Patent Litigation and the Internet

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I. Introduction

Patent infringement litigation has not only increased dramatically in frequency over the past few decades,^6 but also has seen striking growth in both stakes and cost.~7 Although a relatively rich literature has added much to our understanding of the nature, causes, and consequences of patent litigation during the past two decades,^8 many interesting questions remain.

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^7 In its 2001 economic survey, the American Intellectual Property Law Association (AIPLA) reported that 251 law firms had responded to its request for data on patent infringement litigation costs for cases with stakes exceeding $25 million, and that the median cost per party through the end of discovery in such cases was $1.5 million. AMERICAN INTELLECTUAL PROPERTY LAW ASSOCIATION, REPORT OF ECONOMIC SURVEY 2001, at 85. Eight years later, AIPLA reported that 398 law firms had responded to its inquiry about patent cases with stakes exceeding $25 million, and that the median cost per party through the end of discovery in such cases was $3 million. AMERICAN INTELLECTUAL PROPERTY LAW ASSOCIATION, REPORT OF ECONOMIC SURVEY 2009, at I-129.
remain inadequately addressed. The nuances of and trends in patent litigation in different technology fields and industries, for example, are still understudied.\(^9\) It is also the case that litigation of patents on new technologies has received a dearth of attention. Here we seek to help begin filling these gaps by empirically analyzing the phenomenon in a very particular context—the litigation of Internet patents. In particular, we study litigation of patents on Internet business processes issued during the first few years in which such patents were granted, and determine whether it differs from litigation of patents in other fields and, if so, how.

Patents on methods of doing business on the Internet (Internet patents) have been the subject of intense debate and criticism for a number of years.\(^{10}\) Indeed, since 1998, when the Court of Appeals for the Federal Circuit held that there was no per se exclusion of these Internet-
implemented methods from the realm of patentable subject matter,\textsuperscript{11} many have questioned the wisdom of the decision and sought to have its result altered.\textsuperscript{12} In addition to the issue of subject matter eligibility for patenting, critics have questioned whether the U.S. Patent & Trademark Office (PTO) has improvidently granted Internet patents that appear at first glance to be obvious, thus failing one of the key requirements for patentability.\textsuperscript{13} The importance of the Internet as a rapidly growing commercial platform combined with concerns for an open and free Internet added to the intensity of these debates.

Despite the importance of these debates, there has been relatively little empirical study of Internet patents, and no study of the increasing litigation in which they have been involved. In one of the few studies of the patents themselves, Allison and Tiller analyzed the quality of Internet patents by comparing them to other kinds of patents.\textsuperscript{14} Allison and Tiller built a data set of 1,093 Internet-implemented process patents, and compared many of their characteristics with those of a randomly selected set of 1,000 contemporaneously issued patents from the general population of patents (non-Internet patents, or NIPs).\textsuperscript{15} The purpose was to empirically test the merits of the many criticisms of these patents, all of which had been made without the support of any data. Measuring a number of characteristics that previous research had associated with patent quality and private economic value, such as the total number of claims and prior art

\textsuperscript{11} State Street Bank v. Signature Financial Group, Inc., 149 F.3d 1368 (Fed. Cir. 1998). The court’s decision applied to business processes whether Internet-implemented or not, but the most important and controversial of these have involved Internet implementations. In Bilski v. Kappos, 130 S.Ct. 3218 (2010), the Supreme Court agreed that there was no patentability exclusion for such processes. The Court disagreed with the legal standard employed by the Federal Circuit in \textit{State Street}, but upheld the absence of a patentability exclusion. \textit{Id.} at __.

\textsuperscript{12} See Allison & Tiller, supra note 10, for a detailed discussion of the criticisms of the \textit{State Street} decision and efforts to alter it.


\textsuperscript{14} Allison & Tiller, supra note 10.

\textsuperscript{15} \textit{Id.}
references, as well as several other characteristics first employed by the authors, the study found that Internet patents appeared to be of higher average quality and value than the average patent.\textsuperscript{16}

Researchers in economics and law have compiled evidence to support a link between the economic value of patents to their owners (private patent value) and litigation propensity.\textsuperscript{17} In 2004 Allison, Lemley, Moore, and Trunkey (ALMT) conducted the most comprehensive comparison ever made litigated and unlitigated patents.\textsuperscript{18} Measuring a number of patent characteristics that had been linked to litigation propensity and private economic value, as well as some characteristics not previously considered but that logically might suggest value and a greater likelihood of litigation, the authors found that litigated patents were a completely different breed than patents that had not been involved in litigation. With a high degree of significance, the authors found that litigated patents contained more claims and more references to prior U.S. patents, foreign patents, and other kinds of publications (“nonpatent prior art” references of all kinds, and were cited more often as prior art by subsequent patents (i.e., had more “forward citations”). They were disproportionately represented in some technology areas and in some industries, and were much more likely to have originally been issued to individuals and small businesses and to be owned by domestic rather than foreign entities. They also had spent much more time in “prosecution” (examination within the PTO) from their original filing dates than unlitigated patents, primarily as a result of patent applicants having invested more in

\textsuperscript{16} Id. at 1003. Allison & Tiller also found that these early Internet patents appeared to be of greater quality and value than patents in many individual technology fields. Id.

\textsuperscript{17} See sources cited in ALMT, supra note 8, at 448-51.

\textsuperscript{18} Id. The authors employed a data set of approximately 7,000 patents that were the subject of patent infringement lawsuits that terminated in 1999 and 2000. Id. at 444 fn. 33. The authors did not identify how many times those patents had been litigated and, thus, it can only be said that they were litigated at least once. The sample of litigated patents was compared with a randomly selected set of unlitigated patents from the general patent population.
continuing applications leading to the generation of multiple patents on closely related
inventions—a patent portfolio that can have greater value than the sum of its parts.19

Allison and Tiller’s findings revealed that Internet patents, at least those issued during the
formative years of digital commerce, possessed value-indicating characteristics very similar to
those of the litigated patents subsequently studied by ALMT. Given that these characteristics
suggest not only value but also litigation propensity, the next logical questions are whether these
Internet patents later experienced unusually high rates of litigation, and how these patents fared
in court compared with other patents. The current study contributes to the empirical literature on
patent infringement litigation by comparing litigation rates for early Internet patents with those
for a large comparison set of contemporaneously issued NIPs, and by comparing the outcomes of
litigation involving both types of patents. Delving more deeply, we further investigate litigation
rates and outcomes for two subgroups of Internet patents identified by Allison and Tiller—those
covering relatively broad Internet business “models”20 and those covering narrower Internet
business “techniques.”21 The important difference between these subgroups is that the claim
language in those Internet patents classified as business models is usually broader, that is, more

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19 Id. at 438. Either counting the number of continuing applications, or counting the number of patents issuing from
the same original application allows us to view decisions of patent applicants to invest more in creating families of
patents on related technologies and more closely tailoring their patents to potentially infringing activities in an
industry. Each of these techniques picks up similar information. Id at 457-60. On the value of patent portfolios,
20 Such a patent contains claims of a sufficiently broad nature that the invention could form the foundation for an
entire business, or line of business, on the Internet. The Priceline.com reverse auction model for purchasing airline
tickets was an early example of this type of patent on a broad business model. U.S. Patent No. 5,797,127, “Method,
apparatus, and program for pricing, selling, and exercising options to purchase airline tickets” (filed Dec. 31, 1996).
Another example of a patent of this kind is U.S. Patent No. 6,006,265, “Hyperlinks resolution at and by a special
network server in order to enable diverse sophisticated hyperlinking upon a digital network” (filed Apr. 2, 1998),
which is a method for distributing hypervideo, i.e., digital video broadcasting incorporating hyperlinks.
21 Such a patent covers an invention narrower in scope and intended not as a business model, but only as a means of
solving a specific business problem. Amazon.com’s patent on the “one-click” technique for merchandise ordering
was an early prototype of the narrower business technique type of patent. U.S. Patent No. 5,960,411, “Method and
system for placing a purchase order via a communications network” (filed Sept. 12, 1997). Another example of
such a patent is U.S. Patent No. 6,006,332, “Rights management system for digital media” (filed Sept. 12, 1997),
which provides a method for controlling unauthorized access to copyrighted material distributed by content owners
over the Internet.
general, than in the other subgroup. More general claim language tends to increase the universe of potential infringers, thus creating at least a possibility of higher litigation rates and perhaps greater win rates.  

Using both univariate comparisons and multiple regression techniques, we find primarily that: (1) Internet patents and their two subtypes were litigated at a far higher rate than NIPs—they were between 7.3 and 11 times more likely to end up in infringement litigation, depending on the model we used; (2) within the category of Internet patents, those on business models were litigated at a significantly higher rate than those on business techniques; (3) once patent infringement litigation was initiated, the owners of litigated Internet patents were significantly less likely to settle before judgment than the owners of litigated NIPs, but this finding did not hold up in our regression analyses because of the effects on settlement of other variables; (4) Internet patents and NIPs went to trial at about the same rate; (5) when failing to settle, the owners of Internet patents and NIPs experienced essentially the same win/loss rates as did the owners of patents within the two Internet subgroups; (6) patents issued to small entities, especially individuals and small businesses, were much more likely to be litigated than those issued to large entities, a finding that did retain a high level of statistical significance in multiple regression; and (7) contrary to findings elsewhere, the number of defendants per case did not affect settlement likelihood or win rates.

22 The breadth of patent claims is a function of relative language generality or specificity (fewer or more “limitations” in patent law jargon), and is only determined once a court has construed the language of disputed terms in patent claims. Claim construction (interpretation) occurs prior to trial in an infringement case, and is a function to be performed solely by a judge, not a jury. Hearings in which claim construction takes place are called “Markman hearings,” after Markman v. Westview Instruments, 517 U.S. 370 (1996), in which the Supreme Court held that claim construction is a question of law that should only be determined by a judge. Subsequently, the U.S. Court of Appeals for the Federal Circuit concluded that a trial court’s claim construction decisions are reviewable under a de novo standard. Cybor Corp. v. FAS Technologies, Inc., 138 F.3d 1448 (Fed. Cir. 1998) (en banc). To our knowledge, no one has yet devised a means to empirically estimate the breadth of patent claims.  

23 Univariate statistics are the results of the comparison of the same variable between two or more data sets. Some statisticians use the term “bivariate” statistics for the same procedure.
These findings raise some intriguing questions for further research, such as (1) whether litigation of patents on other relatively new technology fields would compare similarly to litigation of patents from the general population, the latter consisting predominantly of patents on more mature technologies; and how litigation of patents on different technologies early in their maturation periods might compare to each other. Are patents on young technologies likely to be stronger and more valuable on average because there is less relevant prior art to require the narrowing of patent claim language or because applicants perceive greater potential innovation importance and are willing to invest more in the patenting enterprise, thus leading to more litigation? Do they generate more uncertainty because of their newness, contributing to more contention? Also, the Internet patents in our data set, whether litigated or not, did show many of the same internal characteristics as patents in all fields that wind up in litigation,\(^24\) and it would be very interesting to see whether this is true of patents in other young fields of patenting activity such as flash memory, smart phones, nanotechnology, and others. We also posit other questions for future research that are not limited to the context of new patent fields. For instance, our current study found that the average number of defendants per case had no significant effect on the likelihood of settlement or on win rates, possibly because infringement plaintiffs in our data did not sue many defendants at one time, but others have found the number of defendants to significantly affect both settlement rates and win rates when patent owners do name more defendants than they did in our study.\(^25\) Thus, an investigation empirically probing the wisdom of patent owners’ litigation strategies when deciding whether to sue multiple alleged infringers in a single lawsuit or in several different ones may bear interesting fruit in other contexts. In addition, given our finding of significantly different litigation rates for patents on online business

\(^{24}\) Allison & Tiller, *supra* note 10.

models than on online business techniques, the former clearly appearing to have broader claims, another research question is whether methods can be devised to create empirical estimates of patent claim breadth for use in better predicting which patents companies should fear when they assess how much freedom of action they have to innovate in a given field. The role of so-called “non-practicing entities, or NPE’s,” also deserves more research attention. These are companies that do not make or sell products and thus are not vulnerable to patent infringement counterclaims as are product companies that sue for infringement, and consequently may be less reluctant to sue.\textsuperscript{26} There is a significant but imperfect correlation between the fact that a patent was originally issued to a small entity and the identity of a patent infringement plaintiff as an NPE, and in the current study one of our findings is that patents granted to small entities, especially to individuals and small businesses, are much more likely to be litigated.\textsuperscript{27} Thus it may be worthwhile to investigate the NPE/Product company question in future studies of patent litigation among other types of patents.

In Part II we describe our data. In Part III we first make univariate statistical comparisons of litigation rates between Internet patents and NIPs, between the two subgroups of Internet patents and NIPs, and between the Internet patent subgroups themselves. We then use multivariate logistic regression to determine whether being an Internet patent or being within one of the Internet patent subgroups still contributes to the likelihood of being litigated after we controlled for other patent characteristics found to be positively or negatively associated with litigation by previous studies. Part IV expands our study by analyzing more closely a number of other case-specific litigation variables for both Internet patents and NIPs. We conclude and revisit potential future research questions in Part V.


\textsuperscript{27} See infra at Tables 2 and 3 and accompanying text.
II. Description of the Data

Among other data, we employ the data set of Internet patents from Allison and Tiller.\textsuperscript{28} That database included 1,093 patents drawn from PTO “data processing” classifications 705, 707, and 709\textsuperscript{29} that had issued through the end of 1999, most having 1998 and 1999 issue dates.\textsuperscript{30} These patents covered business processes clearly intended for use on the Internet. We then employed the Derwent LitAlert database (“LitAlert”) to identified patents from that data set that had been litigated through April 2009. We also made use of Stanford’s Intellectual Property Litigation Clearinghouse (IPLC) to verify and find additional cases filed after January 1, 2000 (when IPLC data begins) through April 2009. The earliest filed lawsuit alleging infringement of an Internet patent from our data set was initiated in 1998. We thus captured litigation during a period of approximately ten years after the last patents in our data set were issued and longer for some of them.\textsuperscript{31} Most patent litigation occurs when patents are relatively young.\textsuperscript{32} Thus, if a patent is going to end up in infringement litigation at all, it usually does so relatively early in its life. The reason is that, with the exception of pharmaceutical patents, those patents that do have any private economic value typically experience a diminution of that value long before the expiration of the term of protection. At the date of lawsuit filing, the average age of all litigated

\textsuperscript{28} The laborious process by which this data set was built is described in detail in Allison & Tiller, supra note 10, at 1032-1036.


\textsuperscript{30} The earliest issue date of patents in the data set was April 16, 1996.

\textsuperscript{31} Depending on when the patent in our data set was issued, the period between issuance and our cut-off date ranged from 9.3 to 12 years.

\textsuperscript{32} See, e.g., ALMT, supra note 8, at 460. Pharmaceutical patents appear to be an exception because FDA approval requires years, they are likely to have value until the very end of their terms of protection, and on average are litigated later in their lives than other patents. Id. at 475. See also Allison & Tiller, supra note 10, at 1066.
patents in our data set, both Internet and NIPs, is 4.52 years. Of the 1,093 Internet patents, 111 were litigated and 982 were unlitigated.

The first portion of the data set of NIPs came from ALMT’s 2004 study of litigated patents, which included a random sample of 1,000 unlitigated NIPs that were issued between mid-1996 and mid-1998 and had not been the subject of litigation, plus a random sample of 300 NIPs that were issued between mid-1996 and mid-1998 and had been the subject of infringement litigation that terminated during 1999-2000 (litigated NIPs).\(^{33}\) For purposes of the current analysis, some modifications to the original data set were made from updated information. Ten of the original 1,000 unlitigated NIPs were deleted because they had since been litigated. Of the original 300 litigated NIPs, one was dropped because it appeared twice in our dataset. Thus, 990 unlitigated NIPs and 299 litigated NIPs remained from the original ALMT dataset. Both of these sets included patents issued between June 1996 and May 1998, and the litigated patents were involved in cases that terminated in 1999 or 2000.

However, since we included every Internet patent case we could find that was the subject of an infringement lawsuit filed through April 2009, for comparability we also needed a set of litigated NIPs in cases that were restricted to those in which litigated terminated in 1999-2000 as were the 299 from ALMT. To identify a set of litigated NIPs similar to the 299 from ALMT, we identified the first patent number issued in the beginning of June 1996 (5,522,091) and searched through the last patent number issued in May 1998 (5,758,361). We then randomly generated 5,000 patent numbers from between the two end-points using a uniform distribution. To identify which of these NIPs had been litigated, we searched LitAlert in the same manner as for the Internet patents. The search generated 55 litigated NIPs, or about a 1 percent NIP litigation rate. Because we wanted a similar number of litigated NIPs and litigated Internet patents, we searched

\(^{33}\) ALMT, supra note 8, at 445-448.
an additional 5,000 randomly selected NIPs assuming that the 1 percent litigation rate would be constant. This second set of 5,000 was generated by adding 10 to each patent number in the original set of 5,000 patents, e.g., 5,289,210 became 5,289,220. The additional set did not contain duplicates of any patents in the first list of 5,000 patents.34 We checked this final list against the NIPs used from ALMT and against the Internet patents to ensure that the new chosen NIPs were unique. To find the litigated NIPs from the 10,000 patents we again relied on the information available in the LitAlert database and in the IPLC. These searches resulted in a total 136 litigated NIPs.

For each patent we then searched for the specific cases in which it was the subject of litigation using LitAlert and the IPLC.35 We dropped a small number of cases because of incorrect associations in LitAlert between cases and patent numbers that we were unable to correct. We also filtered out cases that had not yet terminated so that we could examine outcomes. The result was 365 unique terminated cases, of which 196 involved at least one NIP, 167 involved at least one Internet patent, and 2 involved both kinds of patents. Because some patents were litigated in more than one distinct case, and because some cases involved the litigation of more than one patent, we treated each assertion of a distinct patent in a distinct lawsuit as an observation. Our final data set includes 453 assertions, or “case-patent pairs.” To prevent having duplicates cases in our data, we used only the docket number from the court in which the case closed as an identifier.

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34 Adding the same number to a set of random numbers, called a monotonic transformation (i.e., using a monotonic function) produces another set of random numbers.

35 Stanford Law School recently spun off the IPLC to a private company, Lex Machina, in which Stanford is a large stakeholder, the web site for which is http://lexmachina.com.
We used the IPLC, Westlaw’s Patent-Docket database, and PACER to identify a number of case-specific variables from the dockets. These variables included the total number of defendants, whether patent owner or the accused infringer initiated the case, whether the case had been transferred from another federal district, the year the case was filed, the regional federal circuit in which the deciding district court was located, the age of the patent at the time of the litigation, and whether the patent had been litigated previously. Occasionally, a case was transferred to another court at some point.

III. Internet Patents and the Likelihood of Litigation

A. Descriptive Results

As shown in Table 1, the Internet patents in our data set were litigated at a far greater rate than the comparison set of NIPs. Moreover, broader Internet business model patents were litigated at a much greater rate than narrower business technique patents, possibly supporting the idea that broader claim language increases the universe of potential infringers and promotes

36 This database is called DOCK-PATENT in Westlaw.
37 http://pacer.psc.uscourts.gov/
38 See supra Part
39 In the remainder of the article, we use the term “plaintiff” to refer to the patent owner and “defendant” to refer to the accused infringer, even though patent litigation is sometimes initiated by the party that does not own the patent, because by far the most common scenario has the patent owner filing as a plaintiff. When a patent owner sues for infringement, the accused infringer always files a counterclaim seeking a declaratory judgment of noninfringement and invalidity. When, because of a dispute with the patent owner, an accused infringer initiates the case by seeking a declaratory judgment of noninfringement (and usually invalidity, as well), the patent owner will file a counterclaim for infringement. The case involves the same issues regardless of which party is the initiator, but being able to initially select the venue is sometimes viewed as an advantage. See Kimberly A. Moore, Forum Shopping in Patent Cases: Does Geographic Choice Affect Innovation?, 79 N.C.L.R. 889 (2001) (finding substantive and procedural differences among federal districts).
litigation.\textsuperscript{40} Given that there is no good way to measure the breadth of claim language empirically, however, we can only surmise that such a phenomenon contributed to these results.\textsuperscript{41}

\textbf{Table 1: Litigation Rates for Internet Patents and NIPs}

\begin{center}
\begin{tabular}{|l|c|c|c|c|}
\hline
 & Total Patents in Data Set & Total Patents Litigated & Patent Litigation Rate & P-Value Univariate Comparison w/ NIPs \\
\hline
Internet patents-all & 1,093 & 111 & 10.16\% & p = 0 \\
\hline
Internet patents-model & 345 & 52 & 15.10\% & p = 0 \\
\hline
Internet patents-technique & 748 & 59 & 7.89\% & p = 0 \\
\hline
NIPs & 10,000 & 136 & 1.36\% & \\
\hline
\end{tabular}
\end{center}

B. Logistic Regression Design

We then determined whether the differences in litigation rates reported in Table 1 continued to be significant while taking into account the effects of several patent characteristics shown by prior research to be positively or negatively associated with litigation propensity and

\textsuperscript{40} If we compare the two subgroups of Internet patents (models & techniques) only with each other, the litigation rate for the broader Internet models exceeded the rate for narrower Internet techniques with an extremely high degree of statistical significance (p = 0.0003).

\textsuperscript{41} In our assessment of Internet model patents as having broader claims than Internet technique patents, we borrowed from Justice Potter Stewart:

I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description [of hard-core pornography]; and perhaps I could never succeed in intelligibly doing so. But I know it when I see it, and the motion picture involved in this case is not that." (emphasis added)

value. This is a particularly interesting question in our current study because Allison and Tiller found that the average Internet patent issued during the first few years in which such patents began being issued in substantial numbers possessed many of the same characteristics as litigated patents more generally, regardless of whether the Internet patents had been litigated. Some patent characteristics suggesting litigation propensity and private economic value can be disaggregated into sub-characteristics which themselves may differently associated with litigation likelihood than the aggregated measure of which they form a part. Because it is statistically incorrect to include both an aggregate measure and its disaggregated subparts as independent variables in the same regression model, we run different regressions for aggregates and their constituents.

Recall that, in our effort to identify litigation rates, we found it necessary to acquire a random sample of 10,000 NIPs issued during the same time-period as our data set of Internet patents to discover a large enough number of litigated NIPs for statistical analysis. Compared with the total number of issued patents, litigated ones represent rare events, thus requiring this kind of oversampling. Unlike the univariate comparisons of litigation rates, there is a need in our regression models for the data sets to be of sizes that are not wildly incomparable. This is the situation that would confront us if we used the sample of 10,000 NIPs in the regressions, unless we also drew a comparably sized sample of Internet patents. The latter is an impossibility, because (1) a relatively small number of Internet patents had been granted by the late 1990’s when we collected our population of them, and (2) we were constrained to include only Internet patents and NIPs that had been issued a long enough time ago that enough of them would have

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42 The data set of 1,093 Internet patents was the product of an effort to collect all of the patents meeting our definition issued through the end of 1999. Thus, it is a population (or “census”) rather than a sample. We do not claim to have identified 100% of such patents issued during that time frame, because we undoubtedly missed some, but the set is nevertheless a substantially complete population.
been litigated for us to have sufficient numbers for statistical analysis. It would have been impossible, therefore, for us to have Internet patents in numbers comparable to the set of NIPs from which we derived our NIP litigation rate.

As a consequence, we use only the 2,382 Internet patents and NIPs from the Allison-Tiller and ALMT studies in our regressions: 982 unlitigated and 111 litigated Internet patents from the Allison-Tiller set of 1,093, plus 990 unlitigated and 299 litigated NIPs from ALMT. If we used these 2,382 patents without adjustment, however, they would reveal a litigation rate among NIPs (i.e., patents in general) of approximately 23% (299/(299 + 990), or 299/1,289), which of course we know to be breathtakingly wrong based on both common knowledge and the obviously more accurate rate of approximately 1% derived from our examination of litigation in a random sample of 10,000 NIPs—with a random sample of this magnitude, we can infer with great confidence that this is very close to the actual rate of litigation in the general population of patents (excluding certain small subsets such as early Internet patents). We thus had to accomplish an adjustment by specifying a weighted logistic regression model derived from the rare events logistic regression technique proposed by King and Zeng.\textsuperscript{43} The model is weighted so that the proportion of litigated NIPs within our sample is the same as the inferred proportion of litigated NIPs in the general population. The binary dependent variable (litigated or not) is identified as 1 if a patent was litigated and 0 if the patent was not litigated. The weights are denoted as

\[
\mathcal{W}_1 = \frac{\tau}{\tilde{y}}
\]

and

\textsuperscript{43} See Gary King & Langche Zeng, \textit{Logistic Regression in Rare Events Data}, 9 \textit{Political Analysis} 137 (2001). The concept is similar to that of a simple weighted average, used in the logistic regression context to help solve the problem of logistic regression with rare events.
where $\tau$ is defined as the 1% rate of NIP litigation in the general population and $\bar{Y}$ is the rate of NIP litigation implied by the sample (the 23% resulting from our deliberate oversampling). \textsuperscript{44} Furthermore, $w_1$ is the weight assigned to all records containing litigated NIPs and $w_0$ is the weight assigned to all records containing unlitigated NIPs. The Internet patents, both litigated and unlitigated, received a weight of only 1 because the data set already reflects the appropriate proportion of litigated Internet patents. Using this paradigm, the following weights were applied to the NIPs in our data set:

$$
\begin{align*}
  w_1 &= \frac{1}{1289} \\
  w_0 &= \frac{99}{1289}
\end{align*}
$$

and,

$$
\begin{align*}
  w_0 &= \frac{99}{1289}
\end{align*}
$$

Our binary dependent variable is whether a patent was litigated or not. As independent variables, we used: (1) whether the patent was classified as an Internet patent (and also whether it was a Internet patent-model or Internet patent-technique), as well as (2) several patent characteristics previously found to be either positively or negatively associated litigation,
including (a) the time the patent spent in the PTO from original application filing,\textsuperscript{45} the number of inventors,\textsuperscript{46} the number of patent claims,\textsuperscript{47} the number of prior art references in the patent,\textsuperscript{48} whether the patent was originally issued to a small entity owner,\textsuperscript{49} and whether the patent was originally issued to a foreign owner.\textsuperscript{50} Because some of our independent variables are

\textsuperscript{45} See, e.g., ALMT, \textit{supra} note 8, at 459-60 (final proofs) (finding that applications for patents that were later litigated spent far more time in prosecution from original filing than did applications for patents that were not litigated).

\textsuperscript{46} \textit{Id.} at 478 (finding in both a population study and a more granular sample study that litigated patents covered inventions with slightly fewer inventors than unlitigated ones, although in the sample study for which the data correspond most closely to those in the present study, the difference was too minor to be significant). \textit{Id.} at 479. Allison & Tiller, \textit{supra} note 10, at 1058-62, argued that a larger number of inventors might be indicative of greater patent value, and found empirically that Internet patents did have significantly more inventors than the average NIP. However, Allison & Tiller’s finding largely disappeared when Internet patents were compared with NIPs in individual technology areas because the finding pertaining to the average NIP was substantially driven by the relatively large number of patents in a few technology fields such as mechanics that were characterized by few inventors. In any event, there is enough evidence that the number of inventors may be associated with litigation propensity to include it in the model, especially since it does not appear to be significantly correlated with the other independent variables we use.

\textsuperscript{47} Most researchers have found that the total number of claims within patents is strongly associated with greater litigation propensity. See, e.g., Jean O. Lanjouw & Mark Schankerman, \textit{Characteristics of Patent Litigation: A Window on Competition}, 32 RAND J. ECON. 129 (2001); Jean O. Lanjouw & Mark Schankerman, \textit{Stylized Facts of Patent Litigation: Value, Scope and Ownership}, NAT’L BUREAU OF ECON. RES. WORKING PAPER NO. 6297 (1997).

\textsuperscript{48} This can be automated because the word “claim” appears in the text of a patent claim only when the claim is a dependent one, and not when it is independent. Thus, we can count the number of times the word “claim” appears in the claims field of the patent and subtract 1 because the term also appears once at the beginning of the set of claims (i.e., “I claim . . . .,” “We claim . . . .,” “It is claimed that . . . .,” etc.). The resulting number is then subtracted from the total number of claims in the patent.

\textsuperscript{49} The total number of prior art references was found in prior research to be associated with the likelihood of litigation with a high level of significance. See ALMT, \textit{supra} note 8, at 453. Also, Internet patents contained many more total prior art references than did NIPs. See Allison & Tiller, \textit{supra} note 8, at 1040-44.

\textsuperscript{50} Litigated patents were found in prior research to have been issued disproportionately to small entity owners rather than large entities. Segregating small entities into subgroups, it was found that patents granted to individual and small business owners were much more likely to be asserted in litigation, but this was not true of nonprofits (such as universities). See ALMT, \textit{supra} note 8, at 479 Table 5. It is not uncommon for the ownership of a patent to change after issuance and before litigation, however, so the fact that litigated patents were significantly more likely to have been issued originally to small entities does not automatically mean that small entities are more likely than large entities to assert patents in litigation. See Moore, \textit{Populism and Patents}, supra note 8, at 96–97 (documenting a high rate of pre-litigation transfer of patents). See also John R. Allison, Mark A. Lemley, & Joshua Walker, \textit{Extreme Value or Trolls on Top}, 158 U. PA. L. REV. 1, 20-22 (2009) (in a study comparing characteristics of patents that had been litigated 8 or more times during a recent nine-year period with those that had been litigated once during that period, finding evidence that a substantial portion of patents in both data sets of litigated patents had been assigned after issuance and before litigation). Patents issued to foreign owners are much less likely to be litigated than those issued to U.S. owners. See ALMT, \textit{supra} note 8, at 478-79 Tables 4 & 5 (p < 0.0001 for both foreign ownership in the population study and for foreign inventorship in the more finely graded sample study. This finding is unsurprising given the significant jury bias
aggregates of others (i.e., Total Number of Claims is the aggregation of Independent Claims and Dependent Claims, Total Number of Prior Art References is the aggregation of references in a patent to prior U.S. patents, foreign patents, and other publications (“nonpatent references”)), and Small Entity ownership status is the aggregation of individual, small business, and nonprofit ownership status), we cannot place all covariates in the same regression model. Thus, we constructed two different models, one with all the aggregated independent variables and the other with the disaggregated ones.

C. Logistic Regression Results

1. Using Aggregated Independent Variables

First, we examine the relationship between the probability of a patent being litigated and whether or not it is characterized as an Internet patent (or Internet patent-model or Internet patent-technique), while controlling for all of the aggregated independent variables. The results of these regressions are reported in Table 2. Logit (1) describes the Logit model for conducting logistic regression (used when the dependent variable is binary) with all Internet patents as an independent variable, and Logit (2) describes the same model with, instead, each of the two Internet patent subgroups as independent variables.

against foreign patent owners in American patent infringement litigation. See Moore, Xenophobia, supra note 8, at 1548-49. Jury bias does not explain all of the clearly lower win rates in patent infringement litigation for foreign-owned U.S. patents, because foreign entities disproportionately acquire U.S. patents in technology areas where there is less patent litigation overall. Id. at 1533-37. However, Moore’s data make it clear that jury bias provides a substantial part of the explanation. Id. at 1548-49. The evidence shows, inter alia, that foreign-owned patents are not more likely to be invalid that those with domestic owners. Id. at 1533-35, 1542.
Table 2: Litigation Likelihood: Logistic Regression with Aggregated Variables

<table>
<thead>
<tr>
<th>Dependent Variable = Litigated or Not</th>
<th>Logit (1)</th>
<th>Logit (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent variables</strong></td>
<td><strong>Odds ratios; Standard errors in parenthesis</strong></td>
<td></td>
</tr>
<tr>
<td>Internet patent-all</td>
<td>8.419 (1.285) ***</td>
<td></td>
</tr>
<tr>
<td>Internet-model</td>
<td>10.493 (2.184) ***</td>
<td></td>
</tr>
<tr>
<td>Internet-technique</td>
<td>7.282 (1.281) ***</td>
<td></td>
</tr>
<tr>
<td>Years in PTO</td>
<td>1.134 (0.063) **</td>
<td>1.135 (0.063) **</td>
</tr>
<tr>
<td>Number of inventors</td>
<td>1.027 (0.046)</td>
<td>1.022 (0.046)</td>
</tr>
<tr>
<td>Total # of claims</td>
<td>1.007 (0.003) **</td>
<td>1.007 (0.003) **</td>
</tr>
<tr>
<td>Total # of prior art references</td>
<td>1.000 (0.001)</td>
<td>1.000 (0.001)</td>
</tr>
<tr>
<td>Small entity</td>
<td>3.110 (0.590) ***</td>
<td>2.807 (0.584) ***</td>
</tr>
<tr>
<td>Foreign owner</td>
<td>0.391 (0.153) **</td>
<td>0.396 (0.155) **</td>
</tr>
<tr>
<td>Standard Errors(^{51})</td>
<td>Robust</td>
<td>Robust</td>
</tr>
<tr>
<td>Pseudo R-squared(^{52})</td>
<td>0.167</td>
<td>0.170</td>
</tr>
</tbody>
</table>

N = 2382 *** p < 0.01; ** p < 0.05

\(^{51}\) When we say “robust” in connection with standard errors, we mean that we ran our logistic regression models in a way that accounts for the fact that the variances in the distributions of each of our independent variables might not be equal. That is, we ran our models to account for any possible heteroskedasticity in the error terms.

\(^{52}\) The pseudo R-squared is a measure of the goodness-of-fit for a logistic regression model, the model being the selected group of independent variables. See Joseph F. Hair et al., Multivariate Data Analysis 318-20 (5th ed. 1998). It is not a true R-squared as is found in OLS regression, but may be interpreted similarly. We used McFadden’s pseudo R-squared, a commonly employed pseudo R-squared method, which runs from 0 to 1 in the same manner as a true R-squared. The closer the measure is to 1, the better fit the model is to the actual data.

There are a multitude of variables that affect whether various patents are asserted in litigation, most of them idiosyncratic and undiscoverable. When, as here, there is so much noise in the data, a pseudo R-squared for even a good-fitting regression model necessarily will be relatively low on a scale of 0 to 1, as illustrated by the 0.167 and 0.170 shown in Table 2. One additional independent variable that we chose not to include and that may have slightly improved the goodness-of-fit of our models (and thus raised the pseudo R-squareds) a bit is the number of time that later patents cited the patents in our data sets as relevant prior art. Often called “forward citations” or “citations received,” this metric has been shown to be positively associated with the likelihood of litigation. One reason we chose not to include this metric as another possible explanatory variable is that it is significantly correlated with a number of the variables that we did include, such as claims and references, and we concluded that there was consequently enough multicollinearity (interactions, or correlations, among independent variables) in our models without injecting more. Although it would not have been unreasonable to include this additional variable, including it might have artificially increased our pseudo R-squared and the addition would have had little if any effect on our primary findings relating to Internet patents. The construction of any multiple regression model requires the exercise of considerable judgment.
We reported results as odds ratios for ease of interpretation. These results show that, even after controlling for the other factors itemized in Table 2 that are either known or suspected to influence litigation likelihood, being an Internet patent greatly increased the likelihood of a lawsuit (p < 0.01). A patent issued during the late 1990’s on an Internet business process was about 8.4 times more likely to be litigated than a non-Internet patent issued during the same time frame, holding other factors constant. Separating Internet patents into broader online business models and narrower online business techniques, we see that business models were 10.5 more times likely to be litigated than NIPs, while business techniques were 7.3 times more likely to be litigated. These findings were also significant at the 1% level.

The regression models also reveal that the number of years a patent spends in the PTO from original filing, total claims in the patent, and initial ownership of the patent by a small entity all have a positive and statistically significant effect on a patent’s likelihood of being litigated. Indeed, initial issuance of a patent to a small entity made the patent about 3 times more likely to be litigated, controlling for the effects of the other variables. These patents were thus either much more likely to be asserted in infringement litigation by their small entity owners or

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53 If the odds ratio is exactly 1 for an independent variable, the independent variable has no effect on the likelihood of the patent being litigated. When the odds ratio is greater than 1 for an independent variable, the variable has a positive effect on the likelihood of the patent being litigated. When the odds ratio is less than 1 for an independent variable, the variable has a negative effect on the likelihood of the patent being litigated. The amount by which the odds ratio is more or less than 1 reveals the magnitude of the effect on likelihood.

54 Our logistic regression results from using Logit models are robust to Probit and Linear Probability (OLS) models. In other words, we also tried other generally accepted models for regressing on binary dependent variables and didn't get results that would contradict those from our Logit models.

55 Both of these results are statistically significant at the 1% level.

56 When the time spent in prosecution at the PTO is measure from the original filing date, the metric captures the amount of time devoted by the applicant to the filing of various types of continuing applications, something that requires significant investment and suggests that the applicant is seeking to build a portfolio of patents on closely related technologies. This is probably an indicator of perceived patent importance by the applicant and greater willingness to invest more in the acquiring the patent. See supra note 19.

57 As with time spent in the PTO, the idea of investment-willingness in the face of greater perceived importance may also apply to other variables such as the number of claims within patents. The drafting of more claims increases attorney fees and PTO filing fees. U.S. PAT. & TRADEMARK OFF., MANUAL OF PATENT EXAMINATION PROCEDURES § 1.16 (rev. 2010).
sold to others who were far more likely to assert them.\textsuperscript{58} And, as expected, whether the patent
had a foreign owner when it was granted significantly decreased the likelihood that it would be
litigated, a finding that we discuss in more detail below.\textsuperscript{59} Also of note is that the total number
of prior art references had no effect one way or the other on the likelihood of litigation.

2. Using Disaggregated Independent Variables

Before decisively drawing the conclusions made above about Internet patents and
litigation, we performed a sensitivity analysis to ascertain whether separating the aggregated
variables into their components affects the statistical significance of the variables of interest.
More specifically, we broke the total claims, total references, and small entity owner variables
into their constituent elements, and report these results in Table 3.

\textsuperscript{58} There is an active market for subsequently litigated patents. See, e.g., Moore, \textit{Populism and Patents}, supra note 8, at 96–97; Allison, Lemley, & Walker, \textit{Trolls on Top}, supra note 8, at 20–22. Thus, even though some small entity
owners may have sold their patents prior to litigation, small entities nevertheless can be very active themselves as
patent infringement plaintiffs. See, e.g., Allison, Lemley, & Walker, \textit{Repeat Patent Litigants}, at 689-90 (final
proofs) (small entities extremely over-represented as plaintiffs for patents litigated 8 or more times during the
period 1-1-2000 to 2-28-2009). Within the category of small entities, \textit{individuals} do litigate at a slightly lower rate
than \textit{corporations} (large and small combined), but are still well represented as plaintiffs, see Moore, \textit{Populism and
Patents}, id. at 94 (“It appears that individuals litigate slightly less often than corporations—individuals receive
14.9\% of patents and initiate only 11.9\% of patent suits.”), but it is unclear what the litigation rate is for small
businesses (corporations with fewer than 500 employees) within the overall small entity category.

On average, small entity patent owners are far less likely than large entity owners to make and sell
products. On average, small entity owners may thus have less to lose from filing infringement lawsuits than large
entities. The reason is that a patent owner that does not make and sell products (a so-called non-practicing entity, or
NPE) need not fear a counterclaim for patent infringement because an NPE does not do anything that could
constitute infringement. See ALMT, supra note 8, at 468-69.

\textsuperscript{59} The Internet patents from the Allison & Tiller study had few foreign owners relative to NIPs, thus creating a
possible biasing effect in the regression models for our current study of Internet patent litigation. For the current
study, however, we ran a correlation table for Internet patents and foreign owners and found that the negative
correlation was not high enough to affect our logistic regression results in a meaningful way.
Table 3: Litigation Likelihood: Logistic Regression with Disaggregated Variables

<table>
<thead>
<tr>
<th>Dependent Variable = Litigated or Not</th>
<th>Logit (1)</th>
<th>Logit (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent variables</strong></td>
<td>Odds ratios; Standard errors in parenthesis</td>
<td></td>
</tr>
<tr>
<td>Internet patent-all</td>
<td>8.968 (1.420) ***</td>
<td></td>
</tr>
<tr>
<td>Internet-model</td>
<td></td>
<td>10.983 (2.320) ***</td>
</tr>
<tr>
<td>Internet-technique</td>
<td></td>
<td>7.803 (1.414) ***</td>
</tr>
<tr>
<td>Years in PTO</td>
<td>1.107 (0.069) *</td>
<td>1.108 (0.069) *</td>
</tr>
<tr>
<td>Number of inventors</td>
<td>1.032 (0.048)</td>
<td>1.026 (0.048)</td>
</tr>
<tr>
<td>Number of independent claims</td>
<td>1.064 (0.025) ***</td>
<td>1.062 (0.025) ***</td>
</tr>
<tr>
<td>Number of dependent claims</td>
<td>1.002 (0.004)</td>
<td>1.002 (0.004)</td>
</tr>
<tr>
<td>Number of U.S. patent references</td>
<td>1.008 (0.005) *</td>
<td>1.008 (0.005) *</td>
</tr>
<tr>
<td>Number of foreign patent references</td>
<td>1.034 (0.017) **</td>
<td>1.034 (0.017) **</td>
</tr>
<tr>
<td>Number of nonpatent references</td>
<td>0.989 (0.007)</td>
<td>0.990 (0.007)</td>
</tr>
<tr>
<td>Individual owner at issuance</td>
<td>3.092 (0.720) ***</td>
<td>2.753 (0.689) ***</td>
</tr>
<tr>
<td>Nonprofit owner at issuance</td>
<td>2.350 (1.838)</td>
<td>2.078 (1.670)</td>
</tr>
<tr>
<td>Small business owner at issuance</td>
<td>3.236 (0.723) ***</td>
<td>3.007 (0.709) ***</td>
</tr>
<tr>
<td>Foreign owner at issuance</td>
<td>0.390 (0.150) **</td>
<td>0.395 (0.153) **</td>
</tr>
<tr>
<td>Standard Errors</td>
<td>Robust</td>
<td>Robust</td>
</tr>
<tr>
<td>Pseudo R-Squared</td>
<td>0.177</td>
<td>0.179</td>
</tr>
</tbody>
</table>

N = 2382  *** p < 0.01; ** p < 0.05  * p < 0.10

As shown in Table 3, the Internet patent variable in the disaggregated-variables model was also a predictor of litigation at a 1% significance level. The substitution of the disaggregated variables for their aggregates increased the odds ratios somewhat for Internet patents to the point that they were about 9 times more likely to be litigated than NIPs. When we separated Internet patents into subgroups, we found that online business models were 11 times more likely and online business techniques were 7.8 times more likely to be litigated than NIPs,
findings that were also significant at 1%. Thus, the increased sensitivity created by drilling
down more deeply to disaggregated independent variables led to findings of somewhat greater
litigation likelihood for Internet patents as a whole and for the subgroups.

While taking into account the cumulative effects of all other independent variables in the
disaggregated models, including the type of patent, we found that the number of independent
claims, the status of the patent owner as an individual at the time of patent issuance, and the
status of the patent owner as a small business all had highly significant positive effects on a
patent’s likelihood of being litigated.

Thus, our results confirm the finding of ALMT in 2004 that it is the number of
\emph{independent} claims, not dependent claims, that accounts for the previously observed effect of
\emph{total} numbers of claims on litigation likelihood. Moreover, the disaggregated analysis teases out
the fact that the large effect on litigation propensity of small entity status is mostly accounted for
by patents originally issued to either individuals or small businesses and not by nonprofits such
as universities or research foundations. The nonprofit status of the owner at the time the patent
was issued as did have quite a large odds ratio, but the number of patents having such owners in
our data sets was much too small for the large odds ratio to be statistically significant. We can
only speculate about whether patents initially owned by universities and other nonprofits would
have been as statistically prone to end up in litigation as individuals and small businesses had
their representation been greater in the data.\footnote{It bears repeating that a patent’s original ownership status does not necessarily mean that entities having the same ownership status later file an infringement lawsuit because there is a relatively active market for patents that end up in litigation.}

As with the aggregated variables models reported in Table 2, here too we see that initial
issuance of a patent to a foreign owner significantly reduces the probability of the patent being
litigated. Again, this is unsurprising given Kimberly Moore’s clear findings of jury bias against
foreign patent owners.\(^6_1\) The finding also presents a potential contradiction in our regression results. What we have is this: (1) Foreign owners of U.S. patents are quite significantly less likely to litigate;\(^6_2\) (2) Foreign owners of U.S. patents cite significantly more references to foreign patents as prior art than do domestic owners of U.S. patents;\(^6_3\) and (3) More citations to foreign patents in U.S. patents overall significantly increases the likelihood of litigation.\(^6_4\)

Table 3A shows a matrix of U.S.-foreign ownership of U.S. patents and the citation of foreign patents as prior art references. One can see rather striking, but logically intuitive differences.

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\(^6_1\) See Moore, Xenophobia, supra note 8, at 1504.
\(^6_2\) See supra Tables 2 & 3; ALMT, supra note 8, at 454.
\(^6_3\) See Moore, Xenophobia, supra note 8, at 1537-1542.
\(^6_4\) This positive effect on litigation likelihood is of modest magnitude (odds ratio of 1.034) but is statistically significant at \(p < 0.05\) because the number of observations was relatively large. The effect that the number of foreign patent references has on litigation likelihood is probably due to the fact that it is more time-consuming and expensive for U.S. patent applicants to find and analyze foreign patents than it is for them to find and analyze prior U.S. patents. This suggests that, when a patent applicant perceives that its invention is likely to be relatively important, and perhaps more likely to be sold to someone else or litigated by the applicant itself, the applicant probably has a greater willingness to invest more in acquiring the patent. It should not be as difficult or expensive for a foreign applicant to acquire knowledge of and to analyze prior foreign patents within its own area of localized news dissemination and language facility, and litigated U.S. patents with foreign ownership do cite significantly more foreign patents than do unlitigated U.S. patents with foreign ownership. Moreover, domestic owners of litigated U.S. patents who likely have to invest more to cite prior foreign patents than they have to invest to cite prior U.S. patents are represented in much greater numbers in our data set than are foreign owners of litigated patents.
Rounding off the numbers reported in the table, we see the following: In our data set of 2,382 U.S. patents, foreign owners of *litigated* patents cited an average of 3.361 foreign patent references, while foreign owners of *unlitigated* patents cited an average of 2.426 foreign patent references. On the other hand, U.S. owners of *litigated* patents cited an average of 2.505 foreign patent references, while owners of *unlitigated* patents cited an average of 0.76 foreign patent references.

Going back to the apparent conundrum presented by the facts that, on average, foreign owned patents are much less likely to be litigated, foreign owned patents have significantly more foreign patent references, and litigated patents have significantly more foreign patent references,
we have a classic econometric question about the difference between individual effects and cross effects of variables in a model. The answer is that the previous statements look at one variable at a time, whereas the overall model doesn’t do that. Instead, it considers any variable in light of the effects of all other variables, and is also affected by attributes of a data set that are not even included explicitly as regression variables. For example, foreign ownership is clearly underrepresented in our set of Internet patents because U.S. law and U.S. inventors were the innovation forerunners in this field.\textsuperscript{65} Another example is that, even though U.S. owners cited many fewer foreign patent references overall than did foreign owners, they cited more such references in litigated patents than they did in unlitigated ones, and the number of U.S. owners of litigated patents in our data set overwhelmed the number of foreign owners of litigated patents. The situation also presents an opportunity to recognize the very important distinction between statistical significance and magnitude.\textsuperscript{66} Here, for instance, even though we found that the number of foreign patent references as a predictor of litigation was statistically significant at $p < .05$, the magnitude of the effect was modest as shown by the odds ratio of 1.034 (odds of litigation increased by 3.4\% when a patent includes reference to a prior foreign patent).\textsuperscript{67} On the other hand, the negative effect of foreign ownership on litigation likelihood was much greater in

\textsuperscript{65} Moreover, foreign owners still would be underrepresented in a data set of recent Internet patents because of U.S. dominance of Internet innovation and patenting, and because the laws of some countries make it much more difficult to get this sort of patent. [Authors’ note to editors: We could be more specific here, but more background and more citations would be required.]

\textsuperscript{66} Although an independent variable in a logistic regression model can have a positive or negative magnitude of meaningful size but not be statistically significant, and a variable can be statistically significant while having an effect of very small magnitude, significance and magnitude clearly are not independent of one another. \textit{See, e.g.} Allison & Sager, \textit{supra} note 8, at 1792 (observing the interrelationship between the statistical significance and the magnitude of effect of an independent variable’s effect). Not only magnitude of difference, but also sample size has an effect on statistical significance levels, and in multiple regression, the presence of other variables also has an impact.

\textsuperscript{67} Although an odds ratio of 1.034 reveals a modest 3.4\% increase in the odds of litigation when a patent includes a foreign patent reference, the effect is much more than modest as additional foreign patent references are added, because the odds ratio is multiplicative rather than additive. Thus, one cannot just add 3.4\% for each reference. For example, suppose that a patent has 10 foreign references. The odds are not increased by 34\%, but by $1.034^{10} = 1.397$, or nearly 40\%.
magnitude (odds ratio of 0.391—odds of litigation decreased by 61% if the patent had a foreign owner) despite having the same level of statistical significance.

We return now to the other results reported in Table 3. In the disaggregated model the amount of time a patent application spent in the PTO from its original filing was not significant in Table 3 Model 1 and only marginally significant in Table 3 Model 2, whereas it had been significant at > 0.5 in the aggregated model results reported in Table 2. The variable also experienced a substantial decrease in its odds ratio when some of the independent variables were disaggregated. This decrease in the effect on litigation likelihood of how long patent applications spent in the PTO is probably the result of changes in the correlations between time-in-prosecution at the PTO and a couple of other variables, such as the different types of prior art references.68 It is inevitable that, when working statistically with patent characteristics, some of them are correlated with each other, a fact that can complicate multiple regression analysis. The idea of investment-willingness in the face of greater perceived importance applies to more than one patent characteristic and thus to more than one of our independent variables.69 Thus, a patent applicant holding such a perception may be likely to make investments that cause an increase in multiple metrics within a patent such numbers of claims, numbers of prior art references, and numbers of continuing applications that increase time spent in the PTO.

Further, separating prior art references into their three types reveals some interesting insights. Apparently, the fact that the total number of prior art references had no effect at all on litigation likelihood in the aggregated-variables models shown in Table 2 was attributable primarily to the number of so-called “nonpatent references” (sometimes called “other

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68 For instance, the independent variable “total prior art references” was correlated with the “years in the PTO” independent variable but two of the constituent elements of total references—number of U.S. patent references and foreign references accounted for the largest part of that correlation.

69 See supra note 19 and accompanying text.
publications”). These are references in patents to prior articles in scientific journals, theses and dissertations, books and book chapters, government and industry group reports, company press releases and popular press articles, and so on. The number of these references had a very small negative effect in the disaggregated model, contributing to a small and modestly significant positive effect (p < 0.10) for the number of references to U.S. patents, and a significant positive effect for the number of references to foreign patents (< 0.5). We have no ready explanation for our finding of a negative association between litigation propensity and the number of references to items of prior art such as articles in scientific journals, a finding contrary to that of ALMT. Internet patents overall did include much larger numbers of nonpatent references than did NIPs. Because Internet patents were litigated at a much greater rate than NIPs, one might expect that the number of nonpatent prior art references would have a significant positive effect on the odds of litigation. The fact that it had a modest negative effect must have been attributable to changes in correlations with other independent variables, as occurred with time in prosecution.

We should not overlook the most important result of disaggregating certain independent variables into their constituents, however—the effect on litigation likelihood of Internet patents as a whole and the effect of the two subgroups of Internet patents remained strikingly large.

D. Limitations of Our Data

The data used in the analyses just explained has at least one unavoidable limitation. In their study of litigated patents, ALMT controlled for technology field, and to a lesser degree, for industry. Prior research had shown differential litigation propensities among technologies and

70 Allison & Tiller, supra note 10, at 1040 (finding that Internet patents included an average of 10 nonpatent references, while NIPs included an average of 2.37).
industries, which ALMT confirmed. We also wished to refine our regression analyses further by controlling for technology field but were unable to do so. Initially, we conceived of accounting for technology differences by using the PTO classifications. This did not work.

Neither the PTO nor the international patent classification (IPCs) system is suitable for delineating technology categories or industries at a conceptual level. The main problem, though, is that our data set of Internet patents all fall within the same field of technology and the same industry (computer), and consequently we were not able to effectuate a technology-industry control despite the fact that a number of different fields were represented in our set of NIPs.

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71 See, e.g., Moore, Xenophobia, supra note 8, at 1533-37.
72 ALMT, supra note 8, at 438, 472-73.
73 See Allison & Tiller, supra note 8, at 1027-28. The PTO classification system identifies most classes and subclasses at a very low level of functional abstraction and is not especially helpful in conceptually defining technologies in a science or engineering sense. PTO classes and subclasses also are frequently entwined in rather cryptic ways. For example, Class 345 is defined as “Computer Graphics Processing, Operator Interface Processing, and Selective Visual Display Systems.” The class definition states: “This class provides for processes and apparatus for selective electrical control of two or more light-generating or light-controlling display elements in accordance with a received or stored image data signal. The image data includes character, graphical information or display attribute data. The image data may include, for example, information data from a peripheral input device, from the reception of a television signal, from the recognition of image data, or from the generation or creation of image data by a computer. This class also provides for digital data processing systems or methods for data processing for visual presentation, wherein the processing of data includes the creation or manipulation of graphic objects (e.g., artificial images), text or use of an operator interface by a digital data processing system prior to use by or within a specific display system.”

Not only does the class combine different technology areas, such as computer hardware, software, and optics, but it also does so in a very functional way rather than a conceptual way. To further illustrate, Subclass 74 within Class 395 is “Machine Element or Mechanism, particularly subclass 471 for control elements which move in two planes,” showing the system’s focus on low-abstraction functionality.

The system is designed to assist patent examiners in searching for prior art according to functions achieved by inventions, not by technological concepts. Although the World Intellectual Property Organization’s system of International Patent Classifications may be better suited than the PTO’s classifications for identifying technology areas, it also was designed for purposes quite different than ours and similarly operates too often at too low a functionally oriented level to serve our definitional objectives.

74 Another unavoidable limitation is that, as stated before, the litigation of a patent is a rare event and to collect sufficient data for these events, the litigated NIPs were disproportionately sampled. Therefore, even with the weighting we performed, the standard errors and the coefficients may be biased since the rare events are coming from a finite sample. For a more in-depth discussion about the possible biases in the standard errors and the coefficients, see King and Zeng, supra note 44, at 142-143.
IV. Internet Patents in Litigation

In the previous section we showed that, among other things, Internet patents issued during the formative years of such patenting were about 8 times more likely than non-Internet patents to be litigated after controlling for other factors, the rate being even higher for patents on broader Internet models. We next analyze the cases themselves to see if there are differences in how Internet patents and NIPs fared in court after the litigation decision was made. In Part A we examine the way Internet patents and NIPs fare in courts, and in Part B we present the conclusions from our analysis.

To examine any possible differences between outcomes in Internet patent and NIP cases, we grouped the cases into four categories: trial, settlement, likely settlement, and other. We chose to examine these outcomes because we are interested the way Internet patents and NIPs are treated in the litigation process. By looking at differences between settlement rates and trial rates of Internet patents NIPs, we can better understand similarities and differences in the treatment of the two patent types once their owners have decided to sue perceived infringers. We included likely settlements since there were many situations where it was unclear from the docket whether the parties had actually settled but the disposition seemed to suggest that they did. We defined each of the categories as follows:

- **Clear Settlement**: Cases that ended in settlement but were not included in the Trial group. This includes cases for which the docket mentions settlement conferences (after which it is stated that the case either settles or is dismissed with prejudice or terminates.
by plaintiff’s voluntary dismissal); cases that are declared settled; or cases that end in a consent judgment or agreed order.

- **Likely Settlement**: Includes all cases that are dismissed with prejudice by plaintiff or both parties, joint stipulation of dismissal by both parties, plaintiff voluntary dismissals, and other docket information making it probable that the parties settled. This category does not include any of the cases in the Trial or Settlement categories.

- **Trial Win Rate**: This category contains patent-case pairs where the case actually went to trial – in some instances, the case settled after trial judgment, but because the case went to trial before it settled we include it in the trial category.

- **Other**: The other category includes those cases that do not fall within either the Trial, Settlement, or Likely Settlement categories. These cases include those that were closed administratively (put on long-term “hold” without removal from the docket), dismissed by the judge without prejudice, terminated by default judgment, dismissed with prejudice where the party was unknown, dismissed on jurisdictional grounds, and terminated because defendants went bankrupt. Also included here rather than in a separate category are summary judgments for defendants because very few of them in our data terminated the case on its merits, and the number that did was too small for regression results to be meaningful. Had there been enough dispositive summary judgments on the merits for analysis, we would have placed them in a separate category.

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75 It is worth observing that, with many cases involving multiple patents and multiple claims within each patent being asserted, saying who “won” can be dicey. Janicke & Ren sought to identify the “main winner,” which can be rather subjective and fraught with peril. Paul M. Janicke & LiLan Ren, *Who Wins Patent Infringement Cases?*, 34 AIPLA Q.J. 1, 8-9 (2006). The more precise and accurate way of trying to determine who wins a patent infringement case is to treat each patent asserted within a case as a separate assertion with a separate outcome as we did in our study by using case-patent pairs as the unit of observation. If there are any instances in which there were different outcomes for different claims within a single patent, the unit of study should be individual claims that were asserted, which one might call case-claim pairs.
We first analyzed the differences in settlement rates between the different types of litigated patents, considering only clear settlements.

Table 4: (Clear) Settlement Rates for Internet and NIP Cases

<table>
<thead>
<tr>
<th>Patent Type</th>
<th>All Cases</th>
<th>Internet Patents-All</th>
<th>Internet Model</th>
<th>Internet Technique</th>
<th>NIPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settled Cases</td>
<td>149</td>
<td>57</td>
<td>32</td>
<td>25</td>
<td>92</td>
</tr>
<tr>
<td>Total Cases</td>
<td>453</td>
<td>251</td>
<td>103</td>
<td>148</td>
<td>202</td>
</tr>
<tr>
<td>Settlement Rate</td>
<td>32.90%</td>
<td>22.70%</td>
<td>31.10%</td>
<td>16.90%</td>
<td>45.50%</td>
</tr>
<tr>
<td>P-Value Univariate Comparison w/ NIPs</td>
<td>0.0001</td>
<td>0.0155</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows that, just considering clear settlements, cases involving NIPs settled at a much higher rate than those involving Internet patents as a whole (p < 0.0001), and those involving the subgroups of Internet models (p < 0.0155) and Internet techniques (p < 0.0001). Not shown in the table is that, within the category of all Internet patents, cases involving patents on Internet models settle much more frequently than those involving patents on Internet techniques (0.0083).

Any number of factors may affect settlement rates, and some of these factors may differ depending on the type of case. For example, risk aversion and strategic behavior may vary from one kind of case to another as a result of asymmetry of stakes—the negative consequences of a loss at trial may be more severe for one party than another. Allison, Lemley, and Walker have observed that, in a patent case, the patent owner may be more willing to settle if it expects to be a
repeat player by later suing at least one other defendant for infringement of the same patent, given the existence of non-mutual collateral estoppel.\textsuperscript{76}

Patent owners who file lawsuits put their underlying patents at risk. A significant percentage of litigated patents are held invalid, \textsuperscript{77} and a finding of invalidity is the death knell for a patent. Because of the arcane civil procedure doctrine of offensive nonmutual collateral estoppel, the consequences of validity and invalidity holdings are highly asymmetric.\textsuperscript{78} A patentee who wins a suit against defendant \emph{A}, having proven the patent infringed and fought off a validity challenge, gets no credit for the win in a subsequent suit against defendant \emph{B}.\textsuperscript{79} Because \emph{B} was not a party to the first suit, it is entitled to once again challenge the validity of the patent, even on the very same grounds rejected in the first lawsuit.\textsuperscript{80} The same is true in subsequent suits against defendants \emph{C}, \emph{D}, \emph{E}, and so on.\textsuperscript{81} Indeed, for this reason Federal Circuit Judge Rich used to insist that patents were not held valid, but merely held “not invalid.”\textsuperscript{82} By contrast, should \emph{A} succeed in proving the patent invalid, the game is up. The doctrine of collateral estoppel will prevent the patentee from enforcing the patent against \emph{B}, \emph{C}, \emph{D}, or \emph{E}; each of those defendants is entitled to rely on the patentee’s prior loss to defeat the lawsuit.\textsuperscript{83} And even existing licensees will be permitted to stop paying royalties and file their own challenge to the patent.\textsuperscript{84} [footnotes in the original]

\textsuperscript{76} Allison, Lemley, & Walker, \textit{Repeat Patent Litigants}, \textit{supra} note 8, at 2 (final proofs).

\textsuperscript{77} See, \emph{e.g.}, John R. Allison & Mark A. Lemley, \textit{Empirical Evidence on the Validity of Litigated Patents}, 26 \textit{AIPLA Q.J.} 185, 205 (1998) (finding that 46\% of patents litigated to judgment are held invalid); Janicke & Ren, \textit{supra} note 75, at 5-6 (2006) (finding that patentees win only 25\% of cases litigated to judgment, in part because of invalidity and in part because of noninfringement).

\textsuperscript{78} \textit{E.g.}, Blonder-Tongue Labs, Inc. \textit{v.} Univ. of Ill. Found., 402 U.S. 313, 325 (1971) (discussing consequences and fairness of nonmutuality of estoppel in patent litigation).

\textsuperscript{79} Indeed, the Federal Circuit has even refused to allow the prior judgment to be considered by the jury in a subsequent lawsuit. \textit{See} Mendenhall \textit{v.} Cedarapids, Inc., 5 F.3d 1557, 1575 (Fed. Cir. 1993).

\textsuperscript{80} \textit{Id.}

\textsuperscript{81} \textit{Id.}

\textsuperscript{82} \textit{See, \emph{e.g.}}, Thomson, S.A. \textit{v.} Quixote Corp., 166 F.3d 1172 (Fed. Cir. 1999).

\textsuperscript{83} In patent law, this is true even if the patentee has already litigated and won one or more cases before its first loss. \textit{See, \emph{e.g.}}, Mendenhall \textit{v.} Barber-Greene Co., 26 F.3d 1573, 1577 (Fed. Cir. 1994); Miss. Chem. Corp. \textit{v.} Swift Agric. Chems. Corp., 717 F.2d 1374, 1379 (Fed. Cir. 1983); Stevenson \textit{v.} Sears, Roebuck & Co., 713 F.2d 705, 709 (Fed. Cir. 1983).

A patent owner’s propensity to settle or not could also be affected by its concern about establishing a reputation for “going to the mat” for the purpose of getting better settlements from future defendants. Also, a repeat player in patent litigation, asserting multiple patents and/or the same patent against many accused infringers may refrain from settlement and take cases to judgment more frequently than an objective observer might think rational could be simply playing a lottery in the hope of one gigantic payoff. Moreover, either party’s settlement-trial mentality can sometimes be affected by factors the same as or analogous to factors in other kinds of cases. These could include vindication, revenge, and various kinds other kinds of reputational interests.

Settlements are by far the most common litigation outcome in general, not just in patent cases. Settlement cannot necessarily be considered either a success or a failure for the plaintiff in any kind of case, including a patent one. On the one hand, anecdotal evidence reveals that at least some form of payment usually accompanies the settlement of a patent infringement case. On the other hand, a plaintiff receiving a damages payment that does not even cover its litigation expenses is unlikely to view the outcome as a success, and a plaintiff receiving a payment

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85 Allison, Lemley, & Walker, Repeat Patent Litigants, supra note 8, at 709 (final proofs). Such a plaintiff still faces the risk created by nonmutual collateral estoppels, however.


87 Email correspondence with Mark A. Lemley, a noted patent scholar at Stanford Law School who also litigates patent infringement cases (Feb. 19, 2011) (on file with authors). Hard statistics of any quality are very difficult to generate because the terms of settlement agreements are almost always made confidential by terms of the agreements.
exceeding its expenses is still likely to take that view if far more was genuinely expected in order to be viewed as compensable.

However, before drawing any conclusions about settlement rates, we also examined rates after combining clear and likely settlements. The results are reported in Table 5.

Table 5: (Clear + Likely) Settlement Rates for Internet and NIP Cases

<table>
<thead>
<tr>
<th>Patent Type</th>
<th>All Cases</th>
<th>Internet Patents-All</th>
<th>Internet Model</th>
<th>Internet Technique</th>
<th>NIPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settled Cases (Clear plus Likely)</td>
<td>333</td>
<td>187</td>
<td>81</td>
<td>106</td>
<td>146</td>
</tr>
<tr>
<td>Total Cases</td>
<td>453</td>
<td>251</td>
<td>103</td>
<td>148</td>
<td>202</td>
</tr>
<tr>
<td>Settlement Rate</td>
<td>73.50%</td>
<td>74.50%</td>
<td>78.60%</td>
<td>71.60%</td>
<td>72.30%</td>
</tr>
<tr>
<td>P-Value Univariate Comparison w/ NIPs</td>
<td>0.5982</td>
<td>0.2340</td>
<td>0.8887</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We initially categorized outcomes into two settlement groups, clear and likely, because as one can see from our discussion of how we made the calls on likely settlements that determining from docket sheets and other sources when a case settles is not a science, to say the least, and we wished to have one category of which we were absolutely sure and another of which we could be reasonably sure. We witnessed dramatic changes after combining the two groups: (1) As one would expect, settlement rates rise very substantially to levels closer to, but somewhat larger than those observed in patent cases by Kesan and Ball.88 (2) The settlement-rate differences

88 Kesan & Ball, supra note 86, at 265 (finding likely settlement rates ranging from 65 percent to 68 percent for the years 1995, 1997, and 2000). See also Allison, Lemley, & Walker, Repeat Patent Litigants, supra note 8, at 688-89 (final proofs) (in an empirical study of outcomes in patent cases filed during 2000-2008, finding a settlement rate of
between Internet patents and NIPs all but disappear, with no comparison being anywhere close to statistically significant. Internet model cases do settle at a higher rate than Internet technique cases (78.60% vs. 71.6%), but that difference is also far from being statistically significant (p < 0.2113). Given that we are fairly confident that settlements actually occurred in our group of likely settlements, and that these findings show rates of only 6-10% greater than those found by Kesan and Ball in the latter half of the 1990’s, we suspect that the rates reported in Table 5 are representative. Also, we would not have been surprised to discover rates quite different than in other analyses of settlement in patent infringement lawsuits because approximately one-half of the cases in our data set involved a very distinctive type of patent covering a new field of patenting activity.

The rate at which litigated Internet patents and NIPs went to trial represents another relevant dimension on which to make comparison. This category excludes those cases that clearly or probably settled before trial (but not those that settled after trial) and those that were disposed of by the judge’s ruling on a pretrial motion. The resulting measures, presented in Table 6, reveal a bit more evidence about the parties’ attitudes toward risk after having allowed pretrial discovery and Markman hearings89 to have concluded and having both survived summary judgment motions without bargaining to an outcome.

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89 So named after Markman v. Westview Instruments, Inc., 517 U.S. 370 (1996) (holding that claim construction—interpretation of disputed language in the claims within a patent that are being asserted against an accused infringer—is a question of law solely for judicial determination and is not a jury question. A trial judge engages in claim construction after having held a Markman hearing, which is a prerequisite to any finding of infringement or invalidity because of the need to first determine the precise contours of the claimed invention. Among other things, the Markman case has resulted in the parties to a patent case having to invest more at an earlier stage of the proceeding and increasing the allotment of resources to the pretrial stage. All of the cases in our study were decided well after the Markman ruling, so we do not have to account for any effect it may have had on settlement rates.
Table 6: Rate at Which Cases Went to Trial

<table>
<thead>
<tr>
<th>Patent Type</th>
<th>All Cases</th>
<th>Internet Patents-All</th>
<th>Internet Model</th>
<th>Internet Technique</th>
<th>NIPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Went to Trial</td>
<td>21</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Total Cases</td>
<td>453</td>
<td>251</td>
<td>103</td>
<td>148</td>
<td>202</td>
</tr>
<tr>
<td>Trial Rate</td>
<td>4.6%</td>
<td>3.6%</td>
<td>3.9%</td>
<td>3.4%</td>
<td>5.9%</td>
</tr>
<tr>
<td>P-Value Univariate Comparison w/ NIPs</td>
<td>0.246</td>
<td>0.4587</td>
<td>0.2846</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As was true of settlement rates, none of these differences is statistically significant. This was even truer for the comparison of Internet models and techniques (p < 0.8341). Although the 5.9% trial rate for NIPs in our data was substantially greater in magnitude than the settlement rates for Internet patents and subgroups (3.6%, 3.9%, 3.4%, respectively), the number of observations was simply too small to produce statistically significant results without absolute differences of much greater magnitude. Such results are an inevitable characteristic of the variable in question unless the data set of litigated patents is exceptionally large, because rates at which cases go to trial will always be quite small. Our finding of a trial rate of 5.9% for NIPs is quite close to the 5% rate found by Kesan and Ball found in the 1990’s, which adds to the confidence in our results because their data sets resembled our set of NIPs by including patents on a variety of technologies rather than the narrow patenting field in our set of Internet patents. We could speculate that a slightly lower trial rate for Internet patents than for NIPs, coupled with a slightly higher rate of settlement for those NIPs, could reveal a simple offset between settlement and trial, leaving the effect of pretrial judicial dispositions about the same in the two
groups. Again, however, the low absolute numbers and resulting statistical insignificance, along with the uncertainties created by the presence of other variables in the model, cautions against drawing such an inference.

Although it is not statistically possible to reject the idea that Internet patents and NIPs go to trial at the same rate, another reasonable difference to test for is whether the patent holder wins more or less frequently at trial when the case involves an Internet patent. We coded a plaintiff win for purposes of this analysis if there was a judgment for a patent holder after trial on at least one patent claim. The results are presented in Table 7.

**Table 7: Patent Holder Wins if Case Went to Trial**

<table>
<thead>
<tr>
<th>Patent Type</th>
<th>All Cases</th>
<th>Internet Patents-All</th>
<th>Internet Model</th>
<th>Internet Technique</th>
<th>NIPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent Owner Win</td>
<td>14</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Total Cases Going to Trial</td>
<td>21</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Patent Owner Win Rat</td>
<td>66.7%</td>
<td>66.7%</td>
<td>75.0%</td>
<td>60.0%</td>
<td>66.7%</td>
</tr>
<tr>
<td>P-Value Univariate Comparison w/NIPs</td>
<td>0.9999</td>
<td>0.7555</td>
<td>0.7933</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Internet patent and NIPs experienced identical win rates at trial. The trial win rate was larger for Internet models than for Internet techniques, but the very small numbers of observations made it almost impossible for a difference of any magnitude to be statistically significant, and the difference between 75% and 60% (3/4 and 3/5) certainly was not (p = 0.6353). Rates based on numbers of observations this small can be interesting to consider descriptively, but they provide no basis for inferences about an entire population or for predictions of likely future events.
From the results presented in Tables 5 through 7, it appears that any differences in dispositions between cases involving Internet patents and those involving NIPs are not significant, and that these different types of patents fare about the same once they are in court. Although the number of observations was large enough for us to draw inferences about settlement rates—they’re about the same—we cannot draw any inferences about rates at which patent cases go to trial or about trial win rates from such a small number of observations.

To follow up on these findings, we then ran logistic regressions to see whether the relationships between the type of patent and the settlement rates (clear and likely), trial rates, and win rates at trial still held after controlling for specific case and patent characteristics.

We first looked at the differences in the likelihood of settlement between litigated Internet patents and litigated NIPs. Using a logit regression and a case-patent pair as our unit of analysis, we analyze the relationship between the probability of a settlement and the type of patent, while controlling for a number of case and patent specific variables. For this analysis, we dropped the case-patent pairs where the case was still ongoing. We also ran these regressions using cases only as the unit of study, or observation, which removes the effects of variables that were specific to individual patents except for whether they are Internet patents or NIPs.

Because the following regressions use a database of only litigated patents, whereas previous ones also included unlitigated ones, we included litigation-related controls for (1) “litigation year” (the year in which the case was filed), and (2) “regional circuit” (the regional federal circuit in which the district court was located). The first control accounts for any possible temporal differences in patent law or litigation. The second accounts for any possible effects caused by different circuit court rules; it also provides a rough control for any geographic

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90 Again, case-patent pair refers to the fact that we had to treat the assertion of each patent as a separate observation when multiple patents were asserted in the same case, because there can be and often are different outcomes for different patents asserted in the same case.
differences in jury or judge attitudes toward this type of litigation and of the parties’ knowledge of these attitudes on settlement negotiation strategies — doing so at the district court level would have been more precise, but we believed that controlling for all 53 districts in which these cases were litigated would have provided more complication than value. An example of how the “regional circuit” control would help the explanatory power of these regressions is that an inordinate percentage of early Internet patents had California inventors, and cases involving these patents were disproportionately litigated in California federal districts where juries might favor these inventors.\textsuperscript{91} The cases in these three districts, which constituted most of the cases in the Ninth Circuit, were captured together by the circuit control.\textsuperscript{92} The results of the first of these regressions are reported in Table 8.

\textsuperscript{91} Of the 453 case-patent pairs across both Internet patents and NIPs, 99 were litigated in the 3 California federal districts, which accounted for most of the cases within the geographic area of a single circuit, the Ninth. Again, Internet patents were disproportionately of California origin. 

\textsuperscript{92} We realize that all patent cases are appealed to the U.S. Court of Appeals for the Federal Circuit, but we’re only talking about a geographic statistical control.
Table 8: Logistic Regressions for (Clearly) Settled Cases

<table>
<thead>
<tr>
<th>Dependent Variable = (Clear) Settlement or Not</th>
<th>Logit (1) Case-Patent Pairs</th>
<th>Logit (2) Case-Patent Pairs</th>
<th>Logit (3) Case Only</th>
<th>Logit (4) Case Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent variables</strong></td>
<td>Odds ratios; Standard errors in parenthesis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet patent-all</td>
<td>0.346 (0.142)**</td>
<td></td>
<td>0.472 (0.124)**</td>
<td></td>
</tr>
<tr>
<td>Internet-model</td>
<td></td>
<td>0.555 (0.254)</td>
<td></td>
<td>0.751 (0.232)</td>
</tr>
<tr>
<td>Internet-technique</td>
<td></td>
<td>0.204 (0.095)***</td>
<td></td>
<td>0.296 (0.110)*****</td>
</tr>
<tr>
<td>Total Defendants</td>
<td>1.040 (0.028)</td>
<td>1.038 (0.025)</td>
<td>1.031 (0.031)</td>
<td>1.029 (0.029)</td>
</tr>
<tr>
<td>Patent owner initiated case (not the accused infringer)</td>
<td>1.346 (0.432)</td>
<td>1.290 (0.423)</td>
<td>1.886 (0.662)*</td>
<td>1.836 (0.656)*</td>
</tr>
<tr>
<td>Transferred from other ct.</td>
<td>1.357 (0.695)</td>
<td>1.212 (0.613)</td>
<td>1.496 (0.797)</td>
<td>1.294 (0.697)</td>
</tr>
<tr>
<td>No. of Independent Claims</td>
<td>0.902 (0.039)**</td>
<td></td>
<td>0.883 (0.036)*****</td>
<td></td>
</tr>
<tr>
<td>No. of Dependent Claims</td>
<td>1.011 (0.006)*</td>
<td>1.012 (0.006)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of U.S. Pat Reference</td>
<td>1.012 (0.007)</td>
<td>1.012 (0.007)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Inventors</td>
<td>0.983 (0.083)</td>
<td>0.991 (0.085)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Entity</td>
<td>2.708 (0.731)**</td>
<td>2.427 (0.679)*****</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years in PTO</td>
<td>1.142 (0.072)**</td>
<td>1.140 (0.071)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of Patent at Litigation</td>
<td>0.740 (0.126)*</td>
<td>0.722 (0.129)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patent Previously Litigated</td>
<td>1.001 (0.262)</td>
<td>1.064 (0.281)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Errors</td>
<td>Robust</td>
<td>Robust</td>
<td>Robust</td>
<td>Robust</td>
</tr>
<tr>
<td>Sample Size</td>
<td>453</td>
<td>453</td>
<td>363</td>
<td>363</td>
</tr>
<tr>
<td>Pseudo R-Squared</td>
<td>0.187</td>
<td>0.199</td>
<td>0.131</td>
<td>0.141</td>
</tr>
</tbody>
</table>

*** p < 0.01; ** p < 0.05 * p < 0.10
Based on the results from Table 8, being categorized as an Internet patent decreased the likelihood of a case having a clear settlement even after controlling for case and patent specific factors—changing the type of patent from an NIP to an Internet patent reduced the odds of being clearly settled by about 65%, and the change was statistically significant at a high level (p < 0.01). This appears to be truer for Internet techniques (reduced odds by about 80% below what they would be if the patent was an NIP, with p < 0.01) than for Internet models (reduced odds by about 45% below that of an NIP, and change was not statistically significant). Thus, a substantial portion of the decreased odds of clear settlement shown by Internet patents was accounted for by relatively broader Internet model patents. Further, the result holds regardless of whether we consider case-patent pairs as the unit of analysis or just the cases without any information about the patent characteristics. We discuss some of the other independent variable findings after considering the regression results when both Clear and Likely Settlements are combined because, again, considering only Clear Settlements does not tell the whole story and perhaps not even the most accurate story. These results are presented in Table 9.
Table 9: Logistic Regression with Clear and Likely Settlements Included

<table>
<thead>
<tr>
<th>Dependent Variable = (Clear + Likely) Settlement or Not</th>
<th>Logit (1) Case-Patent Pairs</th>
<th>Logit (2) Case-Patent Pairs</th>
<th>Logit (3) Case Only</th>
<th>Logit (4) Case Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables</td>
<td>Odds ratios; Standard errors in parenthesis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet patent-all</td>
<td>0.774 (0.256)</td>
<td>0.921 (0.255)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet-model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet-technique</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Defendants</td>
<td>0.995 (0.040)</td>
<td>0.992 (0.035)</td>
<td>0.949 (0.028)*</td>
<td>0.935 (0.032)*</td>
</tr>
<tr>
<td>Patent owner initiated case (not the accused infringer)</td>
<td>1.140 (0.394)</td>
<td>1.111 (0.383)</td>
<td>1.385 (0.503)</td>
<td>1.347 (0.487)</td>
</tr>
<tr>
<td>Transferred from other ct.</td>
<td>1.026 (0.579)</td>
<td>0.935 (0.536)</td>
<td>1.115 (0.619)</td>
<td>1.009 (0.563)</td>
</tr>
<tr>
<td>No. of Independent Claims</td>
<td>1.051 (0.042)</td>
<td>1.030 (0.043)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Dependent Claims</td>
<td>0.998 (0.006)</td>
<td>0.999 (0.006)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of U.S. Pat. References</td>
<td>0.998 (0.010)</td>
<td>0.997 (0.009)</td>
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<td></td>
</tr>
<tr>
<td>No. of Inventors</td>
<td>0.949 (0.078)</td>
<td>0.959 (0.078)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Entity Owner</td>
<td>1.623 (0.413)*</td>
<td>1.520 (0.391)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years in PTO</td>
<td>1.041 (0.065)</td>
<td>1.044 (0.066)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of Patent at Litigation</td>
<td>0.879 (0.092)</td>
<td>0.874 (0.090)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patent Previously Litigated</td>
<td>0.908 (0.251)</td>
<td>0.929 (0.258)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Errors</td>
<td>Robust</td>
<td>Robust</td>
<td>Robust</td>
<td>Robust</td>
</tr>
<tr>
<td>Sample Size</td>
<td>453</td>
<td>453</td>
<td>363</td>
<td>363</td>
</tr>
<tr>
<td>Pseudo R-Squared</td>
<td>0.143</td>
<td>0.152</td>
<td>0.159</td>
<td>0.172</td>
</tr>
</tbody>
</table>

*** p < 0.01; ** p < 0.05 * p < 0.10
As shown in Table 9, if we combine both Clear and Likely Settlements and thus use all cases that were probably settled, being classified as an Internet patent no longer significantly affects the likelihood of settlement. This is true for both case-patent pairs and cases only. There is a negative effect on settlement probability, but it is not statistically significant. Within the group of Internet patents, being a broad Internet model patent is positively but insignificantly associated with settlement, while being a narrower business technique patent is negatively associated at the marginally significant level of 10% level. Recall that these effects are measured in comparison with NIPs while holding all of the listed variables and controls constant. Not only does the type of patent have an insignificant effect on the likelihood of settlement, but almost nothing else had much of an effect, either. At least in our data, this is clearly one of those phenomena that defy explanation by means of multiple regression techniques because it is mostly affected by factors that are unsystematic or unobservable.

An interesting finding of insignificance was that the number of defendants per case had no significant effect on the probability of settlement. One would expect such a variable to have a negative effect, that is, the more defendants there are, the less likely it is that the parties will be able to achieve a bargained outcome.\(^93\) Allison, Lemley, and Walker recently found a strong inverse relationship between average number of defendants per case and settlement probability,\(^94\) but their study involved a very different kind of data set—they compared the litigation experience between patents that had been litigated at least 8 times during a nine-year period (2000 through early 2009) and patents that had been litigated only once during that period.\(^95\) In the data set of “most-litigated” patents,” these highly litigious plaintiffs also sued a much larger  

\(^93\) See Allison, Lemley, & Walker, Repeat Patent Litigants, supra note 8 (final proofs).
\(^94\) Id at 699.
\(^95\) Id.
number of defendants per case than in the “once-litigated” set or in the data set we used for this study, thus introducing a factor that one would not find in all data sets of litigated patents.\(^96\)

Thus, it may very well be that the number of defendants in a patent infringement case has little effect on the likelihood of settlement—up to a point. There probably is a point at which the number of defendants in a case does begin to meaningfully reduce the odds of settlement, presenting the intriguing question of where that point might be.

In our last two inquiries, we used the same regression models from our examination of settlement likelihood to analyze the likelihood that a case would go to trial and, if it did, the odds of a patent owner win. The results of these regressions, which lacked reliability because of relatively small numbers—only 21 cases went to trial and final judgment—showed that Internet patents and NIPs did not differ in their likelihood of going to trial or in patent owners’ win rates. We were not able to compare the two Internet patent subtypes with NIPs. Also, when these 21 cases were subdivided into groups such as small entities, the results lacked any useful meaning.

As an example of the problems one encounters when running multiple regression models with relatively small numbers of observations, 9 of the 21 cases that went to trial asserted infringement of patents owned by small entities, and the patent owners won 8 of them, leading to some bizarre regression findings (odds ratio for small entity patents trial wins an astonishing 144.524, with a standard error of 267.621).\(^97\) Although the huge magnitude of the likelihood caused it to be significant statistically, the very large standard error caused the finding to have no reliability and thus no practical utility.

\(^96\) Id at 701 (plaintiffs in the most-litigated patent group sued an average of 5.19 defendants per case while those in the once-litigated group sued an average of 2.13 defendants per case). In our current study, plaintiffs named an average of 2.36 defendants per case.

\(^97\) When an independent variable like small entity owner status is constant or almost constant across the dependent variable(s), one gets either an extremely large or a missing standard error. See, e.g., SAS Institute, Inc., Problem Note 10397: Extremely large standard error or missing standard error when explanatory variable is constant across alternatives, available at http://support.sas.com/kb/10/397.html, last accessed on Feb. 24, 2011. Such a phenomenon is manifestly more likely to occur when the number of observations is relatively small.
V. Conclusions and Suggestions for Further Research

Internet patents and their subtypes, or at least those that were granted during the first several years of such patents’ existence, were litigated at a far higher rate than contemporaneously issued patents drawn randomly from the general patent population, even after controlling for other patent characteristics that may be associated with litigation probability. Further, patents on broadly claimed Internet business models were litigated at a significantly higher rate than more narrowly claimed Internet techniques.

Once owners of these different kinds of patents made the decision to sue, however, they and their patents experienced quite similar fates. Although cases involving Internet patents were less likely to settle before judgment than those involving NIPs, this differential did not hold up in the multiple regression analyses because of the effects of other variables. Moreover, Internet patents, the two Internet patent subtypes, and NIPs went to trial at about the same rate and experienced essentially the same win/loss rates. Also, patents issued to small entities, especially individuals and small businesses, were much more likely to be litigated than those issued to large entities. And, in our data, neither settlement nor win rates was significantly affected by the number of defendants that patent owners chose to sue.

Our findings raise some intriguing questions for further research, such as (1) whether litigation of patents on other relatively new technology fields would compare similarly to litigation of patents from the general population, the latter consisting predominantly of patents on more mature technologies; and (2) how litigation of patents on different technologies early in their maturation periods might compare to each other. Are patents on young technologies likely
to be stronger and more valuable on average because applicants perceive greater potential innovation importance and are willing to invest more in the patenting enterprise, thus contributing to more litigation? Do they generate more uncertainty because of their newness, leading to more legal contention? Also, the Internet patents, whether litigated or not, showed many of the same internal characteristics as patents in all fields that wind up in litigation, and it would be very interesting to see whether this is true of patents in other young fields of patenting activity such as flash memory, smart phones, nanotechnology, and others.

There also are some other intriguing possibilities for future research not limited to the context of new patent fields. For instance, our finding that the average number of defendants per case had no significant effect on the likelihood of settlement or on win rates may be worth pursuing further because others have found the number of defendants to significantly affect both settlement rates and win rates when patent owners named more defendants per case than they did in our data. Examining this question using other data could shed light on the wisdom of patent owners’ litigation strategies when they decide whether to sue multiple alleged infringers in a single lawsuit or in several different ones. Could there be an optimal number of defendants in patent cases? In addition, given our finding of significantly larger litigation rates for patents on online business models than on online business techniques, the former clearly appearing to have broader claims, another research question is whether methods can be devised to at least create empirical estimates of patent claim breadth for use in better predicting which patents companies should fear when assessing how much freedom of action they have to innovate in a given field. The role of so-called “non-practicing entities, or NPE’s,” also deserves more research attention. These are companies that do not make or sell products and thus are not vulnerable to patent infringement counterclaims as are product companies that sue for infringement, and
consequently may be less reluctant to sue. There is a significant but imperfect correlation between the fact that a patent was originally issued to a small entity and the identity of a patent infringement plaintiff as an NPE, and in the current study one of our findings is that patents granted to small entities, especially to individuals and small businesses, are much more likely to be litigated. Thus it may be worthwhile to investigate the NPE/Product company question in future studies of patent litigation among additional types of patents.