dependent claim. To illustrate, consider the hypothetical patents diagrammed below:

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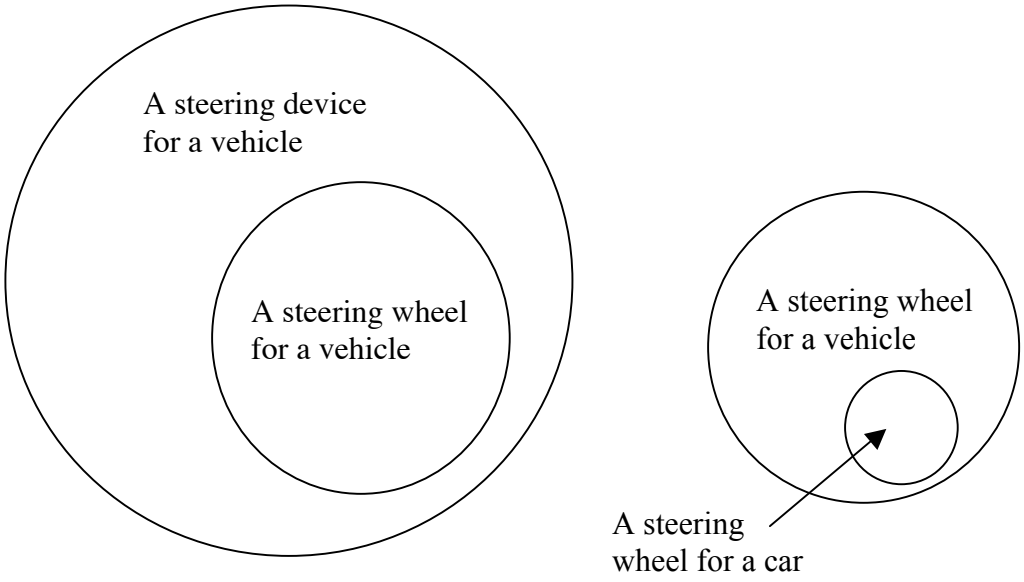
patents owned by shell companies are not counted in this study. For example, Intellectual Ventures owns over 35,000 patents, but distributes them between 1,300 shell companies. Maurits Dolmans & Daniel Ilan, *European Antitrust and Patent Acquisitions: Trolls in the Patent Thickets*, 8 COMPETITION L. INT'L 7, 11 (2012).

[181] Where NPE patents are characterized frequently as "overbroad." *See, e.g.*, Testimony of Q. Todd Dickinson (Dec. 17, 2013), *available at* http://ipwatchdog.com/blog/dickinson-senate-testimony-12-17-2013.pdf) (characterizing NPE strategy as involving "assertion of allegedly invalid or overbroad patents"); Jonathan H. Ashtor, Michael J. Mazzeo, and Samantha Zyontz, 21 Geo. Mason L. Rev. 958, 971 (2014) ("there is considerable evidence of PAEs asserting broad and ambiguous patents" but noting that "case data suggests that these individual examples might not reflect the general rule."); Timo Fischer & Joachim Henkel, *Patent Trolls on Markets for Technology – An Empirical Analysis of NPEs' Patent Acquisitions*, 41 RES. POL'Y 1519, 1520 (2012) ("The probability that a traded patent is acquired by an NPE rather than a practicing entity increases (a) in the scope of the patent…").



Broader Patent **Narrower Patent**

Previous research has reported that NPE patents are indeed systematically different from the patents of practicing entities, and this is supported by my data. For example, studies have found that NPE patents have a greater number of claims,[182] which may indicate that NPE patents are broader.[183] The NPE patents studied for this Article also have more claims as compared to non-NPE patents,[184] and therefore may be broader.[185]

Even if NPE patents have the same breadth as patents owned by practicing entities, other differences could lead to differential use of claims during litigation. For example, NPEs might be acquiring high quality patents with dependent claims that cover useful infringing behavior. Practicing entities might have lower quality patents with dependent claims that are very narrow and cover very little, or very little of use when litigation occurs. Unfortunately, it is difficult to test this hypothesis empirically because we do not have good proxies for patent quality,

[182] Fischer, *supra* note 9, at 14 ("Patent trolls clearly acquire patents that…have more claims."); Jonathan H. Ashtor, Michael J. Mazzeo, & Samantha Zyontz, *Patents at Issue: The Data Behind the Patent Troll Debate*, 21 GEO. MASON L. REV. 957, 958 (2014) ("PAE patents had a *higher* number of claims than patents asserted by other patent holders in the cases studied. On average, PAE patents had 33.39 claims and non-PAE patents had 21.24 claims.").

[183] Although some scholars, including myself, are skeptical that number of claims correlates with breadth. *See* Section III.B, *supra*.

[184] 37 for NPEs as compared to 21 for practicing entities.

[185] Although NPE and PE patents have the same mean number of IPC classes (2.2), which is sometimes used as an indicator of breadth. As with number of claims, some scholars, including myself, are skeptical that number of IPC classes correlates with breadth. *See* Section III.B, *supra*.

particularly when the patents at issue are litigated and valid.[186]

3. Selection by Courts

A third possible explanation for the finding that NPEs win using dependent patent claims is selection not on the part of the NPE, but on the part of the court. It may be that courts are skeptical of NPEs or hostile to NPEs, such that NPEs must present a stronger case than practicing entities to reach final judgment.[187] If this is the case, NPEs may only win if they use dependent claims, because they may only win if they litigate stronger cases that are further from the decision standard.[188] Alternatively, NPEs may perceive themselves as unpopular with courts and as needing stronger cases to win, and therefore seek to settle and avoid judgment on the merits unless they have a strong case.[189] However, this explanation does not entirely square with findings that NPEs have lower litigation costs than practicing entities.[190]

B. Other Factors Correlating with Claim Use

The correlation between the plaintiff's status as an NPE and how patent claims are used was one of the most salient findings of this study. However, there are other interesting correlations (and lack thereof) in the data, which are discussed in this section.

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[186] For example, whether the patent owner pays the patent maintenance fees (which are assessed every few years, and must be paid to keep the patent from being abandoned) is a proxy for patent value, and therefore indirectly for quality, but maintenance fees are paid for all litigated patents. Similarly, the validity of a patent or proxies aimed at obtaining information on the validity of a patent are measures of quality, but most patents in this sample are valid.

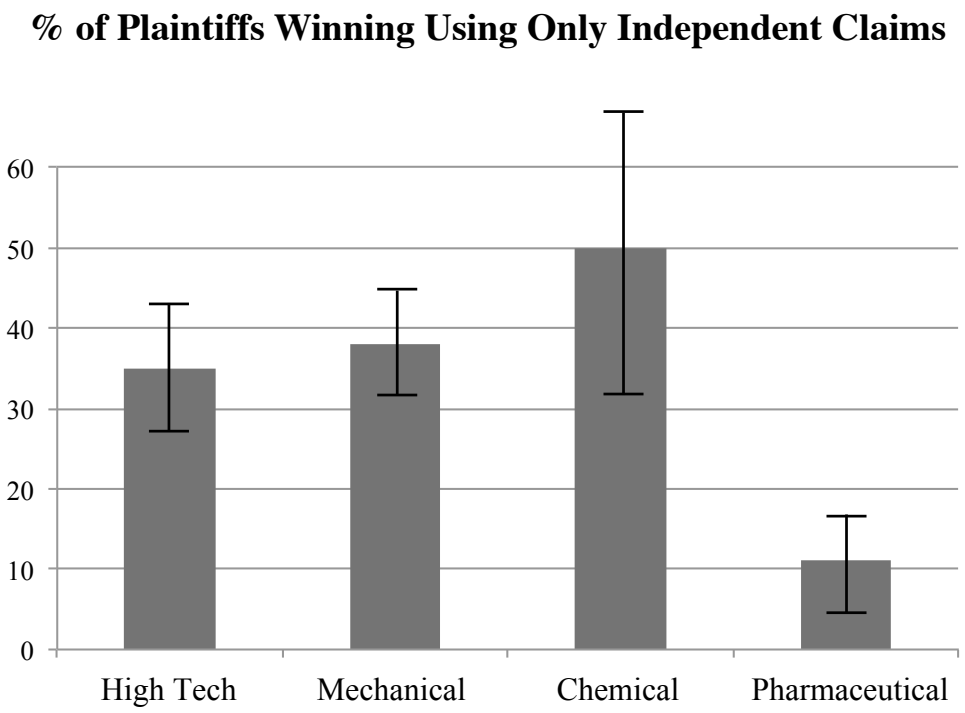
[187] And therefore to be included in the sample studied in this Article.

[188] Dependent claims are likely to be further from the decision standard on both validity and infringement. *See* Section I.B, *supra*.

[189] Although this explanation is not consistent with prior research that has found that NPEs lose on both infringement and validity more often than practicing entities. *See, e.g.*, Michael Risch, *A Generation of Patent Litigation*, 52 SAN DIEGO L. REV. 67, 69 (2015). *But see* Shrestha, *supra* note 66, at 201 (finding that NPEs are more likely to win than practicing entities).

[190] *See* Greg Reilly, *Linking Patent Reform and Civil Litigation Reform*, 47 LOY. U. CHI. L.J. 25 (forthcoming 2015).

1. Industry



Patent claim use differs by industry. Plaintiffs asserting patents covering inventions in the high tech, mechanical and chemical industries are more likely to need independent claims to win than patents in the pharmaceutical industry (the difference is significant at $p<0.01$). The differences in claim use between the high tech, mechanical, and chemical industries are not statistically significant.

Pharmaceutical Patents

Patent owners in the pharmaceutical industry are substantially less likely to require the broadest claim of the patent. This is not surprising. As explained in Section I.B, *supra*, product development in the pharmaceutical industry is closely governed by statute and regulation, and infringement occurs in predictable ways.[191] One consequence of this is that an infringing product is likely to be similar to a product produced by a patent owner.[192] Because patent applicants

[191] Janet M. Freilich, *The Paradox of Legal Equivalents and Scientific Equivalence: Reconciling Patent Law's Doctrine of Equivalents with the FDA's Bioequivalence Requirement*, 66 SMU L. REV. 59, 78-80 (2013).

[192] In the pharmaceutical industry, the patent owner is very unlikely to be an NPE. *See, e.g.*, Stu Hutson, *Pharma 'Patent Trolls' Remain Mostly the Stuff of Myth*, 15 NATURE MEDICINE 1240,

typically draft dependent claims that cover their products,[193] the infringing product is therefore likely to be close to a dependent claim, and the dependent claim can be used in litigation.

Patent litigation in the pharmaceutical industry is commonly between brand name and generic drug companies, and this is the case for approximately 90% of the pharmaceutical cases in this Article. Generic drug manufacturers often seek to enter the market before the patents covering their brand name counterparts have expired,[194] but, due to strict FDA regulations, are only able to make minimal changes as compared to the brand name product.[195] Thus, differences between infringing products and patents in the pharmaceutical industry are both minor and predictable.[196] Additionally, many generic drug manufacturers make products that are identical to the brand name drug, stipulate to infringement, and only contest validity. As a result, dependent claims can be drafted with reasonable confidence that they will be used in future litigation.

High Tech Patents

While owners of high tech patents are more likely to win using only independent claims than owners of pharmaceutical patents, enforcement of high tech patents is not significantly different from use of mechanical patents. This is somewhat surprising, as mechanical patents are typically held out as the archetype around which the patent system was designed, in contrast to which software patents are characterized as "broad" and often "too broad."[197] This Article does not take any position on whether software patents are too broad, but it does suggest that, at least with respect to which type of claims are used, software patents are not dissimilar from mechanical patents.

2. Size

I studied three variables related to size: size of (patent applicant) entity, size of portfolio, and size of patent family. As seen in the summary statistics table, taken alone, each variable is significantly correlated with claim use. The trend is the same for each variable: size is inversely correlated with breadth of claim used.

1240 (2009). However, there is growing concern that NPEs may be increasing in the pharmaceutical industry. *See* Robin Feldman & W. Nicholson Price II, *Patent Trolling – Why Bio & Pharmaceuticals Are at Risk* 2 (2014) available at http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=2395987.

[193] Section I.C., *supra*.

[194] Freilich, *supra* note 191, at 59.

[195] *Id*.

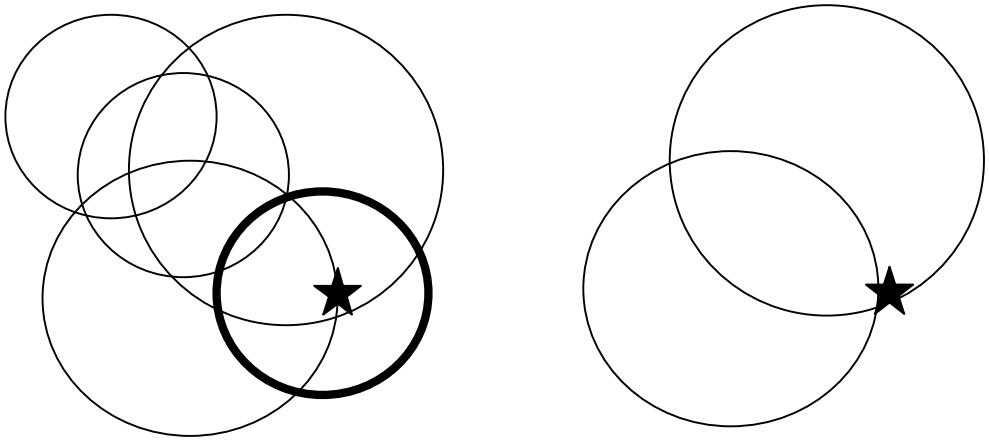
[196] *See* Freilich, *supra* note 191, at 78-82.

[197] *See supra* note 5.

Plaintiffs asserting patents filed by large applicants are less likely to need independent claims to prove infringement than plaintiffs asserting patents filed by small applicants. Plaintiffs with large patent portfolios are less likely to need independent claims than plaintiffs with small patent portfolios. Plaintiffs litigating patents from large families are less likely to need independent claims than plaintiffs litigating patents from small families. In the multivariate regression, entity size ceases to be significant but portfolio and family size continue to be significantly correlated with type of claim use.

Why does size matter? I suggest that, as with NPEs,[198] selection may be a factor. Entities with a large patent portfolio or patents from large families likely have a series of closely related patents covering a broad intellectual space. This might allow them to select a patent squarely covering the infringing behavior, and avoid the need to use solely independent claims, which is more risky.[199] Companies with only a small number of patents, by contrast, are more likely to have only one patent covering the infringing behavior. Thus, that patent is the only option for litigation, irrespective of where the infringement falls within the patent's scope. This is illustrated in the diagram below, with stars representing the infringing behavior and circles representing patents.

Large Portfolio **Small Portfolio**



The following two case studies contrast a company with a small portfolio

[198] Section IV, *supra*.

[199] Both because the trier of fact may find the defendant's product to fall outside of the patent's scope and because the periphery of a patent is more likely to be invalid.

stretching its patent by using the broadest claims with a company with a large portfolio able to win using dependent claims of several patents.

U.S. Patent 4,908,016 (the '016 patent) claims a "water jet massage apparatus and method" which consists of a water-proof sheet of material placed over a person's body after which water jets can apply pressure to the body without getting the person wet.[200] The '016 patent is owned by Aqua Massage International, a 40 person company founded by a husband-and-wife team in Groton, CT.[201] Aqua Massage International alleged that the defendants, former distributors of the device, "set out to copy the patented water jet massage device . . . add[ing] some insubstantial structural elements."[202]

According to the USPTO's assignment database and litigation filing documents,[203] Aqua Massage International owns only two utility patents.[204] The changes made by the defendant were apparently substantial enough that the infringing device did not share many features with the most detailed invention described by either patent – nor did it even fall literally within the scope of the broadest claim of either patent. Rather, the jury found that the defendants' device infringed claim 1 of the '016 patent (an independent claim) under the doctrine of equivalents,[205] and that the defendants' device did not infringe the second patent at all.[206] Thus, Aqua Massage International had to stretch its patents to cover the infringing behavior.

Contrast Aqua Massage International with Koninklijke Philips N.V. ("Philips"), a company owning tens of thousands of patents. Several Philips patents were part of this study's sample, including U.S. Patent No. 5,023,856 (the '856 patent), a patent relating to recordable and rewritable compact disks.[207] Philips sued Princo Corporation for patent infringement and the court found on

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[200] U.S. Patent No. 4,908,016 at Abstract.

[201] B. Dufresne, *Massage Company Hopes to Wash Away Competition*, THE DAY, F6, Hartford, CT, March 17, 2003.

[202] Plaintiff's Response Opposing Defendants' Motion for Partial Summary Judgment of Non-Infringement, Aqua Massage v. Licht, 0:030-cv-060493 (S.D. Fla.), 2004 WL 2022786 at *3.

[203] Complaint for Patent Infringement, Dkt. No. 1 at 1, Aqua Massage v. Licht, 0:030-cv-060493 (S.D. Fla. Mar. 21, 2003).

[204] Aqua Massage International is also the assignee of a design patent.

[205] The doctrine of equivalents allows courts to find infringement outside the literal scope of the patent claims if the infringement has "insubstantial differences" from the patent or "performs substantially the same function in substantially the same way to obtain substantially the same result." Hilton Davis Chemical Co., v. Warner-Jenkinson Co., Inc., 62 F. 3d 1512, 1519 (Fed. Cir. 1995).

[206] Final Judgment, Dkt. No. 171 at 2, Aqua Massage v. Licht, 0:030-cv-060493 (S.D. Fla. Oct. 12, 2004).

[207] In re Princo, 478 F.3d 1345, 1348 (Fed. Cir. 2007).

summary judgment that the defendant infringed dependent claims of the '856 patent.[208] It is perhaps not surprising that Philips was able to win using the dependent claims of its patent because Philips owns multiple patents covering the defendant's product.[209] Moreover, Philips actually owns 4% of the *total* number of US granted patents in the subject area covered by the '856 patent.[210]

A striking example of how large patent portfolios can be used to ensure patent infringement comes from the famous dispute between IBM and Sun Microsystems. IBM asserted seven patents, to which Sun responded that these patents were not infringed and were invalid. IBM replied that even if "you don't infringe these seven patents . . . we have 10,000 U.S. patents" and can "find seven patents you do infringe" unless "you want to make this easy and just pay us $20 million."[211]

Another possible explanation for the importance of size in litigation strategy is the plaintiff's tolerance for the risk of patent invalidation. Small companies may have only a small number of products, increasing the harm caused by a competitor's entry, and therefore raising the likelihood that a broad claim should be asserted, even at great risk of patent invalidity. Moreover, other research has shown that small entities' patents are more likely to be litigated, and scholars have speculated that this may be because "they have little to lose from entering into patent litigation."[212] When deciding how to assert a patent, small entities may have little to lose from asserting broadly.[213]

Size may also be a proxy for the amount of money or resources a company can devote to its patents; these companies may be able to obtain broader or better patents. Alternatively, a patent application filed by a large company might cover a more important technology, which might be more likely to be closely copied by

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[208] And dependent claims of the other 5 patents asserted in the lawsuit. U.S. Philips Corp. v. Princo Corp., 361 F. Supp. 2d 168, 186 (S.D.N.Y. 2005).

[209] Which Philips sold as a package license, sparking an antitrust suit. *Id*. at 183.

[210] Each patent is assigned International Product Classifications. For each IPC assigned to the '856 patent, I divided the total number of US granted patents assigned to Philips having that classification by the total number of US granted patents having that classification. The percent of patents owned by Philips varied between 2.3% and 5.6% for the 8 IPC classifications assigned to the '856 patent, for an average of 4.2%.

[211] Michael A. Carrier, *A Response to Chief Justice Roberts: Why Antitrust Must Play a Role in the Analysis of Drug Patent Settlements*, 15 MINN. J.L. SCI. & TECH. 31, 33 (2014).

[212] *Id*. at 479.

[213] This fits with previous research finding "aggressive litigation defense by small firms [which] suggests that patents are of greater marginal value to these firms, especially considering the fact that litigation costs are more burdensome for a smaller firm with lower cash reserves and a weaker ability to raise external funding." Jonathan M. Barnett, *Private Protection of Patentable Goods*, 25 CARDOZO L. REV. 1251, 1283 (2004).

infringers. However, the significant variables in the regression are those associated with the *plaintiff*, not the patent *applicant*, which suggests that resources available during patent prosecution are not a full explanation.

3. Jury Trials

Jury trials are positively correlated with use of independent claims. The increased use of juries in litigation where the outer scope of the patent is enforced may be because outcomes in jury cases are less predictable;[214] therefore broader assertion may be necessary. Another possibility is that it is easier to explain independent claims, which are shorter and have fewer limitations, to juries. Alternatively, plaintiffs may request juries in cases where they feel they have only a small chance of winning, or for a case that is emotionally strong but not legally strong, because the unpredictability of juries may increase the odds of winning in those circumstances. These legally weak cases are likely to be those where infringement is at the very edge or just outside of the patent's broadest claim; therefore independent claims would be needed to win. Another possibility is that plaintiffs in jury cases are less concerned about the patent's validity, and so are willing to use weaker claims, as juries have been shown to be more likely to uphold a patent's validity.[215] When an industry variable is added to the regression above, the jury variable ceases to be significantly correlated with choice of claims.[216]

4. Number of Claims

The number of claims is inversely correlated with breadth of claim used, meaning that patents with a smaller number of claims are more likely to use the broadest claims of their patent. [217] This may simply be a result of how many

[214] There is certainly a perception that juries are unpredictable, although the evidence varies as to whether this is empirically true. Valerie P. Hans & Theodore Eisenberg, *The Predictability of Juries*, 60 DEPAUL L. REV. 375, 376 (2012); Kimberly A. Moore, *Judges, Juries, and Patent Cases: An Empirical Peek Inside the Black Box*, 99 MICH. L. REV. 365, 368 (2000).

[215] John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 213 (1998).

[216] Likely because most pharmaceutical trials do not use juries, and pharmaceutical trials are also significantly less likely to involve the periphery of a patent.

[217] Some scholars have argued that number of claims is correlated with the breadth of a patent. N. van Zeebroeck, et al., *Claiming More: The Increased Voluminosity of Patent Applications and its Determinants*, CEB Working Paper No. 06/018, at 5 (2007) *available at* https://dipot.ulb.ac.be/dspace/bitstream/2013/53916/1/RePEc_sol_wpaper_06-018.pdf. I, like other scholars, do not believe this to be the case. *See, e.g.,* Allison, *supra* note 222, at 19. However, for those who think that a larger number of claims indicates increased breadth, these results suggest that patentees with narrower patents are more likely to use the full scope of their patents.

claims are available to choose from during litigation. For example, if a patent has only one claim, then the outer claim of the patent *must* be asserted. As the number of claims goes up, the gradations between claims may be finer.[218] When a portfolio size variable is added to the regression above, the number of claims variable ceases to be significantly correlated with choice of claims.

C. Factors Not Significantly Correlating with Claim Use

Most variables do not have a significant correlation with which patent claims are used, which provides some information about how patent claims are *not* used. However, care must be taken when interpreting negative results, because lack of correlation may be due to sample size and it is possible that a correlation would be seen if sample size were larger.

a. Timing

Patent priority date and case filing date do not significantly correlate with claim use behavior. There is anecdotal evidence that "bad" patent behavior has been increasing over time.[219] For example, there are many stories about patent owners no longer only suing in their "core" business area to keep out competitors, but also using their patents more broadly to extract rent from non-competitors.[220] Thus, one hypothesis I considered was that broad enforcement might have increased over time. At least at this sample size, I have no evidence that this hypothesis is correct.

b. Breadth Measures

Breadth, as crudely proxied by IPC classifications, does not significantly correlate with claim usage. I wondered whether, if a patent was broader to begin with, the patentee might not need to enforce the outer bounds. Or, conversely, perhaps the type of patentee who seeks a very broad patent is also the type of patentee who will want to enforce the outer bounds of the patent. From the data in this study, I have no support for either of these proposals, as claim use is not significantly correlated with breadth. Note, however, that we do not have very accurate measures of breadth, so this is an area for further research as measures of breadth become more sophisticated and accurate.

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[218] Note that this does not have to be true. Patent claims can be drafted in many different ways. However, it seems likely to be true on balance.

[219] Jaffe & Lerner, *supra* note 16. I take no position here on whether this behavior should in fact be characterized as "bad."

[220] *See, e.g.*, JAMES BESSEN & MICHAEL MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK, 197 (2008).

c. Value Measures

Forward citations do not significantly correlate with which type of patent claims are used. Forward citations are a proxy for patent value, albeit a rough one.[221] It is possible that the most valuable patents would also be those asserted broadly, or vice versa. The data in this study do not show any relationship between forward citations and claim use. However, this may be due to the skew in the sample used by this study. There is evidence that patents asserted in litigation are more valuable than patents not asserted in litigation.[222] Thus, it may be that patent value does correlate with choice of claim to use; we simply cannot see the correlation because by studying already valuable patents, any correlation is lost in the noise.

D. Other Factors

I also examined venue and lead litigation firm, which could affect the results, for example, if a particular firm had an institutional practice of asserting particular types of claims. Lead litigation firm was defined as the firm with the most lawyers listed as representing the patent owner. No firm litigated more than 5% of the cases, and only two firms litigated more than 3% of the cases.[223] 193 firms were represented in the sample as a whole. Because of the diversity of firms, it is unlikely that the results were significantly affected by institutional litigation practices of a particular firm.

Venues have different procedural rules about how and when claims are asserted, and different venues may be more or less favorable to certain types of litigation strategies. For example, the Eastern District of Texas famously draws a large number of NPE plaintiffs.[224] In the studied sample, litigation occurred in 55 different district courts. The most common venue was the District of Delaware, accounting for 89 cases. Other common venues were the Central District of California (26 cases), the District of Massachusetts (21 cases), the District of New Jersey (25 cases), the Eastern District of Texas (53 cases), the Northern District of California (22 cases), and the Southern District of New York (21 cases). When a

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[221] *Id*.

[222] John R. Allison, et al., *Valuable Patents*, 92 GEO. L.J. 435, 445 (2004).

[223] Fish & Richardson and Morris Nicols litigated 21 and 13 cases, respectively.

[224] Andrei Iancu & Jay Chung, *Real Reasons the Eastern District of Texas Draws Patent Cases – Beyond Lore and Anecdote*, 14 SMU SCI. & TECH. L. REV. 299 (2011); 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. 195 (2007); Alisha Kay Taylor, *What Does Forum Shopping in the Eastern District of Texas Mean for Patent Reform*, 6 J. MARSHALL REV. INTELL. PROP. L. 570 (2007).

"venue" variable was added to the regression described above,[225] using the District of Delaware as the reference venue, the plaintiffs in the following venues were significantly ($p<0.05$) more likely to win using only independent claims: Central District of California, District of Massachusetts, Northern District of Georgia, Southern District of Texas, and Western District of New York. No venues were significantly less likely to win using only independent claims than the District of Delaware.

VI. IMPLICATIONS

A. An Expanded Model of Patent Use: Ex Ante vs. Ex Post

In Section V, *supra*, I proposed that some plaintiffs' use of dependent claims could be explained by *ex post* selection of patents after the infringement had occurred, and in response to the infringing behavior. This explanation interacts with a large body of theoretical work on how patents are and should be used *ex ante* and *ex post*, [226] and has important implications for the design of patent doctrine. Below, I suggest that plaintiffs who select patents *ex post* present a new model of patent use, in contrast to the traditional model wherein plaintiffs must predict patent needs *ex ante*.

The historical model of the patentee's role in obtaining a patent is predominantly *ex ante* – the patentee's drafting choices before patent grant set the

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[225] Section II.A.2, *supra*.

[226] *See, e.g.*, Tun Jen Chiang, *Fixing Patent Boundaries*, 108 MICH. L. REV. 523, 529 (2010) (arguing that ex post adjustment of scope is problematic because it impedes the notice function of patents); Tun Jen Chiang, *Levels of Abstraction* 105 NW. L. REV. 1097, 1111 ("The fact that real patent scope is determined ex post by judicial interpretation" creates uncertainty and harms "every participant in the patent system."); John F. Duffy, *On Improving the Legal Process of Claim Interpretation: Administrative Alternatives*, 2 WASH. U. J. L. & POL'Y 109, 115 (2000) ("The quality of an authoritative claim interpretation depends not on its fidelity to some abstract ideal of interpretation, but on its *predictability*."); Jeanne Fromer, *Claiming Intellectual Property*, 76 U. CHI. L. REV. 719, 759 (2009) ("postponing delineation of the extent of the set of protected works under a central claiming regime until adjudication – as with standards in general – typically means less expenditure on claim drafting."); William R. Hubbard, *Efficient Definition and Communication of Patent Rights: The Importance of Ex Post Delineation*, 25 SANTA CLARA COMPUTER & HIGH TECH. L.J. 327, 368-71 (2009) (arguing for more ex post adjustment of patent scope); Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. L. REV. 1495, 1500-08 (2001) (suggesting that delayed scope setting reduces costs because scope must be determined for only a small fraction of patents); Douglas Lichtman, *Rethinking Prosecution History Estoppel*, 71 U. CHI. L. REV. 151, 182 (2004) (favoring delayed patent grant, "because patents are both rarely asserted and rarely read, it is probably inefficient to expend significant resources improving patent clarity across the board."); JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE 222 (2008) (criticizing Lichtman's contention that "decisions about patent boundaries are 'better' if made later' because… it necessarily follows that boundaries will be unclear at an earlier date when the given technology is adopted.").

bounds of the patent, and patent rights are then maintained statically throughout the life of the patent.[227] More recent scholarship argues that while certain aspects of the patent are fixed *ex ante*, the scope of the patent is malleable within certain limits.[228] Even under the malleability model, the portions of the patent that are fixed *ex ante* are not insignificant. The patentee drafts the specification[229] and claims of the patent during the application phase and the prior art is fixed as of the priority date of the patent. Once the patent is granted, the claims of the patent in conjunction with the specification and prior art demarcate a defined space over which the patentee is granted the right to exclude others.[230] After patent grant, the patentee can make modifying arguments during litigation by arguing the doctrine of equivalents or pursuing certain claim construction strategies. However, these opportunities are both limited by *ex ante* drafting choices and closely governed by the courts, which are (arguably) guided by a calculus of social benefit.[231]

In contrast to the traditional *ex ante* model and the recent malleability model, this Article provides evidence that certain classes of litigants, in particular NPEs and large players, are better modeled as conducting *ex post* patent selection. As discussed in Section V.A, *supra*, NPEs do this by first acquiring knowledge of infringement and then acquiring a patent that fits the infringement. As discussed in Section V.B, *supra*, plaintiffs with large patent portfolios may do this by selecting a patent that fits the infringement from within their portfolio. This flips the traditional model on its head and enhances the malleability model.

NPEs are able to practice *ex post* patent selection because many products, in particular in the high tech space, infringe on thousands, if not hundreds of thousands, of patents.[232] The product owners may be aware of the potential infringement in the abstract, but it is more expensive to identify and license all of these patents than to pay damages in a patent infringement lawsuit, so the owners simply await the lawsuit.[233] The NPE, therefore, having identified an infringing

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[227] Rantanen, *supra* note 23, at abstract.

[228] *Id*.

[229] A narrative portion of the patent describing the invention. 37 C.F.R. 1.15(b)(1).

[230] *See, e.g.*, Christopher A. Cotropia, *Patent Claim Interpretation Methodologies and Their Claim Scope Paradigms*, 47 WM. & MARY L. REV. 49, 65 (2005).

[231] Although exactly which calculus guides doctrine of equivalents decisions is debated and claim construction decisions may have no relation to social benefit at all. *See* Meurer & Nard at 1949 ("Recent decisions have moved away from a deontological fairness theory…Unfortunately, the courts have not replaced their fairness theory with a new normative account that explains when and how the DOE contributes to social welfare.").

[232] Colleen Chien, *Predicting Patent Litigation*, 960 TEX. L. REV. 283, 287 (2011) ("250,000 patents cover smartphone technology."). *See also* Brian J. Love, *The Misuse of Reasonable Royalty Damages*, 74 MO. L. REV. 909, 932 (2009).

[233] Mark A. Lemley, *Ignoring Patents*, 2008 MICH. L. REV. 19, 20 (2008). *But see* Ted Sichelman, *Are There Too Many Patents to Search – A Response* (July 3, 2015), *available at*

behavior, has a long menu of possible patents to acquire, and can select the one best suited to litigation. One characteristic of a patent well suited to litigation is one where the infringement falls into a dependent claim.[234]

Large players may behave analogously. As defined by this Article, large players are not merely companies with significant assets or a large number of employees;[235] large players are large in the patent sense: companies with large patent portfolios or companies having patents coming from large families. Both of these markers indicate an aggregate of closely related patents, increasing the likelihood that an infringing behavior will fall within or arguably within the scope of several patents. This allows *ex post* selection of the best patent to assert.

Previous research has suggested that large portfolios can be used to address *ex ante* "uncertainty by allowing holders to secure protections along a broader swath of the technological-development path than would be possible" with individual patents.[236] This Article's discussion of *ex post* selection of strong patents for litigation from a large portfolio provides an additional mechanism by which large portfolios can be used to hedge risk.

Notably, other classes of litigants cannot pursue an *ex post* selection strategy. In the examples above, selection relies on having a menu of patents from which to select. Some entities, for example, small companies, will not have access to a multiplicity of patents under which they can bring litigation. They may have only one option for litigation, and are therefore constrained to use that patent if they wish to bring suit, irrespective of whether the infringing behavior falls into the core or the periphery of the patent. Thus, their behavior better fits the traditional *ex ante* model of patent setting or the malleability model.

The primary harm from *ex post* patent selection is that it creates two classes of patent owners: those who can afford *ex post* patent selection and those who cannot. This means that the two classes are not similarly situated with respect to patent doctrine. Thus, if these doctrines altered,[237] they will disproportionately affect

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https://blogs.law.harvard.edu/nplblog/2015/07/02/are-there-too-many-patents-to-search-a-response-ted-sichelman/ (arguing that it is feasible to conduct patent clearance searches).

[234] *See* Section I.B, *supra*.

[235] Plaintiff revenue or number of employees did not show a significant correlation with claim choices. However, because many plaintiffs in the sample were individuals, universities, or private companies, for whom revenue is either not applicable or not obtainable, the number of plaintiffs for whom this information could be gathered was small. Therefore it is possible that a correlation exists, but was simply not seen in this study.

[236] Parchomovsky & Wagner, *supra* note 82, at 38.

[237] Which is frequently suggested. *See, e.g.*, Alison E. Cantor, *Using the Written Description and Enablement Requirements to Limit Biotechnology Patents*, 14 HARV. J.L. & TECH. 268, 290 (2000); Janice M. Mueller, *The Evolving Application of the Written Description Requirement to*

litigants who are unwilling or unable to create big patent families or to acquire their patents *ex post*. This may mean that policy will not be implemented effectively against litigants able to select patents *ex post* unless the policy is designed to prevent *ex post* patent selection. This can be seen, for example, with the use of the doctrine of equivalents, which enables plaintiffs to argue during litigation that the scope of their patents should be expanded beyond the literal language of the patent claim. Prior research has noted that there are few NPE winners of doctrine of equivalents cases.[238] The prior research fits with the present data: of the NPEs who acquired patents after infringement began and litigated using dependent claims (suggesting strategic claim choice), only one needed the additional scope provided by the doctrine of equivalents to win its case. Perhaps NPEs generally do not need to use *ex post* adjustment doctrines such as the doctrine of equivalents because they can use *ex post* patent selection instead.

Disparate effects of laws on two different groups is always a concern, and, in patent law, worse effects on small inventors are of particular concern. Small inventors are archetypal heroes of the American innovation system.[239] One of the most positive perceptions of the patent system comes from its ability to "work[] hand in hand with…the small inventor by providing those who have little more than good ideas much-needed clout in the commercial marketplace."[240] However, there is a literature suggesting that this perception does not always comport with reality. Small inventors generally have fewer resources than their larger counterparts and, in the parts of the patent system where resources matter, they are unsurprisingly disadvantaged.[241]

For example, David Abrams and Polk Wagner have predicted that the recent transition from a 'first-to-invent' system to a 'first-to-file' system will result in a drop in patent applications filed by small inventors, drawing on evidence from Canadian inventors after a similar change to Canada's patent system.[242] In earlier

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Biotechnological Inventions, 13 BERKELEY TECH. L.J. 615 (1998); Sean B. Seymore, *Heightened Enablement in the Unpredictable Arts*, 56 UCLA L. REV. 127, 154 (2008); Emanuel Vacchiano, *It's a Wonderful Genome: The Written-Description Requirement Protects the Human Genome From Overly-Broad Patents*, 32 JOHN MARSHALL L. REV. 805, 808 (1999).

[238] John R. Allison & Mark A. Lemley, 59 STAN. L. REV. 955, 974 (2007) (noting, but cautioning against, an interpretation of data on the doctrine of equivalents to conclude that "courts are reacting negatively to so-called 'patent trolls'").

[239] *See, e.g.*, Mark D. Janis, *Patent Abolitionism*, 17 BERKELEY TECH. L.J. 899, 910-22 (2002) (discussing the "heroic inventor motif").

[240] David S. Abrams & Polk R. Wagner, *Poisoning the Next Apple? How the America Invents Act Harms Innovators*, 65 STAN. L. REV. 515, 518 (2013).

[241] Although studies have found that individuals are more likely to use continuations. Mark Lemley & Kimberly Moore, *Ending Abuse of Patent Continuations*, 84 B.U. L. REV. 63, 89 (2004).

[242] *Id*. at 518-19 ("Small inventors are much more likely to be resource constrained…placing the small inventor at a potential disadvantage in a FTF regime."). *See also* Gerald J. Mossinghoff,

research, Mark Lemley and Colleen Chien studied interferences and found that large entities were more likely to initiate the proceedings, and, "small entities are getting bogged down in interference proceedings initiated by larger companies."[243] Discussions of patent reform in the 1990s produced similar research on the effect of policy changes on small inventors.[244]

To be sure, *ex ante* patent policy still matters, even for parties who can select patents *ex post*. Whatever rules apply *ex ante* create the universe of patents available to be selected *ex post*. *Ex post* selectors simply benefit by having an additional opportunity to acquire patents after obtaining more information[245] about the type of patent that will be needed.

B. Implications for Related Empirical Work

The findings presented in this Article may partially explain puzzling results of previous empirical work. There are numerous empirical studies on the effect of changes to patent laws on innovation. Many find that increased patent strength does not correlate with increased innovation,[246] which is somewhat paradoxical because patents are designed to strengthen innovation.[247] Several scholars have found that patent protection has an "inverted U" shape, meaning that an "optimal level" of protection "exists, above which additional strengthening actually tends to discourage innovation."[248]

The only empirical study of the effect of changes in the law of patent scope

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The U.S. First-to-Invent System Has Provided No Advantage to Small Entities, 84 J. PAT. & TRADEMARK OFF. SOC'Y 425, 426 (2002).

[243] Mark A. Lemley & Colleen V. Chien, *Are the U.S. Patent Priority Rules Really Necessary?* 54 HASTINGS L.J. 1299, 1323 (2003).

[244] *See, e.g.*, Dana Rohrabacher & Paul Crilly, *The Case for a Strong Patent System*, 8 HARV. J.L. & TECH. 263, 272 (1995).

[245] About infringement.

[246] Relatedly, a recent study has found that patent licensing does not lead to new innovation. Robin Feldman & Mark A. Lemley, *Does Patent Licensing Mean Innovation* (2015), *available at* http://ssrn.com/abstract=2565292.

[247] Josh Lerner, *The Empirical Impact of Intellectual Property Rights on Innovation: Puzzles and Clues*, 99 AM. ECON. REV. 343, 347 (2009) ("The lack of positive impact of strengthening of patent protection on innovation is a puzzling result. It runs not only against our intuition as economists that incentives affect behavior, but also counter to the findings in the 'law and finance' literature that stronger property rights…encourage economic growth.").

[248] Yi Quian, *Do National Patent Laws Stimulate Domestic Innovation in a Global Patent Environment: A Cross-Country Analysis of Pharmaceutical Patent Protection, 1978-2002*, 89 REV. ECON. & STATISTICS 436, 436 (2007). *See also* Nancy Gallini, *Patent Policy and Costly Imitation*, 23 RAND J. Econ. 52 (1992); Andrew Horowitz & Edwin Lai, *Patent Length and the Rate of Innovation*, 37 INT'L ECON. REV. 785 (1996).

studied reforms in Japanese patent law that led to increased patent scope.[249] The Japanese study found "*no* evidence of a statistically or economically significant increase in either R&D spending or innovative output that could plausibly be attributed" to the changes in patent scope.[250] The authors emphasized the unexpectedness of their results, because within "the theoretical literature, there is a general presumption (or explicit assumption) that broader patent scope or greater patent length will induce more R&D effort."[251] The results of this Article may partially explain why the empirical data conflict with the theoretical models. If the outer reach of a patent's scope is not enforced, expanding patent scope may have less effect on research and development or innovation than would otherwise be expected.

In addition, the results of this Article are commensurate with empirical work on the enforcement of patents as a whole. There is a substantial legal and business literature demonstrating that most patents are never enforced.[252] Only 1% of patents are litigated,[253] and almost half of all patents are abandoned before they expire.[254] Thus, as most patents are never enforced, it is perhaps unsurprising that the broadest claims of most patents are also not needed during enforcement.

CONCLUSION

This Article makes several contributions to the literature. First, it presents evidence that plaintiffs predominantly win litigation using dependent claims of their patents. This adds to the growing body of scholarship on patent litigation behavior, and sets the foundation for future work on how patent claims of different breadths affect litigation behavior.

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[249] Mariko Sakakibara & Lee Branstetter, *Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Law Reforms*, 2 (2001) *available at* http://repository.cmu.edu/cgi/viewcontent.cgi?article=1044&context=sds. *But see* Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. 65, 81-82 (2015) (cautioning that studies of a single country's patent policy may understate policy impact because firms in that country must still compete on the global market.).

[250] Sakakibara, *supra* note 249, at 2.

[251] *Id*. at 8.

[252] *See e.g.*, Martin A. Bader, Oliver Gassman, Nicole Ziegler, & Frauke Ruether, *Getting the Most Out of Your IP – Patent Management Along its Life Cycle*, 17 DRUG DISCOVERY TODAY 281, 284 (2011); David E. Bennett, *The Power of Patents and Their Strategic Use*, 1 BUSINESS NORTH CAROLINA 64, 67 (2002); Irene Troy & Raymund Werle, *Uncertainty and the Market for Patents*, MPIfG working paper No. 08/2 7 (2008), *available at* http://www.econstor.eu/bitstream/10419/41680/1/574282009.pdf.

[253] Mark A. Lemley, *Reconceiving Patents in the Age of Venture Capital*, 4 J. SMALL & EMERGING BUS. L. 137, 145 (2000).

[254] Jonathan A. Barney, *A Study of Patent Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets*, 30 AIPLA Q.J. 319, 324 (2002).

Second, this Article finds that non-practicing entities are less likely to enforce the outermost claims of their patent as compared to practicing entities. This finding adds complexity to conventional assumptions about NPE values and strategies. In particular, closer examination shows that many NPEs strategically acquire patents after infringement has begun, allowing them to select for patents that squarely cover the infringing behavior.

Third, this Article finds that large entities, plaintiffs with large patent portfolios, and patents from large families are more likely to see litigation in dependent claims. This may be because, like NPEs, large players can select patents squarely covering the infringing behavior, but by selecting the patent from the company's portfolio, rather than by acquiring the patent from another entity. These findings are important because they suggest that small players are less able to strategically use the patent system and rely more on features that make individual patents beneficial, such as breadth. Thus, this Article adds to calls for caution in patent reform and indicates that policy prescriptions intended to curb NPE abuses may instead disproportionately harm small inventors.

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