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PATENT TROLLS: EVIDENCE FROM TARGETED FIRMS

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ABSTRACT

We develop a theoretical model of, and provide the first large-sample evidence on, the behavior and impact of non-practicing entities (NPEs) in the intellectual property space. Our model shows that NPE litigation can reduce infringement and support small inventors. However, the model also shows that as NPEs become effective at bringing frivolous lawsuits, the resulting defense costs inefficiently crowd out some firms that, absent NPEs, would produce welfare-enhancing innovations without engaging in infringement. Our empirical analysis shows that on average, NPEs appear to behave as opportunistic patent trolls. NPEs sue cash-rich firms—a one standard deviation increase in cash holdings increases a firm's chance of being targeted by NPE litigation more than fourfold. We find moreover that NPEs target cash unrelated to the alleged infringement at essentially the same frequency as they target cash related to the alleged infringement. By contrast, cash is neither a key driver of intellectual property lawsuits by practicing entities (e.g., IBM and Intel), nor of any other type of litigation against firms. The cash-targeting behavior we observe is driven by large aggregator NPEs, and is not the behavior of small innovators. We find further suggestive evidence of NPE opportunism, such as forum shopping and targeting of firms that may have reduced ability to defend themselves against litigation. Finally, we find that NPE litigation has a real negative impact on innovation at targeted firms: firms substantially reduce their innovative activity after settling with NPEs (or losing to them in court).

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Clearly defined property rights are essential for well-functioning markets. In the case of intellectual property (IP), however, property rights are complex to define, because unlike ownership of physical assets, the space of ideas is difficult to delineate. The United States and many other countries protect inventors' IP through *patents*, property rights allowing ideas' owners sole rights of commercialization—equivalently, the right to block commercialization of arguably similar inventions—for a period of time. In the United States, the legal system is the arbiter of patent infringement; hence, legal action (or the threat of legal action) is the main lever by which patent holders challenge alleged intellectual property infringers.

A new organizational form, the *non-practicing entity* (hereafter, *NPE*), has recently emerged as a major driver of IP litigation. NPEs amass patents not for the sake of producing commercial products, but in order to claim license fees and/or litigate infringement on their patent portfolios. The rise of NPEs has sparked a debate regarding NPEs' value and impact on innovation: Proponents of NPEs argue that NPEs serve a key financial intermediary role, policing infringement by well-funded firms that could otherwise infringe upon small inventors' IP at will. Opponents cast NPEs as organizations that simply raise the costs of innovation by exploiting the fact that an imperfect legal system will rule in their favor sufficiently often—even if no infringement has actually occurred—that the credible threat of the legal process can yield rents from producing, innovative firms.[1] In part reflecting the debate on NPEs, there have been (as of today) a dozen bills introduced in Congress proposing to regulate the licensing and assertion of patents.[2]

In this paper, we provide the first large-sample evidence on precisely which corporations

[1]Bessen and Meurer (2014) estimate that from 2007 to 2010, litigation (and settlement) losses due to NPEs averaged over $83 billion per year in 2010 dollars (just summing over the losses to publicly traded firms). In magnitude, this corresponds to over 25% of annual United States industrial R&D investment.

[2]In the last four years, Congress has considered the Innovation Act (H.R. 9 and H.R. 3309), the Targeting Rogue and Opaque Letters (TROL) Act (H.R. 2045), the Patent Transparency and Improvements Act (S. 1720), the Patent Quality Improvement Act (S. 866), the Patent Abuse Reduction Act (S. 1013), the Patent Litigation Integrity Act (S. 1612), the Innovation Protection Act (H.R. 3309), the Patent Litigation and Innovation Act (H.R. 2639), the Saving High-tech Innovators from Egregious Legal Disputes (SHIELD) Act (H.R. 845), the Stopping the Offensive Use of Patents (STOP) Act (H.R. 2766), and the End Anonymous Patents Act (H.R. 2024). Meanwhile, the United States Patent and Trademark Office (2015) has undertaken an initiative on "Enhancing Patent Quality."

NPEs target in litigation, when NPE litigation occurs, and how NPE litigation impacts targeted firms' innovative activity.

We begin with a parsimonious model of an innovative economy in which a large firm must decide whether to innovate, and—conditional on innovating—must also decide whether to reduce the costs of innovation by infringing upon a small inventor's IP. NPEs help small inventors litigate in response to infringement by the large firm, but can also sometimes win lawsuits when no infringement has occurred.

Our theoretical model supports both sides of the NPE debate: NPE litigation can both reduce infringement and promote a transfer to inventors when infringement occurs, although the value of NPEs to inventors—both in terms of license fees and receipts through litigation—is only as large as the fraction of the damage award that NPEs pass through. As NPEs become effective at bringing frivolous lawsuits, however, the resulting defense costs inefficiently crowd out some firms that, absent NPEs, would prefer to engage in innovation without infringing. Somewhat paradoxically, we also find that the possibility of frivolous lawsuits can lead some innovating firms to infringe *more* because avoiding infringement may not deter suit.

The theory illustrates that the key question for assessing NPEs' welfare impact concerns lawsuit targeting behavior: *Do NPEs on average police against true infringement, or do they primarily behave opportunistically, bringing lawsuits irrespective of whether infringement has occurred?* It is impossible for us to measure targeted firms' infringement activity directly, especially given that most NPE lawsuits are settled before even early stages of evidence discovery occur. However, we can—and do—look for empirical evidence of opportunistic behavior.

We work with two independent sources of data on NPE litigation activity: proprietary data from RPX Corporation, and hand-coded, finely classified data assembled by Cotropia, Kesan, and Schwartz (2014). Together, these data sources cover the complete universe of NPE litigation from 2001 to 2012. We combine our data on NPEs with external data on publicly traded firms.

Using our linked data, we show that NPEs appear to behave opportunistically: they target firms that are flush with cash (controlling for all other characteristics) and firms that have had recent, positive cash shocks. NPEs even target firms that earn their profits from business segments having nothing to do with the allegedly infringing segments. Our findings suggest, for example, that an NPE would likely sue a firm regarding alleged information technology infringement even if the firm is earning all its revenue from a lumber division entirely unrelated to the information technology division—and even if the information technology division is unprofitable. Indeed, a one standard-deviation increase in cash level increases the probability of being sued by an NPE by 12.55% ($t = 5.60$)—a fourfold increase, and profitability in unrelated business segments is almost as predictive of NPE litigation as is profitability in the segment related to the alleged infringement.

Meanwhile, we find some evidence that NPEs may not be policing infringement. The cash-targeting we observe is mostly the behavior of large "patent aggregator" firms; small inventors' lawsuits show a different targeting pattern, in which defendants' cash holdings are not a significant factor. There is also evidence that NPEs bring lower-quality lawsuits, and some evidence that NPEs are actively forum shopping.

In theory, our finding that cash/profitability is a first-order determinant of NPE litigation could simply be picking up a general characteristic of IP litigation, or of litigation more generally. However, our results show otherwise: *Practicing entities* (*PEs*), such as IBM and Intel, who also sue each other for patent infringement, do not behave in the same way as NPEs. We hand-collected the universe of patent infringement cases brought by PEs against other PEs in our sample period (2001–2011), and find that, if anything, PEs are slightly *less* likely to sue firms with high cash balances.[3] Similarly, we found that cash is not a significant the determinant of other (non-IP) forms of litigation—tort, contract, securities, environmental, or labor. This comparison suggests that our results on NPE litigation behavior

[3]All of the other key determinants of NPE targeting have (statistically and economically) no impact on PE litigation behavior, with the exception of ongoing, non-IP-related cases, which has a positive impact on targeting for NPEs, but a negative impact for PEs.

do not just reflect general characteristics of litigation. Rather, our findings are consistent with agent-specific motivations for NPEs in targeting firms flush with cash.

Using several different empirical measures, we also find that NPEs target firms against which they have a higher *ex ante* likelihood of winning. First, we show that NPEs are significantly more likely to target firms that are busy dealing other, non-IP-related litigation. Being tied up with outside litigation increases the probability of being sued by an NPE by roughly 20% ($t = 3.53$). Moreover, we show that, controlling for all other characteristics, firms with smaller legal teams have a significantly higher probability of being targeted by NPEs. We interact our measures of cash holdings with our measures of expected lawsuit success. We find that NPEs systematically target those firms for which the *ex ante* expected profitability of litigation is large. In particular, the payout–probability interaction coefficients are all significant and economically large. Our finding suggests that nearly all the firms targeted by NPEs have large pools of cash for potential payouts and are *ex ante* more likely to result in a positive payoff to the NPE (either through an out-of-court settlement or through an in-court loss).

Lastly, we examine the real impacts of NPE litigation on targeted firms' innovative activity. Using a differences-in-differences approach, we find that firms that lose to NPEs (either in court or through settlement) reduce their research and development investment by roughly 20% going forward, relative to *ex ante* identical firms.[4] Thus, our evidence suggests that NPE litigation causes a real decrease in innovation at targeted firms. Of course, when NPEs win lawsuits, some of the losses to the targeted PE—part of the settlement or damage award, but not the legal costs—should eventually flow back to end inventors. The best available estimates suggest, however, that only a small fraction of the damages won by NPEs are actually paid back to innovators (Bessen, Meurer, and Ford (2011); Bessen and Meurer (2014)). As part of our theoretical model illustrates, when only small transfers reach end inventors, NPEs' value in encouraging invention directly is significantly dampened.

[4]To control for selection of firms targeted by NPEs, we compare firms that are sued by NPEs and "win" to those are sued by NPEs and "lose."

Taken as a whole, our evidence appears most consistent with the view that NPEs on average behave as patent trolls. NPEs chase cash, and have a real negative impact on targeted firms' innovative activity. Alternative interpretations simply do not seem to explain the entire body of evidence. For instance, our results on cash-targeting might be consistent with the possibility that targeted firms are knowingly infringing and are stockpiling cash in anticipation of litigation; however, this alternate explanation is at odds with our finding that NPEs are especially likely to target firms that have had cash shocks, and/or are embroiled in non-IP-related lawsuits. Meanwhile, the idea that NPEs solely target firms that profitability infringe on NPEs' intellectual property is inconsistent with our finding that profitability in related and unrelated operating segments are almost equally predictive of suit.

The remainder of the paper is organized as follows. Section 1 provides background and a literature review. Section 2 develops our model of the economics of innovation and intellectual property litigation. Section 3 describes our data sources. Section 4 presents our empirical results on NPE targeting. Section 5 shows evidence on the real impacts of NPE litigation behavior on innovation. Section 6 provides a discussion, and Section 7 concludes.

1 Background

A United States inventor's patenting process begins with an application to the United States Patent and Trademark Office (USPTO), which assigns the application to a patent examiner. The examiner's job is to compare the filed patent's claims to prior art, in order to determine whether the claimed invention is novel and nonobvious.[5] If the examiner decides to grant the claims in an application, then the USPTO issues a patent to the applicant.[6] The patentability of a patent's claims can be challenged in administrative proceedings before USPTO. Patent validity can be challenged in one of the 94 federal district courts by presenting prior art that

[5] *Prior art* refers to other patents, publications, and publicly disclosed but unpatented inventions that predate the patent application's filing date.

[6] In 2013, the average time between application and initial examiner report was 18.2 months and, on average, it took 29.1 months for the USPTO to issue a patent. The USPTO granted 302,948 patents in 2013. For other USPTO-related statistics, see `http://www.uspto.gov/about/stats/`.

may have been overlooked by USPTO examiners.

Since a patent confers the right to exclude others from "practicing" an invention, patent owners can sue anyone who uses, makes, sells, offers to sell, or imports their inventions without legal permission. If a patent infringement lawsuit is not dismissed in its initial stages, it proceeds to the *discovery* phase, in which both the accused infringer (defendant) and the patent owner (plaintiff) supply documents intended to demonstrate how the allegedly infringing product is made. If a party does not make or sell products or provide services based on the patented invention, then it is likely to have far fewer documents to disclose. Consequently, as NPEs do not produce products, the discovery phase can be far less costly for NPE plaintiffs than for defendants.

If an infringement suit is not settled during the discovery phase, then a court interprets the parties' claims, making determinations both as to whether the patent is valid and whether infringement occurred. A judge or jury who rules in favor of the patent owner can award monetary damages and/or issue an injunction to prohibit further infringement.

The amount of patent-related litigation has increased tenfold since 2000 (see Figure 1). According to a recent United States Government Accountability Office (2013) report, three factors contributed to the rise in IP litigation: (1) the number of patents (especially software-related patents) with unclear scope has increased; (2) courts have been granting large monetary awards in infringement lawsuits, even for ideas that make only small contributions to a product; and (3) markets place a larger valuation on patents than they did before.

Large-scale NPE patent litigation is a recent development; consequently, the empirical literature on NPEs is limited, but growing rapidly. Our paper contributes to this literature by providing the first large-sample evidence about which public corporations NPEs choose litigate, when NPEs target those companies, and how NPE litigation impacts innovative activity at targeted firms.

Many of the existing empirical studies on NPEs have found results consistent with those we present: In a series of surveys, Chien (2013a) found evidence of cash-targeting by NPEs,

consistent with the empirical results we show in Section 4.1. Leychkis (2006) has found evidence that NPEs frequently forum shop (see Section 4.6). Meanwhile, economists and legal scholars have estimated both (1) high direct costs of NPE litigation, suggesting significant harm to targeted firms (Chien (2014); Feldman (2013); Bessen and Meurer (2014)), and (2) low rates of pass-through of NPE winnings to end inventors suggesting little direct value of NPEs to small inventors (Bessen, Meurer, and Ford (2011)). Recent work sought to measure the indirect costs of NPE litigation, as well, finding that NPE litigation substantially reduces innovation at targeted firms (Chien (2013a); Tucker (2014b); Smeets (2015)) and makes it harder for targets to acquire venture capital funding (Tucker (2014a)). Cotropia, Kesan, and Schwartz (2014) developed a detailed, hand-coded dataset of 2010 and 2012 NPE litigation activities; we use this data to confirm our results out-of-sample (see Section 4.9.1). Scott Morton and Shapiro (2014) provided both theoretical and empirical evidence that—given the costs and deadweight losses of NPE litigation—the positive spillovers from NPEs would have to be "very substantial" in order to justify NPE litigation from a social welfare perspective.[7,8]

While there is some evidence that patent aggregation and litigation may have been socially valuable prior to 2000 (Galasso, Schankerman, and Serrano (2013); see also Galasso and Schankerman (2010)), survey evidence suggests that in recent years, patent assertion activity may have done little to promote innovation (Feldman and Lemley (2015)).[9] A concurrent literature in economics suggests that the impact of patent rights on innovation is highly heterogeneous (Galasso and Schankerman (forthcoming)); in particular, patents may discourage valuable follow-on innovation (Williams (2013); see also Sakakibara and

[7]Shrestha (2010) has argued that NPE litigation behavior is closely analogous to that of PEs, but his empirics are hard to square with our data. The Shrestha (2010) study is based on a subsample of only fifty-one NPEs, hand-selected on the basis that their names appear frequently in newspapers and other media. Shrestha (2010) reports fewer than 100 NPE lawsuits per year between 2000 and 2008 and no rise in the total number of IP lawsuits over the 2000-2008 period—inconsistent with both our findings and those of Cotropia, Kesan, and Schwartz (2014).

[8]In parallel, a growing theory literature has begun to illustrate how uncertainty regarding patent quality and/or technology overlap may lead to patent trolling behavior (Lemley and Shapiro (2005); Bessen and Meurer (2006); Choi and Gerlach (2014)).

[9]Feldman and Lemley (2015) find that "very few patent licenses from assertion actually lead to new innovation; most are simply about paying for the freedom to keep doing what the licensee was already doing," both in the case of NPE licensing/litigation *and* in the case of PE licensing/litigation.

Branstetter (2001); Lerner (2009); Williams (2015)).[10] Consequently, the law and policy literatures have begun to sort out potential deficiencies in the patent system more broadly (see, e.g., Lemley and Melamed (2013); Budish, Roin, and Williams (2015); United States Patent and Trademark Office (2015)), while proposing potential reforms (Lemley and Shapiro (2006); Schwartz and Kesan (2014); see especially Helmers, Love, and McDonagh (2013) which hints at how policy lessons from the United Kingdom could be used to reduce patent trolling in the United States).

Our work is also related to the literature that examines the choice between settlement and the pursuit of a court decision. Spier (2005) provides an excellent review of the economics of litigation.[11] While we focus solely on intellectual property, our paper is also related to the well-developed literature on the effect of litigation risk on firm activities.[12]

2 Model

We now introduce a model of innovation and litigation: A firm decides whether to invest in *innovation*, which has net benefit $v > 0$. If the firm does not innovate, then it produces a "safe" product which returns 0. If the firm does innovate, then it must choose whether to *infringe* on the intellectual property of a small inventor; infringement reduces the costs of innovation by $\pi > 0$ (so that innovation with infringement yields net benefit $v + \pi$).

If innovation occurs, then the inventor can bring a suit against the firm at cost c_i; in

[10] Using data obtained from an NPE (but not studying NPEs, *per se*), Abrams, Akcigit, and Popadak (2013) found an inverted-U relationship between patent citations and patent value (as measured in terms of associated revenue).

[11] Previous surveys include those of Cooter and Rubinfeld (1989), Hay and Spier (1998), and Daughety and Reinganum (2000).

[12] Prior research has investigated the impact of litigation risk on several characteristics, including cash holdings (Arena and Julio (2011)), equity-based compensation (Jayaraman and Milbourn (2009)), IPO underpricing (Lowry and Shu (2002); Hanley and Hoberg (2012)), institutional monitoring and board discipline (Cheng, He Huang, Li, and Lobo (2010)), conservatism in debt contracting (Beatty, Weber, and Yu (2008)), audit fees (Seetharaman, Gul, and Lynn (2002)), and auditors' resignation decisions (Shu (2000)). Papers have also investigated the relationship between managers' financial reporting and disclosure decisions and firms' litigation risk (see, e.g., Skinner (1994, 1997); Francis, Philbrick, and Schipper (1994); Johnson, Kasznik, and Nelson (2000); Rogers and Van Buskirk (2009)).

that case, the firm pays court costs c_f.[13] The inventor can bring a suit (i) on his own or (ii) indirectly through an NPE. For now, we assume that the is no possibility of licensing the inventor's intellectual property; we later add licensing to the model, and investigate the impacts of NPEs on license rates.

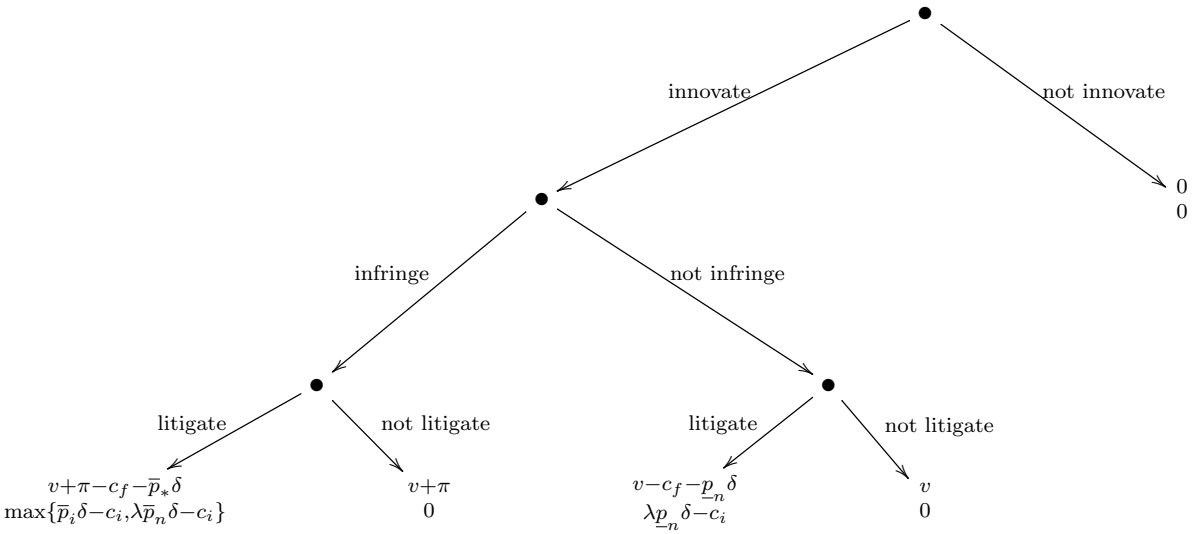

Figure 1: The innovation and litigation game: In stage 1, the firm decides whether to innovate. If the firm chooses to innovate, then he must decide whether to infringe. Then, the inventor litigates (either on his own or through the NPE) if doing so is profitable. For each end node, the top term denotes the firm's payoff, and the bottom term denotes the inventor's payoff.

Courts are assumed to be imperfect. The likelihood that a suit is successful depends on whether infringement has actually occurred, and on whether an NPE is involved. The probability that a suit succeeds is given by

	if(infringement)	if(no infringement)
the inventor sues on his own	$\overline{p}_i$	$\underline{p}_i$
the inventor sues through an NPE	$\overline{p}_n$	$\underline{p}_n$

.

We normalize $\underline{p}_i$ to 0, so that the inventor has no chance of succeeding in court unless

[13] We assume throughout that the NPE passes the costs of litigation through to the inventor. This assumption is not necessary for the qualitative results—it just serves to simplify the exposition.

infringement has occurred. We also assume that

$$\overline{p}_n > \overline{p}_i \text{ and } \underline{p}_n > \underline{p}_i = 0,$$

i.e., that the NPE is always more effective in bringing suit than the inventor is alone—irrespective of whether infringement has occurred. It is also sensible to assume that $\overline{p}_i > 0$ and $\overline{p}_n > \underline{p}_n$, although these assumptions are not strictly necessary for our analysis.

If the inventor sues on his own, he receives the full damage award δ from the firm. If instead the inventor sues through an NPE, he receives fraction $\lambda < 1$ of the damages δ; fraction $(1 - \lambda)$ go to the NPE.

If the firm infringes, then the inventor brings suit when

$$\max\{\overline{p}_i\delta - c_i, \lambda\overline{p}_n\delta - c_i\} > 0 \quad \Longleftrightarrow \quad \max\{\overline{p}_i, \lambda\overline{p}_n\} > \frac{c_i}{\delta}.$$

When $\overline{p}_i \geq \lambda\overline{p}_n$, the inventor sues on his own; when $\overline{p}_i < \lambda\overline{p}_n$, the inventor sues through the NPE.

Thus, if $\max\{\overline{p}_i, \lambda\overline{p}_n\} < \frac{c_i}{\delta}$ (bringing suit is never profitable for the inventor in case of infringement), then the firm will always choose to innovate and infringe (and the inventor will never sue), so that the firm receives total payoff $v + \pi$ and the inventor receives 0.

If $\max\{\overline{p}_i, \lambda\overline{p}_n\} > \frac{c_i}{\delta}$ and the firm innovates and infringes, then the firm receives total payoff

$$v + \pi - c_f - \overline{p}_*\delta, \tag{1}$$

where here we take

$$\overline{p}_* = \begin{cases} \overline{p}_i & \overline{p}_i \geq \lambda\overline{p}_n \\ \overline{p}_n & \overline{p}_i < \lambda\overline{p}_n. \end{cases}$$

In that case, i receives $(\max\{\overline{p}_i, \lambda\overline{p}_n\})\delta - c_i$.

If the firm does not infringe, then the inventor brings suit (through the NPE) when

$$\lambda \underline{p}_n \delta - c_i > 0 \quad \iff \quad \lambda \underline{p}_n > \frac{c_i}{\delta}.$$

In this case, if the firm innovates, then he receives total payoff

$$v - c_f - \underline{p}_n \delta. \tag{2}$$

We henceforth assume that $\max\{\overline{p}_i, \lambda \overline{p}_n\} > \frac{c_i}{\delta}$, so that bringing suit is profitable for the inventor only if the firm infringes. If $\lambda \underline{p}_n < \frac{c_i}{\delta}$, then no suit occurs unless the firm infringes, so if the firm innovates, then he infringes exactly when the benefits of infringement outweigh the costs, i.e., when

$$v + \pi - c_f - \overline{p}_* \delta > 0 \quad \iff \quad v + \pi > c_f + \overline{p}_* \delta.$$

If $\lambda \underline{p}_n > \frac{c_i}{\delta}$, so that bringing suit is profitable for the inventor even if the firm does not infringe, then, conditional on choosing to innovate, the firm's decision as to whether to infringe depends on the comparison of (1) and (2). If the firm innovates, then he infringes exactly when

$$v + \pi - c_f - \overline{p}_* \delta > v - c_f - \underline{p}_n \delta \quad \iff \quad \frac{\pi}{\delta} > \overline{p}_* - \underline{p}_n. \tag{3}$$

2.1 Impact of NPEs on Innovation and Infringement

Combining the preceding observations, we see that:

- When the NPE is significantly more effective at bringing suit than the individual inventor is (i.e., when $\overline{p}_n > \overline{p}_i/\lambda$), and $\underline{p}_n \to 0$, so that the NPE is ineffective at bringing *nuisance suits* (that is, suits when no infringement has occured), the NPE reduces total

infringement: A suit occurs only after infringement, and the firm infringes if and only if

$$v + \pi > c_f + \overline{p}_n \delta. \tag{4}$$

Importantly, infringement is strictly lower than if the NPE were absent, as (4) is tighter than $v + \pi > c_f + \overline{p}_i \delta$, which is the condition that determines infringement absent the NPE.

- However, as the NPE becomes better at bringing nuisance suits, that is, as $\underline{p}_n \to 1$, we have $(\overline{p}_* - \underline{p}_n) \to 0$, so that (3) always holds. In that case, all innovating firms will infringe—even if the benefits of infringement are small. Consequently, if either the defense costs c_f or the damages δ are sufficiently large, then we have

$$v + \pi - c_f - \overline{p}_* \delta < 0,$$

so that the firm will choose not to innovate.

- If $\lambda\delta > c_i$—bringing suit through the NPE is individually rational for the inventor if it is guaranteed to be successful—and either the defense costs c_f or the damages δ are sufficiently large, then as $\underline{p}_n \to \overline{p}_n \to 1$, the firm always chooses not to innovate even if, absent the NPE, the firm would choose to innovate without infringing.

  Specifically, the firm chooses not to innovate when $v+\pi-c_f-\overline{p}_*\delta < 0$. If $v+\pi-c_f-\overline{p}_i\delta < v$, then the firm would innovate without infringing if there were no chance of nuisance suit. Thus, if $\underline{p}_n$ is sufficiently high and the benefits of infringement are low ($\pi < c_f + \overline{p}_i\delta$), the presence of the NPE leads mid-range innovations (those having values $v < c_f + \overline{p}_*\delta - \pi$) to be crowded out of the market.

2.2 Impact of NPEs on IP Licensing

Now, we suppose that the inventor and firm can agree to license terms *ex ante*, in exchange for committing not to litigate infringement. We assume that the firm has all the bargaining power, so that it can force the inventor to take a license that just barely makes him indifferent regarding litigation.

If the firm innovates and infringes, then the inventor stands to earn

$$\max\{\overline{p}_i\delta - c_i, \lambda\overline{p}_n\delta - c_i\} > 0$$

if he brings a lawsuit. Thus, the firm can license the invention for

$$\max\{\overline{p}_i\delta - c_i, \lambda\overline{p}_n\delta - c_i\}. \tag{5}$$

Examining (5), we see that as expected, the NPE only improves the terms of licensing for the inventor when $\overline{p}_i < \lambda\overline{p}_n$, that is, when the inventor would prefer to sue through the NPE instead of litigating on his own. But then the value of the license to the inventor is mediated by the rate at which the NPE passes value through to the inventor: No inventor gains more through licensing than he would earn through bringing suit (although licensing is more efficient because it saves court costs). In particular, if λ is small, then the inventor does not gain much through licensing.[14]

2.3 Welfare Impact of NPEs

Our model illustrates that the welfare impact of NPEs is ambiguous.

When NPEs are more effective at bringing suit than individual inventors are, the threat of NPE litigation can reduce infringement and promote a transfer to inventors when infringement occurs. However, the value of NPEs to inventors is mediated by the fraction λ of the damage

[14]Even so, when λ is very small, it could still be the case that $\overline{p}_i < \lambda\overline{p}_n$ if, as is commonly believed, small inventors are virtually powerless to bring suits against large firms.

award that NPEs pass through: for the NPE to be a useful intermediary, it is necessary that $\overline{p}_n > \overline{p}_i/\lambda$—either most of the proceeds of the suit must go to the inventor, or the NPE must be *much* more effective at litigation than the inventor is. The possibility of NPE-backed lawsuits may help inventors extract licensing fees from firms, but again this effect is mediated by the pass-through rate λ; if λ is small, then the inventor cannot extract a high licensing fee.

Meanwhile, if the NPEs become effective at bringing nuisance lawsuits, then in equilibrium NPEs bring lawsuits even absent infringement. Somewhat paradoxically, this leads innovating firms to infringe *more*, since they know that avoiding infringement will not deter suit.[15] Additionally, the cost of nuisance lawsuits inefficiently crowds out welfare-increasing innovation by some firms that, absent NPEs, would prefer to innovate without infringing.

3 Data

We obtain information on NPEs from RPX Corporation, a company that tabulates information on NPE behavior, including data on patent litigation.[16] RPX Corporation has collected data going back to 1977, capturing from Public Access to Court Electronic Records (PACER) every lawsuit filed by more than 4000 NPEs (approximately 850 parent companies, and 3300 affiliates); the data is thus systematic, and not based on self-reporting.[17,18] We replicate all of our analysis—and find nearly identical results in magnitude and significance—using the hand-coded, publicly available NPE activity data collected by Cotropia, Kesan, and Schwartz (2014) for the years 2010 and 2012 (see Section 4.9.1 and Appendix Table A4).

Patent assertions by NPEs (e.g., "demand letters"), while not formal legal actions, do

[15]This finding echoes the classical insight of Polinsky and Shavell (1989) that when court error is possible, if plaintiffs' costs are low (or if the gains from suit are sufficiently high), then potential defendants will choose to disobey the law, as they will be sued irrespective of whether they obey the law.

[16]RPX Corporation defines an NPE as "A firm that derives the majority of its revenue from licensing and enforcement of patents." Under this definition, traditional legal entities established to license and enforce patents encompass the majority of NPEs. Additionally, individual inventors may be counted, while universities will not be counted (unless they have patent enforcement subsidiaries).

[17]Chien (2013b) compared a subsample of about 1000 of RPX's codings to her own hand-codings, finding no more than 7% disagreement.

[18]RPX Corporation cleans its raw filing data (for instance, removing some "administrative duplicates" representing the same case, but moved across districts).

occur. Patent assertions are unreported by nature, so there is unfortunately no comprehensive dataset of these actions. However, it is widely believed that informal patent assertions have been in decline recently, and are projected to decline further. The two biggest factors driving this decline are the decreasing credibility of patent assertions (given the availability of the formal legal channel),[19] and the rise of legislation (both state and federal) to hold entities liable for unsubstantiated demand letters.[20] Furthermore, as many more NPEs are now suing (see Table I, Panel B), non-legally binding letters simply alleging infringement (and asking for money) are becoming less credible signals. The equilibrium result is that the economically large alleged IP infringements appear to be addressed through lawsuits (all of which are in our data), and this is becoming increasingly true over time. We thus feel that RPX Corporation's systematic and exhaustive collection of NPE lawsuit data likely captures the economically important (and increasingly dominant) component of NPE behavior, even though it does not fully capture patent assertions not backed by litigation (see also Feldman and Lemley (2015) for supporting survey evidence). In Table I (Panel A), we present summary statistics on the firms included in our analysis.[21]

According to RPX Corporation, roughly 69% of NPEs' patents were acquired externally (purchased) by NPEs and their subsidiaries, whereas 19% were originally assigned to NPEs.[22] In total, the data provide detailed information on 13,930 litigation actions by NPEs (i.e., where an NPE is the plaintiff). We focus on the 7,100 NPE cases in which the defendant firm is publicly traded, as for these defendants we can obtain rich, detailed characteristic data for which reporting is required by the Securities and Exchange Commission.

Panel B of Table II shows the time-series of NPE litigation data through our sample period, 2001-2011. As mentioned above, we report data both on all NPE litigation (Column 1) and litigation focused specifically on publicly traded firms (Column 2). From Panel B,

[19] One company executive relayed to us his reply to NPEs that send demand letters: "If you have a truly viable case you will sue; otherwise don't waste my time with this letter(!)."

[20] See, e.g., the Executive Office of the President (2013) report on "Patent Assertion and U.S. Innovation."

[21] Appendix Table A1 presents detailed descriptions of the specific data fields used in our study.

[22] The remaining 12% are a blend of originally assigned and acquired patents.

we see that there has been a sharp rise in NPE lawsuits against publicly traded firms (and all firms more generally) over the past decade. By 2011, 13% of all publicly traded firms were sued by an NPE each year. This rise in IP litigation is also depicted in Figure 1, which first shows the total rise in Intellectual Property (IP) litigation over our sample period, and then separates the rise into the IP cases brought by NPEs and IP cases brought by PEs. From Figure 1, it is apparent that the rise in overall IP litigation is entirely driven by NPE suits. PEs' IP litigation has remained constant over the sample period. We revisit and examine more systematically the difference in IP litigation behavior between NPEs and PEs in Section 4.2.

We obtain firm-level patent information from the database used by Kogan, Papanikolaou, Seru, and Stoffman (2012).[23] This database contains utility patents issued by the USPTO between January 1, 1926 and November 2, 2010, along with citation data on those patents.[24] We obtain information on the in-house legal counsels and law firm associations of public firms from ALM Legal Intelligence, which searches public records to find outside counsel used by companies for corporate, contract, labor, tort, and IP litigation.

To identify involvement in litigation events not related to IP, we use the Audit Analytics Litigation database, which covers the period from 2000 to 2012 and reports information on litigation for Russell 1000 firms from legal disclosures filed with the SEC. Audit Analytics collects details related to specific litigation, including the original dates of filing and locations of litigation; information on plaintiffs, defendants, and judges; and, if available, the original claim amounts and the settlement amounts.

[23]We thank Leonid Kogan, Amit Seru, Noah Stoffman and Dimitris Papanikolaou for providing both patent and citation data.

[24]The USPTO defines *utility patents* as patents issued for the invention of new and useful processes, machines, manufactures, or compositions of matter, or new and useful improvements thereof. A utility patent generally permits its owner to exclude others from making, using, or selling the patented invention for a period of up to twenty years from the date of patent application filing. Approximately 90% of the patent documents issued by the USPTO in recent years have been utility patents.

4 Results

4.1 Cash-Targeting

We begin by examining the determinants of NPE litigation behavior. As a start, we parameterize a central concern of opponents to NPEs; namely, that NPEs bring nuisance suits (i.e., $\underline{p}_n > \frac{c_i}{\delta\lambda}$), and that their prime driver is the ability of targeted firms to pay large damages or settlement fees. We use both levels of cash balances on the balance sheet (*CashLevel*) and changes in cash holdings (*CashShock*) as proxies for the potential proceeds of a suit. We include several firm- and time-level control variables, such as the firm's market value, book-to-market ratio,[25] prior year's stock market performance, and number of recent patent filings, along with time and firm fixed effects. In Table II, we report OLS regression results of the following specification:

$$SuedByNPE = f(TotalAssets, MarketValue, BM, PastReturn, PatentStock, CashLevel, CashShock).$$

The outcome variable, *SuedByNPE*, is a dummy equal to 1 if the firm was litigated by an NPE in a particular year. *CashLevel* is the total amount of cash reported on the balance sheet as of the beginning of the previous fiscal year. *CashShock* is a dummy variable equal to 1 if the change in cash in the most current fiscal year, compared to the previous fiscal year's cash level, is among the top 90% of cash changes in the cross-section. We include firm fixed effects to capture unobserved firm-level time-invariant factors that are correlated with NPE targeting. Likewise, we include time fixed effects to control for variation in litigation activity specific to a given year and for any time trends in litigation propensity. We report various specifications to show the incremental value of each covariate on overall model fit. Column 4 of Table II represents our preferred specification, which includes firm-level characteristics (market value, book-to-market ratio, asset size, prior stock performance of equity), time and firm fixed effects, and our cash variables. We use a log transformation of all variables to

[25] We use Tobin's Q to proxy for investment opportunities.

minimize the effect of outliers.[26] We cluster our standard errors at the firm level in order to broadly allow for any time-series dependency in the probability of being sued over the course of the sample period.

Table II uncovers a strong and consistent pattern: Firms with large cash balances and firms with positive shocks to their cash holdings are more likely to be targeted by NPEs. Controlling for other determinants and for firm and time fixed effects, the *CashLevel* coefficient in Column 2, is 0.0839 ($t = 5.51$), is large and significant, as is the *CashShock* coefficient in Column 3, 0.0185 ($t = 2.02$). To get an idea of the magnitudes, we use the coefficient estimates in the full specification in Column 4. With the average firm-level cash holding of \$300 million, the 0.0857 ($t = 5.60$) coefficient on *CashLevel* implies that a one standard-deviation increase in cash balance increases the chances of being sued by 12.55%. Given that the unconditional probability of being sued for patent infringement is approximately 4.42%, this is close to a fourfold higher probability of being targeted (16.97% vs. 4.42%). The coefficient on *CashShock*, 0.0222 ($t = 2.46$), implies that the probability of being sued goes up nearly 50% following a positive cash shock. Both of these estimates show the large economic impact of cash on NPE targeting.

In sum, Table II reveals the strong impact of cash on NPEs' targeting decisions. In particular, in Column 4, both of these effects are estimated including firm and time fixed effects, along with fine controls for firm size, past returns, and patent stock. Thus, the large coefficients can be interpreted as showing that a firm is likely to be targeted by NPEs when it has an abnormally high cash level (or a shock to that cash level) relative to all other firms' cash levels (and shocks).

We have run a number of robustness checks exploring the relationship between cash and NPE litigation. First, in Panel B of Table VIII, we run specifications identical to those of Table II, but using logit and probit estimation as opposed to OLS. The coefficients on cash remain large and significant, with the implied magnitudes even slightly larger in point

[26]Neither the magnitudes nor the significance levels of our coefficients change appreciably when we do not use log transformation.

estimate. Furthermore, we replace the dummy dependent variable *SuedByNPE* with its continuous counterpart *TimesSued*, measuring the number of times a given firm is sued by NPEs in any given year. We estimate the model in OLS (and Tobit) in the table, and find that both *CashLevel* and *CashShock* are large and significant predictors of the intensity with which firms are sued by NPEs. Next, in Appendix Table A3, we test for any impact of multicollinearity on the estimates. From Appendix Table A3, we see that multicollinearity is clearly not an issue—the coefficients on *CashLevel* and *CashShock* remain large, significant, and importantly stable irrespective of the addition or deletion of any given control variable.[27] Lastly, we cluster standard errors by year (instead of by firm), and estimate specifications with industry (as opposed to firm) fixed effects in Appendix Table A3. Both of these adjustments have nearly no impact on the magnitude or significance on the *CashLevel* and *CashShock* coefficients.

4.2 IP Litigation Behavior of Practicing Entities (PEs) & Litigation Behavior against Firms more Generally

A reasonable response to the results in Table II is to expect that cash-targeting should be the behavior of *any* profit-maximizing litigant. It makes little sense to sue a firm—incurring potentially sizable legal costs, along with the opportunity costs of foregone suits—if the target firm has no ability to pay *ex ante*. However, as it turns out, cash targeting is *not* generally a first-order determinant of litigation beyond NPE IP lawsuits. To see this, we compare the determinants of NPE IP litigation to those of PE IP litigation, and to the determinants of litigation activity more broadly.

4.2.1 IP Lawsuits Brought by PEs

NPEs do not have a monopoly on Intellectual Property litigation. PEs like Apple, General Electric, and Intel also sue each other for patent infringement. If our results were simply

[27]The coefficients are essentially unchanged in magnitude and significance across specifications.

picking up general characteristics of IP litigation, then we might expect to see PEs behaving in much the same way as NPEs. In order to compare PE and NPE behavior, we hand-collected the universe of patent infringement cases brought by PEs against other PEs in the same period (2001-2011). As we already observed in Figure 1, the rise in IP litigation is driven by NPEs. While NPEs have an exponential-type rise in IP litigation over the sample period, PEs' IP litigation has remained essentially constant. Thus, in an aggregate time-series sense, we see a difference between the litigation behavior of the two groups.

We run a more formal analysis of the determinants of PE lawsuits, using a set-up identical to that used for NPEs in Section 4.1. We replicate the specifications used in Table II, but this time we use *SuedByPE* as the dependent variable.[28] The results of this analysis are in Column 1 of Table III. We see that PEs behave very differently from NPEs. Nearly all of the predictors of NPE litigation behavior have a small and insignificant impact on PE litigation behavior. Moreover, the impact of cash goes mildly in the *opposite* direction (in point estimate).

Of course PEs likely have motivations for IP litigation beyond those of NPEs (e.g., competitive responses, defensive tactics, retaliative litigation). However, this comparison does suggest that the results on NPE litigation behavior do not simply reflect general characteristics of IP litigation over time or within the cross-section. Rather, they are consistent with agent-specific motivations for NPEs in targeting firms flush with cash.

4.2.2 Other Litigation Behavior

We next move on to a more general setting, considering *all* lawsuits filed against firms. If the cash-targeting in NPE IP litigation is a general feature of litigation—as we might think—then cash-targeting should show up in other litigation categories. From Audit Analytics, we collected the entire slate of disclosed legal actions taken against publicly-traded firms. Audit Analytics covers the 2000–2012 period and reports information on litigation against Russell

[28] *SuedByPE* is a dummy variable equal to 1 if a firm *only* faces IP lawsuits from PEs in a given year.

1000 firms, recording legal disclosures filed with the SEC.[29]

We run specifications identical to those of Table II, for all other litigation categories. The results are shown in Table III. From Column 2 of Table III, we see that large amounts of cash (or cash shocks) are not positively related to non-IP litigation actions, in aggregate. Even when we separate out the different categories of litigation (tort, contract, securities, environment, and labor), large cash balances are never a significant positive predictor of targeting.[30]

So what drives non-IP litigation? The results suggest that the main determinant of non-IP cases is the infraction itself (e.g., polluting a local waterway in the case of an environmental suit). Importantly, these other cases often have more concrete and provable actions taken by the defendant, as opposed to IP infringement, where the property right is itself more amorphously defined (and so infringement is more subjectively determined). This extra scope given in IP cases makes IP a potentially good candidate for opportunistic, purely profit-driven legal activity.

The sum of the evidence in Tables II and III shows that NPE IP litigation is unique in its cash-targeting nature, in comparison to other forms of litigation, and even within the fine space of IP litigation. In the following sections we explore more closely the behavior of NPEs, and examine whether NPE behavior appears to be—on average—opportunistic legal action.

4.3 Targeting Unrelated Profits

In this section we examine whether NPEs go after profits *unrelated* to alleged infringement. Using finely reported business-segment level disclosures, we are able to extract and separate profits in the business segments related to the alleged infringement from those profits in unrelated segments. In order to do this, we use finely reported business segment disclosures.

As of 1976, all firms are required by Statement of Financial Accounting Standards (SFAS)

[29] Audit Analytics collects details related to specific litigation, including the original dates of filing and locations of litigation; information on plaintiffs, defendants, and judges; and, if available, the original claim and final settlement amounts.

[30] In fact, the sign on cash (driven by tort cases) is even slightly negative for these other cases in aggregate.

14 (Financial reporting for segments of a business enterprise, 1976) and SFAS 131 (Reporting desegregated information about a business enterprise, 1998) to report financial information for any industry segment that accounts for more than 10% of total annual sales. Using these segment-level filings, we extract information on industry classification, sales, and cost of goods sold for each segment of each conglomerate between 2000 and 2011. We then use the concordance between international patent classification (IPC) codes and four-digit United States Standard Industrial Classifications (SIC) to identify the conglomerates' segments associated with the NPE-litigated patents.[31]

After identifying segments related to allegedly infringed patents, we split each NPE-targeted firm's segments into *related segments* and *unrelated segments*. A firm's related segments are those segments that could potentially use the litigated patent in regular operations; its unrelated segments are those that could not. We compute each segment group's gross profits by subtracting cost of goods sold from segment group sales.[32]

We note that not all conglomerates report segment-level information in the same format. For example, a conglomerate may report information on one segment only, or it may report cost of goods sold for only one of the segments in which it operates. Therefore, our final sample contains only conglomerates for which we have both cost and revenue data on at least one related segment and one unrelated segment.

We estimate a model to test whether the probability of being sued by an NPE is correlated with profits obtained from *unrelated* segments, even after controlling for the profitability of related segments. In this model, we include conglomerate fixed effects to control for conglomerate-level unobserved litigation probability. We also control for industry-wide shocks to profitability, by including a variable measuring the average profitability of the segment's industry.

[31]The concordance file we use was developed by Silverman (2003) and later improved by Kerr (2008). This concordance has been used in several other studies, including those of McGahan and Silverman (2001) and Mowery and Ziedonis (2001).

[32]While we would ideally prefer to measure cash at the segment level in order to make our segment-level analysis completely analogous to the tests in Tables II and III, segment-level cash variables are not reported. Thus, we use profitability (revenues net of costs) at the segment level to proxy for profitability of suit.

The results of our segment-level analysis are shown in Table IV. Column 1 of Table IV shows the basic model, while Column 2 includes conglomerate fixed effects. Both columns tell the same story. Consistent with the results in Table II, *RelatedSegmentProfitability* is a large and significant predictor of NPE targeting. But so is *UnrelatedSegmentProfitability*, with nearly the same magnitude and significance. In other words, NPEs seem not to care where their proceeds come from; an NPE's probability of suing a firm increases with the firm's profits even if those profits are derived from segments unrelated to the patent under litigation. In Column 2 of Table IV, we see that the coefficient on *UnrelatedSegmentProfitability*, 0.0033 ($t = 2.61$), implies that, controlling for the profitability of a segment related to the patent allegedly being infringed, a one standard-deviation increase in a completely unrelated segment's profitability increases the chance of being sued by 0.8% (relative to a mean of 1.8%). This compares to an increase in probability of 1% for the same size increase in a related segment's profitability ($t = 3.53$).

Column 3 of Table IV repeats the related vs. unrelated segment comparison for PE firms. From Column 3, we see that neither *RelatedSegmentProfitability* nor *UnrelatedSegmentProfitability* positively predicts PE targeting activity, again highlighting the differences between NPEs' and PEs' litigation targeting behaviors.

In sum, the results in Table IV provide additional, more finely-measured, evidence that NPEs behave opportunistically by targeting cash indiscriminately—NPEs target related cash and unrelated cash at essentially the same rate.

4.4 Which NPEs are Driving Cash Targeting? Large Aggregators vs. Small Inventors

NPEs take many organizational forms. We next explore whether the cash-targeting behavior seen in Tables II and IV varies by NPE type. As mentioned in Section 3, we exclude universities from the sample. This leaves essentially two main categories of patent asserters in our data: *large aggregators* (*LAs*, coded as "Pure Patent Licensing" by RPX) and *small*

innovators (*SIs*, coded as "Inventor(s)" or "SPVs by Inventor(s)" by RPX). In our sample, 54.05% of the 7,100 cases have a large aggregator as a plaintiff; small inventors constitute 35.26% of cases. The remaining 10.68% of cases are not included in the analysis presented in this section, as those cases could not be clearly assigned to the LA group or the SI group. Detailed information on plaintiff types as well as comparison to other samples is provided in Appendix Table A4.

In Table V, we decompose the results shown in in Table II by NPE type. In Column 1 of Table V, the regressand takes a value of 1 if the firm is sued by both a large aggregator (LA) and a small inventor (SI) in the given year. In Columns 2, and 3 of Table V, we reestimate the same specification with the regressand defined as 1 when a firm is only sued by a large aggregator (Column 2), or by a small inventor (Column 3).

From Table V, we see that the entire cash-targeting effect is driven by large patent aggregators. Columns 1 and 2 of Table V show that in cases where a large patent aggregator is involved, *CashLevel* and *CashShock* are large and significant predictors of litigation action. In contrast, in cases involving solely small innovators, neither *CashLevel* nor *CashShock* are significant predictors of targeting, and are both have coefficients that are close to 0. Consequently, we see that the impact of large patent aggregators covers nearly the entire magnitude of the coefficients on both cash variables shown in Table II.

4.5 Comparing the Types of Patents Asserted by NPEs and PEs

We now compare the types of patents asserted by NPEs to those asserted by PEs. There are many ways to parameterize patent similarity; we use a simple approach here. Following Love (2013), we examine whether NPEs disproportionately assert patents just before those patents' expiration dates. We show the breakdown of patent age between NPEs and PEs in Table VI. From this table, we first see that NPE-asserted patents are significantly older than PE-asserted patents. From Column 1 of Table VI, we see that NPEs assert patents that are 25% older than those PEs assert ($t = 2.31$); examining the tail of the distribution (i.e.,

litigation of patents just before expiration), this difference increases dramatically. From from Column 2 of Table VI, we see that patents within five years of expiration (aged older than fifteen years) comprise over a third of NPEs patent litigation cases, but just one in five of PE's asserted patent cases. This 70% larger share of patent assertions just before expiration is highly significant ($t = 10.98$).

NPEs not only appear to be asserting different patents than PEs, but relative to PEs, NPEs are much more likely to sue many times on any given asserted patent. From Column 3 of Table VI, for instance, we see that NPEs sue three times as many times with the same patent as PEs do ($t = 6.65$), again *conditional* on both the NPE and PE suing with a patent.

4.6 Geography of NPE Litigation

Even if NPEs target lawsuits opportunistically, this need not show up in outcomes, as courts remain the ultimate arbiters of patent infringement. Thus, for NPEs to target cash successfully, they would—at minimum—need a credible threat of having courts rule in their favor sufficiently often.

Figure 2 shows the geography of NPE IP litigation in the United States. Unsurprisingly, some well-known innovation hubs (e.g., Silicon Valley) have large amounts of NPE IP litigation. However, validating common anecdotal accounts, we see that the plurality of NPE IP litigation (over 30% of all cases) takes place in the Eastern District of Texas (Marshall, TX). Eastern Texas is not a major innovation center; rather, its courts are favored by NPEs because they are perceived to be plaintiff-friendly (both anecdotally and because of specific rules regarding judgment (Leychkis (2006)).)

The practice of "forum shopping" (i.e., "choosing the most favorable jurisdiction or court in which a claim might be heard" (Garner and Black (2004))) is not unique to IP litigation. However, again, even within the space of IP litigation, we see that NPEs seem to "forum shop" a uniquely large amount. NPE cases and PE cases have very different geographic patterns. For instance, when we run a Wilcoxon test of the distribution of PE vs. NPE

litigation by geographic federal court chosen to target, we see a significant difference between them ($z = 2.35$), with, again, NPEs more concentrated in East Texas.

4.7 Probability of Paying

In this section, we test whether proxies for firm's readiness (and ability) to stave off NPE litigation impact firms' probabilities of being targeted. We create two measures: one measure couting the number of lawyers firms have at their disposal, and the second counting how busy firms are with non-IP litigation actions.

The idea of the first measure—number of lawyers—is that large legal teams may serve to deter NPEs because they could to prolong the court (or settlement) process. The second measure—how busy the firm is with outside litigation—is meant capture the within-firm resource constraint on time and costs spent battling litigation. We expect that if NPEs opportunistically target firms that are unlikely to be able to defend themselves, then (1) having many lawyers should deter suits (so there should be a negative coefficient on the number of lawyers), and (2) being involved in extraneous, non-IP cases should draw more suits (so the associated coefficient should be positive).

In order to measure firms' legal teams, we extract data from the ALM Legal Intelligence Database. We use two measures of legal representation, described in Table VII, and shown in Columns 1 and 2. *NumberOfLawyers* and *NumberOfIPLawyers*, respectively assess firms' total levels of legal representation and levels of legal representation specializing in IP. Our second measure, *OngoingCases*, measures the existence and number of reported, ongoing non-IP-related litigation actions. From Table VII, we see that controlling for all other characteristics, NPEs are less likely to sue a firm with more legal representation. The coefficient in Column 2 on *NumberOfIPLawyers* implies that a one standard deviation increase in IP legal team size decreases the likelihood of suit by 13% ($t = 2.49$). NPEs are also more likely to target firms that are busy with ongoing, non-IP litigation. The Column 2 coefficient on *OngoingCases* of 0.0212 ($t = 3.53$) implies that a one standard deviation increase in outside litigation increases

the probability of being targeted by 18%.

The empirical specification considered in this section also provides evidence against a precautionary savings interpretation of the cash-targeting results shown in Table II. If precautionary savings were driving the relationship seen in Table II, then we would expect the coefficient on *LegalTeamSize* to be positive—firms saving cash to stave off infringement litigation should also be growing their legal teams(!). (At the very least, under the precautionary savings hypothesis, we would not expect the negative and significant relationship observed in the data.) To believe the precautionary savings hypothesis, we would need to believe that firms are raising cash to preempt litigation at the same time as they are actively *decreasing* their legal representation; this seems unlikely. Instead, the findings as a whole appear more consistent with NPEs acting opportunistically—targeting cash-rich firms that are more likely to settle, either because they have recently reduced their legal teams or because they are embroiled in outside litigation.

4.8 Sum of Evidence

In summary, our empirical evidence shows that:

1. NPEs specifically target litigation against firms that are flush with cash.

2. Cash-targeting appears to be unique to NPE IP litigation.

    - Cash is neither a significant positive predictor of PE IP lawsuit targeting, nor of non-IP lawsuit targeting (rather, these other classes of lawsuits appear to have most of the R^2 driven by infractions themselves).

    - More generally, NPE behavior is different from PE behavior even conditioning on the same type of infraction (alleged IP infringement).

3. NPEs target cash unrelated to the alleged infringement with essentially the same frequency that they target cash related to the alleged infringement.

4. The cash-targeting behavior we observe is driven by large aggregator NPEs, and is not the behavior of small innovators.

5. The patents NPEs assert are seemingly different in quality from those asserted by PEs (in particular, on average NPEs assert patents that are closer to expiry). Moreover, NPEs assert patents more aggressively than PEs do.

6. NPEs appear to forum shop, trying the plurality of their cases in a single district in East Texas.

7. NPEs target firms that may have reduced ability to defend themselves against litigation.

While none of our results alone proves opportunistic legal behavior (patent trolling) on the part of NPEs, the sum of the evidence to this point appears most consistent with NPEs behaving as patent trolls. In line with our evidence, there have been increasingly frequent high-profile anecdotal accounts of trolling by NPEs (nearly always litigated in Marshall, Texas). For instance, Lumen View Technology LLC sued numerous online dating companies for alleged infringement on a patent on computerized matchmaking that United States District Judge Denise Cote later pronounced to be obviously invalid. "There is no inventive idea here," Judge Cote declared, pointing out that "matchmaking" is literally ancient (Mullin (November 23, 2013)). Meanwhile, MPHJ Technology Investments sued over sixteen thousand small businesses (along with a number of branches of the United States Government) alleging infringement on a patent covering "scan-to-email" functionality. Many of MPHJ's cases were not only dismissed, but prompted countersuits for deceptive practices (Mullin (January 14, 2014)).

We conduct several robustness checks on our analysis in Section 4.9, and then assess the impact of NPEs on real outcomes in Section 5. We tie back to the theory and discuss welfare implications in Section 6.

4.9 Robustness Tests

In this section, we provide a number of robustness tests, including an out-of-sample test and a number of additional specifications.

4.9.1 Out-of-Sample Test

As mentioned in Section 3, the analyses discussed in the text use data from RPX Corporation, a company that tabulates information on NPE behavior. While the data is all sourced from public documents (namely the USPTO and public court records), RPX retains the dataset itself as proprietary. Cotropia, Kesan, and Schwartz (2014) recently hand-coded and classified NPE IP litigation events for a two-year sample (2010 and 2012), and made this data publicly available at `www.npedata.com`.

We have re-run all of our analyses on the Cotropia, Kesan, and Schwartz (2014) data; the results of this out-of-sample test are shown in Appendix Table A4. We find the same results using the Cotropia, Kesan, and Schwartz (2014) data as with the RPX data: cash is a large and significant predictor of NPE targeting, and this behavior is driven by large aggregator NPEs.[33]

4.9.2 Thicket Industries and Additional Specifications

Patent thickets are dense, overlapping webs of patents that make it difficult to commercialize because products may overlap with large numbers of patented technologies. Certain industries are known to be more prone to patent thickets, and those industries themselves have been linked to strategic patenting behavior (Bessen and Meurer (2013)). We test whether the cash-targeting behavior of NPEs differs between thicket- and non-thicket industries.[34] Columns 1-3

[33]The estimated magnitudes on cash are actually a bit larger in the Cotropia, Kesan, and Schwartz (2014) sub-sample (given the larger standard deviation of cash in later 2010-2012 period), with the coefficient on large aggregators being roughly triple the size of small innovators, and statistically significantly larger. We also calculate the overlap rate between the RPX and Cotropia, Kesan, and Schwartz (2014) samples for the two years available (2010 and 2012) and find a roughly 90% overlap.

[34]We define thicket industries as those having two-digit SIC codes of 35, 36, 38 and 73, following Bessen and Meurer (2014). These industries encompass software, semiconductors, and electronics, and include firms

of Table VII, Panel A show the results.

Column 4 runs the same analysis excluding IT firms (SIC Code 35 (e.g., Apple and IBM) and SIC Code 73 (e.g., Yahoo! and Ebay)); again, cash a strong determinant of targeting, nearly identical in magnitude and significance. Column 5 allows additional non-linearities in cash (cash level squared and cubed); neither loads significantly, and allowing non-linearity does not appear to have a impact on the estimated magnitude or significance of the *CashLevel* and *CashShock* coefficients. In each specification, we also include a new variable (*FinancialConstraints*) that measures how financially constrained firms are.[35] The *FinancialConstraints* variable enters negatively and significantly in nearly all specifications. This means that, controlling for other firm characteristics (including cash), NPEs are significantly less likely to target firms that have more trouble tapping into from outside markets and lenders. For instance, in Column 5, the coefficient of -0.0087 ($t = 2.90$) implies that a one standard-deviation increase in financial constraints reduces the likelihood of NPE targeting by 38%.

Panel B of Table VII shows a number of additional specifications. First, throughout the paper we have used whether or not a firm is sued by an NPE in a given year (*SuedByNPE*). However, a number of firms are sued multiple times by different (or even the same) NPEs within a single year. In Table VIII, Panel B we replace the dependent variable with the the number of times a firm is sued by an NPE in a given year. We find similar results to those presented in Table II: *CashLevel* and *CashShock* are large and significant predictors of the number of times a firm is sued in a given year (both in OLS and Tobit specifications). For instance, Column 1 of Table VII, Panel B shows a coefficient on *CashLevel* of 0.9267 ($t = 3.91$), implying that a one standard-deviation increase in cash triples the number of times a firm is targeted by NPEs. Additionally, Columns 3 and 4 of Table VII, Panel B show the base categorical variable specification of the dependent variable (*SuedByNPE*), but in

such as Apple, Google, and Intel.

[35]Here, we use the Hadlock and Pierce (2010) financial constraints index of firms' constraints on accessing the external funds.

Probit and Logit regression estimations. Again cash remains a large and significant predictor of NPE targeting behavior.

5 Impact of NPE Litigation on Real Outcomes

Up to this point, we have examined which firms NPEs target, and when. We now examine the real impacts of NPE litigation on the firms being targeted. Of course the difficulty in obtaining any causal estimates here is that we have a clear selection problem (that is, it might be the case that the firms that NPEs target experience some outcome not because of NPE litigation, but because they share some common unobservable characteristic). We attempt to alleviate selection concerns somewhat by conditioning on being targeted—we compare two groups of firms, both selected to be sued by NPEs. Specifically, we compare all firms targeted by NPEs, separating targeted firms specifically according to whether (1) they were forced to pay out to NPEs (they either lost in court or settled) or (2) the cases against them were dismissed (including when the court ruled against the NPE).[36] We test whether losing to an NPE and having an NPE lawsuit dismissed lead in different directions in terms of future R&D productivity. Specifically, we focus on how R&D expenditures on projects differ (pre- and post-litigation) among the two classes of targeted firms.

Table IX reports the difference-in-differences results. From Panel A of Table IX, we see that losing to an NPE has a large and negative impact on future R&D activities—again, even conditioning on being selected for litigation. To get an idea of the effect magnitude, the results shown in Panel A imply that firms that lose to a large aggregator NPE (Settled + Won by NPE) invest significantly less in R&D in the years following the loss ($115 million less, $t = 2.40$) relative to firms that were also targeted by NPEs but won (Dismissed + Lost by NPE). Panel A also shows that we see no such patterns for PE vs. PE cases—unlike firms that lose to NPEs, firms that lose to PEs show no reduction in R&D investment. Panel B of

[36] Following Allison, Lemley, and Walker (2010), we exclude case outcomes such as "Stayed," "Transfers," and "procedural dispositions."

Table IX runs parallel trends analysis, showing that the firms in our comparison groups had similarly-moving R&D expenditures prior to the NPE lawsuits.

Lastly, Panel C of Table IX shows an analysis of the same firms pre- and post-difference-in-differences analysis, but in a regression framework where more firm-level determinants of R&D can be included. From Panel C, we see that losing to a large aggregator NPE (again, selecting on being targeted) leads to 1.2% reduction in future R&D expense (scaled by lagged assets).[37] Considering the mean of dependent variable is 6.6% (median: 5.1%), this magnitude is economically large and statistically significant, representing a roughly 20% reduction ($t = 2.12$) in R&D investment. Again, from Column 3 of Table IX, Panel C, we see that there is no resultant reduction in R&D expenditure following losses in PE vs. PE cases.

In all, the evidence in this section strongly supports the idea that NPEs have a real and negative impact on innovation of United States firms, and that within the IP space—like the cash-targeting behavior we have observed—the negative impact on R&D is unique to NPE lawsuits.

6 Discussion

Our results show that NPEs on average sue firms that have substantial cash holdings. While we cannot observe directly whether infringement has occurred in a given case, our results suggest that cash—rather than policing infringement—drives NPE targeting. Cash is a first-order determinant of NPE IP litigation even when that cash is unrelated to the alleged infringement, and even though cash is neither a key driver of PE IP suits nor of non-IP litigation. Meanwhile, NPEs appear to bring lower quality lawsuits, and there is some evidence that NPEs are actively forum shopping.

NPE litigation has a real negative impact on innovation at targeted firms: PEs substantively reduce their innovative activity after settling with NPEs (or losing to them in court).

[37] In these tests we control for Citation Commonality. This is a measure provided to us by Ambercite - a firm that specializes in metrics in the innovation space. Citation Commonality is described in Appendix Table 1, and measures the pairwise similarity between any two patents.

Measuring NPEs' *net* impact on innovation, however, requires accounting for the potential of NPE litigation to positively incentivize innovation by individual inventors. Unfortunately, because most settlement values are not disclosed, we cannot measure the full size of the transfer from PEs to NPEs (much less the transfer from NPEs to end inventors). Further, we cannot measure the increase in innovation incentives that might come from PEs being less likely to infringe (given NPE behavior). Thus, we cannot explicitly measure the potential welfare gains from NPE litigation. Nevertheless, we note that as our theoretical model suggests, the benefits of NPEs in terms of increased innovation incentives for end inventors (both the direct benefits through lawsuits, and the indirect benefits in terms of enhanced licensing potential) depend on the *fraction* of NPE profits passed through to end inventors.

There are three pieces of empirical evidence that somewhat speak to the impact of NPEs on small inventors' innovation incentives. First, Bessen, Meurer, and Ford (2011) directly estimate the pass-through parameter that our theory highlights as the key mediator of NPEs' benefits for end inventors. Bessen, Meurer, and Ford (2011) find very low pass-through, estimating that only five cents of every dollar in damages paid by PEs to NPEs makes it back to end innovators. Thus, one would need to believe in a large multiplier (summing both direct and indirect spillover effects) to justify, from a social-welfare perspective, NPE litigation practices as an efficient mechanism to transfer the marginal dollar of innovative capital—*even if all NPE lawsuits were well-founded*. Second, Feldman and Lemley (2015) find evidence that patent licensing does little or nothing to increase innovation—irrespective of whether NPEs or PEs are the licensors. Lastly, we conduct a simple empirical analysis, presented in Table X, in which we measure changes in innovation outcomes in the *exact* technology areas in which NPE litigation is most frequent. In NPE-heavy areas, both the direct and indirect benefits of NPE litigation should be largest, but Table X shows that there has been no observable increase in innovation by small innovators.

The marginal welfare impact of NPEs is also largely determined by the frequency with

which NPEs successfully bring "nuisance" cases instead of meritorious ones.[38] As our model suggests, NPE nuisance suits stand to crowd out socially valuable innovation (and possibly to *induce* socially inefficient infringement), without any measurable social gains.

7 Conclusion

We provide the first large-sample evidence on the behavior and impact of NPEs. Our theoretical model illustrates that while NPE litigation can reduce infringement and support small inventors, as NPEs become effective at bringing opportunistic lawsuits, they can inefficiently crowd out some firms that would otherwise produce welfare-enhancing innovations without engaging in infringement. Our complementary empirical analysis shows that on average, NPEs appear to behave as opportunistic patent trolls. They sue cash-rich firms—a one standard deviation increase in cash holdings increases a firm's chance of being targeted by NPE litigation more than fourfold. By contrast, cash is neither a key driver of IP lawsuits by PEs, nor of any other type of litigation against firms. The cash-targeting behavior we observe is driven by large aggregator NPEs, and is not the behavior of small innovators. NPEs even target conglomerate firms that earn their cash from segments having nothing to do with their allegedly infringing patents. (Profitability in unrelated businesses is almost as predictive of an NPE suit as is profitability in business segments related to NPE-alleged patent infringement.) We find further suggestive evidence of NPE opportunism, such as late-stage litigation, forum shopping, and targeting of firms that may have reduced ability to defend themselves against litigation. Finally, we find that NPE litigation has a real negative impact on innovation at targeted firms: PEs substantively reduce their innovative activity after settling with NPEs (or losing to them in court).

Setting intellectual property policy regarding patent assertion is first-order. If widespread opportunistic patent litigation makes the United States a less desirable place to innovate, then

[38] From the model of NPE behavior in Section 2, this corresponds to the relationship between $\underline{p}_n$ (NPEs' ability to bring groundless suits) and $\overline{p}_n$ (NPEs' ability to bring meritorious suits).

innovation and human capital—and the returns to that innovation and human capital—will likely flee overseas. That said, innovators will also leave if they feel they are not are protected from large, well-funded interests that might infringe on innovative capital without recompense. Our results provide evidence that NPEs—in particular, large patent aggregators—on average do not protect innovation. Rather, our results are consistent with the view that, on average, NPEs behave as patent trolls that chase cash and negatively impact innovative activities at targeted firms. Given our findings, the marginal policy response should be to more carefully limit the power of NPEs or, in the framework of our model, introduce cost-shifting or screening measures to reduce the incentive to bring nuisance suits.

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Table I. Summary Statistics, 2001–2011

Panel A of this table presents summary statistics on the firms included in the tests. Appendix Table A1 contains the definitions of the variables we use. In Panel B, we tabulate number of observations reported in the RPX database (RPX) by year. RPX records information on cases in which the plaintiff is an NPE. According to RPX, an NPE is an entity that derives or plans to derive the majority of its revenue from the licensing or enforcement of patents and for which RPX has been unable to obtain verifiable evidence that the entity sells products or services that would make it vulnerable to patent counter-assertion. In the information reported below, each defendant is a U.S. firm and "year" refers to the lawsuit filing year. A case (as defined by docket in a given court) may contain several defendants and a given firm may appear as the defendant in multiple cases. Thus, the below table tabulates different aspects of the database using different units of observation. Column (1) reports number of NPE litigation actions by year. In Column (2), we report the number of these in which the defendant is a publicly traded firm. In Column (3), we collapse Column (2) to firm-year level. In Column (4), we report total number of public firms used in the analysis each year. Column (5) reports the fraction of public firms sued by an NPE (Column (2)/Column (3)).

Panel A. Summary Statistics on Firm Characteristics

	Mean	**Median**	**St. dev**	**P05**	**P25**	**P75**	**P95**
Market Value	4,050	338	17,294	13	76	1,491	16,468
Total Assets	10.39	0.52	83.90	0.02	0.11	2.23	25.27
Book to Market	0.70	0.55	0.65	0.12	0.32	0.86	1.72
Past Return	0.13	0.05	0.63	-0.70	-0.22	0.34	1.20
Number of Law Firms	0.66	0.00	4.81	0.00	0.00	0.00	2.00
Cash Shock	0.04	0.00	0.19	0.00	0.00	0.00	0.00
Patent Stock	11.86	0.00	112.23	0.00	0.00	0.00	22.00
In-house Counsel	0.03	0.00	0.17	0.00	0.00	0.00	0.00
Ongoing Cases	0.18	0.00	0.39	0.00	0.00	0.00	1.00
Cash Level	0.31	0.02	1.83	0.00	0.01	0.09	1.00

Panel B. Sample Description

	[1]	[2]	[3]	[4]	[5]
2001	362	151	111	5,606	1.98%
2002	412	152	88	5,373	1.64%
2003	386	154	95	5,401	1.76%
2004	390	198	111	5,066	2.19%
2005	622	302	117	4,959	2.36%
2006	687	357	193	4,760	4.05%
2007	1,381	815	326	4,709	6.92%
2008	1,383	631	278	4,547	6.11%
2009	1,543	885	309	4,412	7.00%
2010	2,931	1,539	525	4,356	12.05%
2011	3,833	1,916	550	4,231	13.00%

Table II. Cash and Probability of Being Sued

In this table, we use a linear probability model to estimate the probability of being sued by an NPE. The outcome variable, Sued by NPE, is a dummy equal to 1 if the firm was litigated by an NPE in a given year. This definition of Sued by NPE does not require that the asserted patent's technology class match the industry of the defendant company. RPX data allows us to observe the type of the NPE. We focus on cases in which the NPE is classified as a patent aggregator or a small investor (see Table III for the case-type classification). Total Assets of the firm are as of the end of the previous fiscal year. Market Value of the equity is measured as of the end of the previous fiscal year. Book-to-market ratio (B/M) is the ratio of book value of equity to market value of equity as of the end of the previous fiscal year. Book value of equity is calculated as sum of stockholders equity (SEQ), Deferred Tax (TXDB), and Investment Tax Credit (ITCB), minus Preferred Stock (PREF). Past Return is the 12-month return prior to fiscal year end. Patent Stock is the number of patents the firm applied for in the past five years. Cash Level is the amount of cash reported on the balance sheet as of the beginning of the previous fiscal year. Cash Shock is a dummy variable equal to 1 if the change in cash in the current fiscal year compared to that of the previous fiscal year is among the top 90^{th} percentile of cash changes. We use log transformation for Total Assets, Market Value, B/M, Patent Stock, and Cash Level. The sample contains firm-year observations between 2001 and 2011. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE
Total Assets	0.0002**	0.0001*	0.0002**	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market Value	-0.0016	-0.0042*	-0.0018	-0.0045*
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
B/M	0.0263***	0.0193***	0.0263***	0.0192***
	(0.0070)	(0.0069)	(0.0070)	(0.0068)
Past Return	-0.0029**	-0.0032**	-0.0030**	-0.0033**
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Number of Patents	0.0041*	0.0033	0.0041*	0.0032
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Cash Level		0.0839***		0.0857***
		(0.0152)		(0.0153)
Cash Shock			0.0185**	0.0222**
			(0.0090)	(0.0090)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420
R2	0.46	0.46	0.46	0.47

Table III. Is Cash Targeting a General Feature of Litigation?

In Column 1 of this table, we define Sued by PE to be equal to 1 if a firm *only* faces IP lawsuits from practicing entities (PEs) in a given year. The sample is obtained from Audit Analytics. We examine cases classified as IP cases (PACER code 830), and then exclude cases in which the plaintiff is classified an NPE (as defined by RPX). This gives us the set of firms that face PE-led IP litigation in a given year. Audit Analytics includes material federal civil litigation and class action claims disclosed to the SEC by the SEC registrants. Case disclosure comes from the firm, which is responsible for determining whether the case is material for the company. Given the severe penalties involved in not disclosing information that is already public (through PACER), a dominant strategy for a CEO is often disclose not only material information but also potentially non-material information that could later be assessed as being within disclosure guidelines. Furthermore, because our interest lies in the public firms (which are SEC registrants, by definition), Audit Analytics provides a comprehensive database for cases we are interested in. In Columns 2-7, we utilize case classifications reported in Audit Analytics to investigate whether the relation between firm characteristics and NPE litigation differ for different case types. Specifically, in Column 2, we first define the dependent variable to be 1 if the firm is involved in a case that is not related to IP rights. To define these cases, we exclude cases where the PACER case code is equal to 810, 820, or 830. We then divide the remaining sample into five categories—tort, contract, securities, environment, and labor—as defined by PACER. Appendix Table A7 outlines the specific case codes used to identify these cases. In Columns 3-7, we define the dependent variable to be 1 if the firm is sued in the case type specified in the column heading. We use the baseline specification used in Table II to facilitate comparison of coefficients across case types. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Sued by PE	All non-IP	Tort	Contract	Securities	Environment	Labor
Total Assets	0.0001	0.0001	-0.0001	0.0001	0.0001	0.0000**	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Market Value	0.0029	0.0366***	0.0070***	0.0114***	0.0223***	0.0006	-0.0004
	(0.0020)	(0.0040)	(0.0020)	(0.0020)	(0.0020)	(0.0010)	(0.0008)
B/M	0.0032	0.0456***	0.0116**	0.0202***	0.0134**	0.0056*	-0.0006
	(0.0050)	(0.0110)	(0.0060)	(0.0060)	(0.0060)	(0.0030)	(0.0022)
Past Return	-0.0001	-0.0026	-0.001	-0.0016	0.0001	0.0003	0.0001
	(0.0010)	(0.0030)	(0.0010)	(0.0010)	(0.0020)	(0.0010)	(0.0006)
Number of Patents	0.003	0.0012	0.0007	-0.0004	0.0036**	0.0008	0.0001
	(0.0020)	(0.0030)	(0.0020)	(0.0020)	(0.0020)	(0.0010)	(0.0004)
Cash Level	-0.0058	-0.0378**	-0.0305**	-0.0122	-0.0081	-0.0187**	-0.0026
	(0.0100)	(0.0180)	(0.0150)	(0.0110)	(0.0120)	(0.0070)	(0.0027)
Cash Shock	0.0089	-0.0034	-0.0024	-0.0102	-0.0004	-0.0004	-0.0004
	(0.0070)	(0.0130)	(0.0090)	(0.0070)	(0.0090)	(0.0060)	(0.0029)
Number of Employees							0.0011*
							(0.0006)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420	53,420	53,420	53,420
R2	0.29	0.34	0.31	0.2	0.24	0.24	0.18

Table IV. Probability of Being Sued: Related vs. Unrelated Cash Flows

In this table, we report the probability that a conglomerate is sued by an NPE as a function of the gross profitability of related and unrelated segments. The unit of observation is a conglomerate-segment-year. Sued by NPE is a dummy variable equal to 1 if the firm was litigated by an NPE that year. To identify segments that are related to litigated patents, we use the IPC-to-SIC concordance developed by Silverman (2003). We use financial statements disclosed in segment filings to collect segment-level information on sales and cost of goods sold and calculate segment profitability as the difference. Industry Profitability is the average profitability of all firms in the same four-digit SIC. Our sample includes all conglomerates which had more than one segment reporting profitability data between 2001 and 2011. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Segment Sued by NPE	Segment Sued by NPE	Segment Sued by PE
Related Segment Profitability	0.1152***	0.0819**	-0.0089
	(0.0425)	(0.0375)	(0.0141)
Unrelated Segment Profitability	0.1107**	0.0683*	-0.0296*
	(0.0441)	(0.0374)	(0.0168)
Industry Profitability	-0.0055***	0.0001	-0.0002
	(0.0015)	(0.0009)	(0.0003)
Conglomerate FE	No	Yes	Yes
N	29,767	29,767	29,767
R2	0.02	0.38	0.25

Table V. Cash and Probability of Being Sued: Comparison of Large Aggregators to Small Inventors

In this table, we report the baseline results for different types of NPEs. In Column 1, the regressand takes a value of 1 if the firm is sued by a large aggregator (LA) and a small inventor (SI) in a given year. In columns 2, and 3, we reestiamate the same specification when the regressand is defined to be 1 when a firm is only sued by a large aggregator (Column 2) or by a small inventor (Column 3) in a given year. In the RPX sample, 54.05 percent of the 7,100 cases have a large aggregator as a plaintiff (coded as "Pure Patent Licensing" by RPX). Small Inventors (coded as "Inventor(s)" or "SPVs by Inventor(s)" by RPX) constitute the 35.26 percent of cases. The remaining 10.68 percent of cases are not included in the analysis, as it is not clear whether they belong to the LA group or the SI group. Detailed information on plaintiff types as well as comparison to other samples is provided in Appendix Table A4. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Both LA and SI	Sole LA	Sole SI
Total Assets	0.0002*	-0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)
Market Value	-0.0038***	-0.0011	0.0004
	(0.0010)	(0.0020)	(0.0010)
B/M	0.0019	0.0066	0.0080**
	(0.0030)	(0.0050)	(0.0040)
Past Return	-0.0005	0.0003	-0.0025***
	(0.0010)	(0.0010)	(0.0010)
Number of Patents	0.0025*	0.0017	-0.0004
	(0.0010)	(0.0020)	(0.0010)
Cash Level	0.0549***	0.0328***	0.0001
	(0.0130)	(0.0110)	(0.0090)
Cash Shock	0.0165***	0.0158**	-0.0066
	(0.0060)	(0.0080)	(0.0070)
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	53,420	53,420	53,420
R2	0.43	0.28	0.21

Table VI. Asserted Patents' Attributes

In this table, we compare patents asserted in two types of cases: NPE vs. PE, and PE vs. PE. We further break down NPE vs. PE cases by plaintiff type (large aggregator, small innovator, and SPV created by small inventors). For each patent-docket pair, we first calculate the time gap between the dates of litigation filing and patent issuance (Age of Patent at Litigation). If a patent has been used for litigation multiple times, we use the average age at time of litigation. We report the median average ages of patents at ligitation, the median numbers of times given patents have been asserted through litigation, and the median numbers of patents for PEs and NPEs.

Plaintiff Type	**Age of Patent**	**% (Age older than 15 years)**	**Times asserted**	**# of Patents**
PE	6.00	21%	1	1,971
NPE (overall)	8.00	36%	3	2,261
Large Aggregator	9.65	44%	3	1,414
Small Inventor: Inventor(s)	8.62	38%	2	676
Small Inventor: SPV by Inventor(s)	5.71	19%	3	171
z-test median NPE (overall)=PE	14.71	10.98	31.53	
t-test mean NPE (overall))=PE	2.31	11.14	6.65	

Table VII. Impact of Legal Team Size and Outside (non-IP) Litigation

In this table, we use a linear probability model to estimate the probability of being sued by an NPE. The outcome variable, Sued by NPE, is a dummy equal to 1 if the firm was litigated by an NPE that year. This definition of Sued by NPE does not require the asserted patent's technology class match the industry of the defendant company. RPX data allows us to observe the type of the NPE. We focus on cases in which the NPE is classified as a patent aggregator or a small inventor (see Table III for the case-type classification). Total Assets of the firm are as of the end of the previous fiscal year. Market Value of the equity is measured as of the end of the previous fiscal year. Book-to-market ratio (B/M) is the ratio of book value of equity to market value of equity as of the end of the previous fiscal year. Book value of equity is calculated as sum of stockholders equity (SEQ), Deferred Tax (TXDB), and Investment Tax Credit (ITCB), minus Preferred Stock (PREF). Past Return is the 12-month return prior to fiscal year end. Patent Stock is the number of patents the firm applied for in the past five years. Cash Level is the amount of cash reported on the balance sheet as of the beginning of the previous fiscal year. Cash Shock is a dummy variable equal to 1 if the change in cash in the current fiscal year compared to that of the previous fiscal year is among the top 90^{th} percentile of cash changes. We use log transformation for Total Assets, Market Value, B/M, Patent Stock, and Cash Level. In Columns 1-3, we introduce different measures of legal team size. In Column 1, we use the total number of law firms representing the firm in litigation in that particular year, as reported by ALM Legal Intelligence. To accommodate the possibility that a given firm may choose not to report representation by law firms in a particular year, we impute the missing observations by using the representation information in the most immediate previous year (our results are not sensitive to this imputation method). We then regress 1 plus the log of the number law firms representing the firm on the (log of the) number of patents the firm has, as well as past return, an indicator variable representing the existence of in-house council, and both firm and year fixed effects. We use the residual of this estimate as a measure of Legal Team Size for each firm-year. For each law firm reported in the ALM database, we collect two more pieces of information (from firm websites): (a) whether the law firm has an IP litigation practice, and (b) how important the law firm's IP practice is within the firm; we recalculate our legal team size variable after incorporating this additional information. Specifically, to calculate the legal team size variable used in Column 2, we replace the total number of law firms with the number of law firms with an IP practice. To calculate legal team size used in Column 3, we replace the total number of law firms with the number of law firms in which IP practice is deemed important. The sample contains firm-year observations between 2001 and 2011. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Sued by NPE	Sued by NPE
Total Assets	0.0001*	0.0001*
	(0.0000)	(0.0000)
Market Value	-0.0047*	-0.0047*
	(0.0030)	(0.0030)
B/M	0.0180***	0.0180***
	(0.0070)	(0.0070)
Past Return	-0.0032**	-0.0032**
	(0.0010)	(0.0010)
Number of Patents	0.0029	0.0029
	(0.0020)	(0.0020)
Cash Level	0.0849***	0.0852***
	(0.0150)	(0.0150)
Cash Shock	0.0225**	0.0225**
	(0.0090)	(0.0090)
Number of Lawyers	-0.1354**	
	(0.0570)	
Number of IP Lawyers		-0.1447**
		(0.0580)
Ongoing Cases	0.0212***	0.0212***
	(0.0060)	(0.0060)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	53,420	53,420
R2	0.47	0.47

Table VIII. Robustness Tests

In Panel A of this table, we report the results for all industries, thicket industries (i.e., industries that are characterized with dense overlapping intellectual property rights and strategic patenting behavior) and non-thicket industries. We use SIC codes 35, 36, 38 and 73 to identify thicket industries, with SIC codes 35 and 73 representing IT firms (see Bessen and Meurer, 2014). We also add three new variables to the baseline specification: R&D Expense is the log of total amount spent on Research and Development, as reported in the income statement of the firm one year prior to the date of litigation filing. Following the literature, if the firm reports nothing for R&D Expense, we assume the amount to be 0. We include the Hadlock and Pierce (2010) financial constraints index, to measure how constrained the firm is in terms of accessing external funds; this index combines information on firm asset size, firm asset size squared, and firm age. We use mean firm age for firms whose ages are missing, to keep the sample size constant across specifications (the coefficient of cash is 50 percent larger when we use the subsample that does not have information on firm age). In the last columns we repeat the same analysis after including cash level squared and cash level cubed. In Panel B, we report several specifications based on different estimation methods. In the first two columns, we change the left-hand side variable to the number of times sued in a given year and use OLS and Tobit respectively. In the last column, we use Probit models.

Panel A. Thicket Industries vs. Non-Thicket Industries

	All Industries	Thicket Industries	Non-Thicket Industries	Excluding IT Firms	All Industries
Total Assets	0.0001*	0.0031**	0.0002**	0.0002*	0.0001
	(0.0001)	(0.0015)	(0.0001)	(0.0001)	(0.0001)
Market Value	-0.0107***	-0.0112**	-0.0105***	-0.0100***	-0.0111***
	(0.0029)	(0.0053)	(0.0035)	(0.0032)	(0.0029)
B/M	0.0093	0.0058	0.0112	0.0095	0.0086
	(0.0069)	(0.0129)	(0.0082)	(0.0075)	(0.0070)
Past Return	-0.0036**	-0.0026	-0.0047***	-0.0037**	-0.0036**
	(0.0014)	(0.0027)	(0.0017)	(0.0015)	(0.0014)
Number of Patents	0.0025	0.0024	0.0015	0.0001	0.0025
	(0.0022)	(0.0030)	(0.0034)	(0.0025)	(0.0022)
Cash Level	0.0847***	0.1088***	0.0730***	0.0760***	0.1116***
	(0.0151)	(0.0342)	(0.0168)	(0.0161)	(0.0313)
Cash Shock	0.0223**	0.0459**	0.0127	0.0157*	0.0221**
	(0.0090)	(0.0220)	(0.0098)	(0.0095)	(0.0090)
Excess Lawyers	-0.1378**	0.0274	-0.2203***	-0.1951***	-0.1403**
	(0.0568)	(0.1018)	(0.0684)	(0.0622)	(0.0567)
Ongoing Cases	0.0213***	0.0095	0.0266***	0.0195***	0.0212***
	(0.0064)	(0.0123)	(0.0074)	(0.0069)	(0.0064)
Financial Constraints	-0.0086***	-0.0171***	-0.002	-0.0026	-0.0087***
	(0.0030)	(0.0059)	(0.0032)	(0.0030)	(0.0030)
R&D Expense	0.0093**	0.0158*	0.0022	0.0046	0.0092**
	(0.0046)	(0.0081)	(0.0058)	(0.0050)	(0.0046)
Cash Level Squared					-0.0309
					(0.0292)
Cash Level Cubed					0.0072
					(0.0071)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	53,420	15,241	38,179	45,225	53,420
R2	0.47	0.47	0.47	0.46	0.47

Panel B. Alternative Estimation Methods

	OLS (Times Sued)	Tobit (Times Sued)	Probit (Sued or Not)
Total Assets	0.0011	-0.0026***	-0.0003
	(0.0007)	(0.0005)	(0.0002)
Market Value	-0.0378*	1.1466***	0.2102***
	(0.0194)	(0.0474)	(0.0134)
B/M	-0.0354	-0.0678	0.0078
	(0.0401)	(0.2865)	(0.0849)
Past Return	-0.005	0.183	0.0294
	(0.0065)	(0.1216)	(0.0214)
Number of Patents	0.0388**	0.3540***	0.0595***
	(0.0172)	(0.0293)	(0.0106)
Cash Level	0.9267***	1.3357***	0.1308**
	(0.2370)	(0.1705)	(0.0540)
Cash Shock	0.1071**	0.5301**	0.0664
	(0.0515)	(0.2195)	(0.0417)
Firm FE	Yes	No	No
Year FE	Yes	Yes	Yes
N	53,420	53,420	53,420
R2	0.56	0.16	0.21

Table IX. Impact of IP Litigation on Real Outcomes

In Panel A of this table, we present the impact of being sued by a patent aggregator on research and development expenditures in the year following litigation filing, in comparison to the year before litigation filing. We use the timing of the case filing as the expectations regarding the case outcome start impacting firm operations after the litigation event becomes common knowledge. Following Allison, Lemley, and Walker (2010), we exclude case outcomes such as "Stayed," "Transfers," and "procedural dispositions." We only use case outcomes RPX codes as "Dismissed," "Settled," "Won by NPE," and "Lost by NPE." In our sample, settlements result in 82 percent of the outcomes, while dismissals arise in 9.8 percent of the cases. We compare two groups of firms based on case outcomes. In the first row of Panel A, for example, we consider the change in R&D expense, before and after litigation filing, comparing defendant firms whose cases were settled with those whose cases were dismissed dismissed. In the second row, we redo the same analysis comparing "Settled or Won by NPE" to "Dismissed or Lost by NPE." Using this difference-in-differences design, we report two statistics: mean of Change in R&D (treated) − Change in R&D (untreated) and median of Change in R&D (treated) − Change in R&D (untreated). We note that some settlements do not necessarily involve conditions that could be significantly different from dismissals. Furthermore, a given firm may be sued multiple times in a given year and these cases may end with different outcomes. To define the treatment sample cleanly, we assume that a firm can only be grouped into the treated sample if *all* the cases against that firm in a given year conclude with Settlement or Won by NPE outcomes. These assumptions assure that the effects we document are conservative. In the first two rows, we examine cases of patent assertion by patent aggregator NPEs. In the next two rows, we redo the same analysis after including the small innovator-related cases in the sample. In the last two rows, we redo the same analysis for PE vs. PE cases. In Panel B, Column 3 we test whether the research outputs of the treated and untreated sets were similar prior to litigation. The last column of Panel B shows the results when we solely focus on cases that took more than two years to conclude. In Panel C, we report the results of the OLS regression in which future R&D Expense (scaled by lag total assets) is regressed on a dummy variable that takes a value of 1 if all the cases filed by NPEs against the firm in a particular year are settled or won by the NPE. The unit of observation is firm-year. The control variables included are as defined in Table IV. In the OLS analysis, if a control variable is missing, we impute the mean of that variable so as to match up the number of observations across panels. To calculate Citation Commonality, we do the following: First, we count the number patents citing a given patent of a firm and the asserted patent of NPE. We then add up the these figures for all patents of the firm. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

Panel A. Real Effect Analysis

					Change in R&D ($t-1$ to $t+1$)	
Sued by	**Treated**	**Untreated**	**N(Treated)**	**N(Untreated)**	**Mean**	**Median**
Large Aggregators	Settled + Won by NPE	Dismissed + Lost by NPE	303	110	-115.47**	-35.01***
					(2.40)	(2.97)
All NPEs	Settled + Won by NPE	Dismissed + Lost by NPE	469	199	-82.28**	-5.16*
					(2.11)	(1.94)
PEs	Settled + Won by PE	Dismissed + Lost by PE	303	57	8.94	2.87
					(0.07)	(0.89)

Panel B. Parallel Trend Analysis

			Parallel Trend Change in R&D ($t-3$ to $t-1$)
Sued by	**Treated**	**Untreated**	**Mean**
Large Aggregators	Settled + Won by NPE	Dismissed + Lost by NPE	-8.00
			(0.18)
All NPEs	Settled + Won by NPE	Dismissed + Lost by NPE	17.06
			(0.59)
PEs	Settled + Won by PE	Dismissed + Lost by PE	-111.90
			(1.10)

Panel C. Real Effects OLS Analysis: Settled + Won by NPE vs. Dismissed + Lost by NPE

Sued by	All NPE	LA	PE
	R&D$(t+1)$/A	R&D$(t+1)$/A	R&D$(t+1)$/A
Dummy (Settled + Won by NPE)	-0.012**	-0.021***	-0.002
	(0.005)	(0.007)	(0.011)
Total Assets	0.000	0.000	-0.001***
	0.000	0.000	0.000
Market Value	-0.015***	-0.0164***	-0.0079*
	(0.003)	(0.003)	(0.004)
B/M	-0.123***	-0.124***	-0.188***
	(0.018)	(0.021)	(0.030)
Past Return	0.029***	0.030***	0.012
	(0.007)	(0.006)	(0.010)
Number of Patents	0.002	0.003**	-0.004***
	(0.001)	(0.002)	(0.002)
Cash Level	0.002	0.004	0.024**
	(0.005)	(0.008)	(0.011)
Cash Shock	-0.007	-0.005	-0.018*
	(0.005)	(0.006)	(0.009)
Excess Lawyers	-0.037	-0.010	-0.120**
	(0.029)	(0.027)	(0.047)
Ongoing Cases	0.012	0.011	0.008
	(0.008)	(0.009)	(0.012)
Citation Commonality	0.008**	0.008**	-0.002
	(0.003)	(0.003)	(0.003)
Intercept	0.226***	0.237***	0.237***
	(0.025)	(0.032)	(0.041)
N	668	413	360
R2	0.26	0.36	0.17

Table X. NPE Litigation and Individual Inventor Patenting Activity, 1995 - 2010

In this table, we estimate an OLS model using past NPE litigation activity to predict the share of all future patents produced by individual innovators (Individual Innovator Share). The unit of observation is year-IPC subclass code. We exclude patents if a technology class (IPC code) is not reported in the Thompson Innovation database. Individual Innovator patents are those which name the same individual as the "innovator" and "assignee." If a patent belongs to multiple IPC subclasses, it is counted towards each. We define past litigation activity by calculating the average number of NPE litigation events in the past 3, 4, and 5 years (Litigation3, Litigation4, and Litigation5). Standard errors are clustered by year and reported in parenthesis. ***, **, and * refer to statistical significance at 1, 5 or 10 percent level.

	Individual Innovator Share	Individual Innovator Share	Individual Innovator Share
Litigation5	-2.0158		
	(2.5914)		
Litigation4		-2.0362	
		(2.3644)	
Litigation3			-2.0699
			(2.1816)
Tech Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	8,975	8,975	8,975
R2	0.80	0.80	0.80

Figure 1. Time Series of NPE, PE, and Total IP Litigation.

This figure shows the number of unique dockets in PACER (Public Access to Court Electronic Records) classified as IP cases (PACER code 830). We use RPX's classification of plaintiffs to split dockets according to whether the plaintiff is an NPE or a PE.

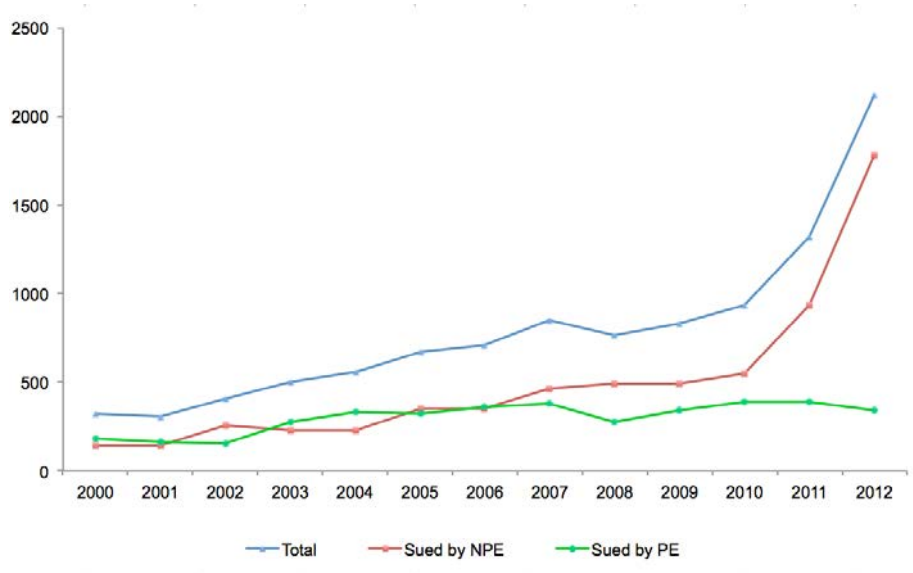
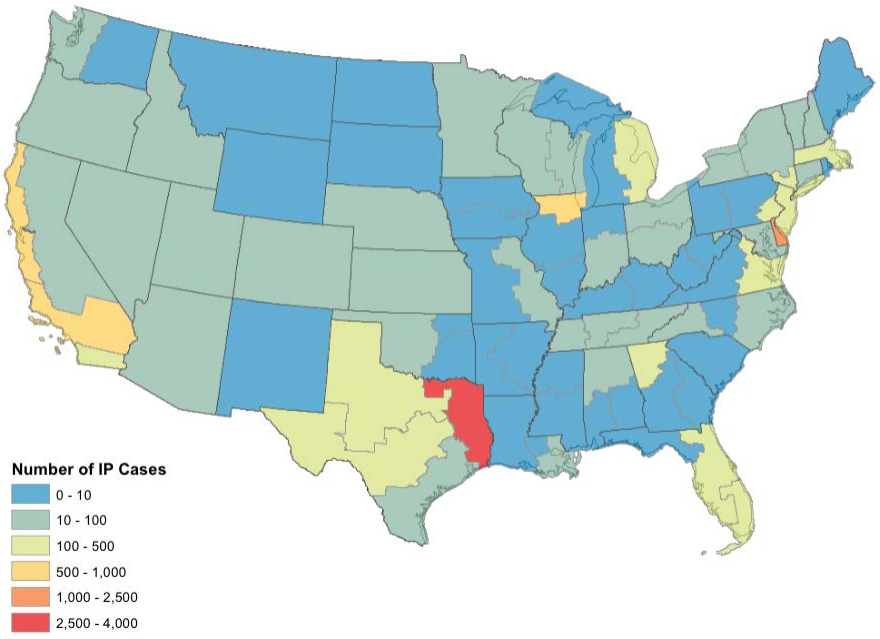


Figure 2. Geography of NPE IP Litigation.

This map charts NPE IP litigation intensity across court districts.



Appendix – Patent Trolls: Evidence from Targeted Firms

Appendix Table A1: Definitions of Variables

	Definition	Source
NPE Litigation	A dummy variable equal to 1 if a firm was litigated by an NPE in a given year.	**RPX**
NPE Litigation (CKS (2014) Sample)	A dummy variable equal to 1 if the firm was litigated by an NPE in 2010 or 2012.	**npedata.com**
Citation Commonality	To construct this, we use the Ambercite data, which provides the pairwise similarity between any two patents as the number of patents citing the patent pair together. We aggregate this to the portfolio level of patents for each firm, and compare it to any given patent that is asserted against the firm.	**Ambercite.com**
Patent Stock	Number of patents the firm filed in the past five years.	**Kogan et al. (2012)**
Number of Law Firms	Number of unique law firms representing a public firm in its ongoing cases.	**ALM Legal Intelligence**
In-house Counsel	A dummy variable equal to 1 if a firm employs an in-house counsel.	**ALM Legal Intelligence**
Ongoing Cases	Number of ongoing non-IP cases.	**Audit Analytics**
Market Value	Market value of firm equity as of the end of the previous fiscal year.	**Compustat**
Total Assets	Total firm assets as of the end of the previous fiscal year.	**Compustat**
Book to Market	Ratio of firm book value of equity to market value of equity as of the end of the previous fiscal year. (Book value of equity is the sum of stockholders equity (SEQ), Deferred Tax (TXDB), and Investment Tax Credit (ITCB), minus Preferred Stock (PREF).)	**Compustat**
Past Return	The twelve-month return prior to the end of the previous fiscal year.	**CRSP**
Cash Level	The firm's level of cash as of the beginning of the previous fiscal year.	**Compustat**
Cash Shock	A dummy variable equal to 1 if a firm's change in cash in the current fiscal year (relative to the previous fiscal year) is among the top 90% of cash increases.	**Compustat**

Appendix Table A2: Measuring Legal Team Size

In this table, we measure firms' legal team sizes, using a model that predicts the number of law firms used by comparable firms. We regress 1 plus log number of law firms on (a) how much intellectual property the firm possesses (log(Patent Stock)), (b) whether the firm has an in-house counsel (In-house Counsel), a department of lawyers housed inside the firm to handle its most frequent legal issues, (c) the most recent market performance of the firm's equity, and (d) firm fixed effects. In the first four columns, the number of law firms counts the total number of law firms representing the firm in litigation in that particular year, as reported by ALM Legal Intelligence. To accommodate the possibility that a given firm may choose not to report representation by law firms in a particular year, we impute the missing observations by using representation information from the most immediate previous year (our results are not sensitive to this imputing method). For each law firm reported in the ALM database, we collect two more pieces of information (from firm websites): (a) whether the law firm has an IP litigation practice, and (b) how important the law firm's IP practice is within the firm; we recalculate our legal team size variable after incorporating this additional information. Specifically, to calculate the legal team size variable used in Column 5, we replace the total number of law firms with the number of law firms with an IP practice. To calculate legal team size used in Column 6, we replace the total number of law firms with the number of law firms in which IP practice is deemed important. We use residual values from Columns 4, 5, and 6 to calculate the legal team size variables used in Table IV.

	Number of Law Firms	Number of Law Firms	Number of Law Firms	Number of Law Firms	Number of Law Firms	Number of Law Firms
	All Law Firms	All Law Firms	All Law Firms	All Law Firms	Law Firms with IP Practice	Law Firms where IP Practice is Prominant
Patent Stock	0.0989***			0.0640***	0.0584***	0.0462***
	(0.0059)			(0.0037)	(0.0036)	(0.0031)
In-house Counsel		1.9239***		1.8382***	1.7702***	1.5024***
		(0.0389)		(0.0358)	(0.0355)	(0.0373)
Past Return			-0.0044***	-0.0049***	-0.0052***	-0.0043***
			(0.0009)	(0.0011)	(0.0011)	(0.0009)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	82,540	82,540	82,540	82,540	82,540	82,540
R2	0.11	0.40	0.03	0.43	0.43	0.41

Appendix Table A3: Alternative Specifications

In this appendix, we examine the results documented in Table II under different specifications. In Panel A, we confirm the stability of results on Cash Level and Cash Shock by including and excluding variables one-at-a-time. In Panel B, we replace firm fixed effects with industry fixed effects. In Panel C, we cluster standard errors by year rather than by firm. We also note that variation inflation factor (VIF) for the baseline model reported in Table II is 2.2, which is well below critical values commonly used as indicator of multicolinearity problems.

Panel A. Assessing Multicollinearity

	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE
Cash Level	0.0922***	0.0857***	0.0916***	0.0839***	0.0877***	0.0855***	0.0866***
	(0.0160)	(0.0150)	(0.0160)	(0.0150)	(0.0150)	(0.0150)	(0.0150)
Cash Shock	0.0228**	0.0222**	0.0235***	0.0218**	0.0223**	0.0220**	0.0224**
	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0090)
Total Assets		0.0001		0.0001	0.0001	0.0001	0.0001
		0.0000		0.0000	0.0000	0.0000	0.0000
Market Value		-0.0045*	-0.0043*		-0.0080***	-0.0036	-0.0046*
		(0.0030)	(0.0030)		(0.0020)	(0.0030)	(0.0030)
B/M		0.0192***	0.0201***	0.0279***		0.0186***	0.0194***
		(0.0070)	(0.0070)	(0.0050)		(0.0070)	(0.0070)
Past Return		-0.0033**	-0.0033**	-0.0025*	-0.0031**		-0.0033**
		(0.0010)	(0.0010)	(0.0010)	(0.0010)		(0.0010)
Number of Patents		0.0032	0.0031	0.0033	0.0032	0.0032	
		(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420	53,420	53,420	53,420
R2	0.47	0.47	0.47	0.47	0.47	0.47	0.47

Panel B. Specification with Industry Fixed Effects instead of Firm Fixed Effects

	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE
Cash Level	0.1212***	0.0830***	0.0719***	0.1131***	0.0853***	0.0831***	0.0951***
	(0.0120)	(0.0130)	(0.0130)	(0.0120)	(0.0130)	(0.0130)	(0.0130)
Cash Shock	0.0523***	0.0365***	0.0361***	0.0447***	0.0368***	0.0367***	0.0396***
	(0.0100)	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0090)
Total Assets		-0.0001		-0.0001	-0.0001	-0.0001	-0.0001*
		0.0000		0.0000	0.0000	0.0000	0.0000
Market Value		0.0111***	0.0113***		0.0100***	0.0111***	0.0138***
		(0.0010)	(0.0010)		(0.0010)	(0.0010)	(0.0010)
B/M		0.0142***	0.0141***	-0.0180***		0.0150***	0.0183***
		(0.0050)	(0.0050)	(0.0050)		(0.0050)	(0.0050)
Past Return		0.0034***	0.0035***	0.0028**	0.0039***		0.0036***
		(0.0010)	(0.0010)	(0.0010)	(0.0010)		(0.0010)
Number of Patents		0.0126***	0.0131***	0.0155***	0.0127***	0.0126***	
		(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420	53,420	53,420	53,420
R2	0.16	0.17	0.17	0.17	0.17	0.17	0.17

Panel C. Specification with Standard Errors Clustered by Year

	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE
Cash Level	0.0922***	0.0857***	0.0916***	0.0839***	0.0877***	0.0855***	0.0866***
	(0.0180)	(0.0170)	(0.0170)	(0.0170)	(0.0170)	(0.0170)	(0.0170)
Cash Shock	0.0228*	0.0222*	0.0235**	0.0218*	0.0223*	0.0220*	0.0224*
	(0.0110)	(0.0110)	(0.0110)	(0.0110)	(0.0110)	(0.0110)	(0.0110)
Total Assets		0.0001***		0.0001***	0.0001***	0.0001***	0.0001***
		0.0000		0.0000	0.0000	0.0000	0.0000
Market Value		-0.0045**	-0.0043*		-0.0080***	-0.0036	-0.0046**
		(0.0020)	(0.0020)		(0.0020)	(0.0020)	(0.0020)
B/M		0.0192***	0.0201***	0.0279***		0.0186***	0.0194***
		(0.0060)	(0.0060)	(0.0050)		(0.0060)	(0.0060)
Past Return		-0.0033***	-0.0033***	-0.0025**	-0.0031***		-0.0033***
		(0.0010)	(0.0010)	(0.0010)	(0.0010)		(0.0010)
Number of Patents		0.0032*	0.0031*	0.0033*	0.0032*	0.0032*	
		(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420	53,420	53,420	53,420
R2	0.47	0.47	0.47	0.47	0.47	0.47	0.47

Appendix Table A4: NPE Categories and Analysis Using Alternative Sample from Cotropia, Kesan, and Schwartz (2014)

In Panel A of this appendix, we utilize a second sample, constructed by Cotropia, Kesan, and Schwartz (2014) and provided on npe-data.com (CKS). CKS hand-coded all patent-holder litigants from the years 2010 and 2012, and classified the nature of the litigants. CKS broke down the litigants into several categories of NPEs (such as "large aggregators" and "patent holding companies"). To accommodate comparability across databases, we matched plaintiff types into three broad categories: (1) Large Aggregators, (2) Small Innovators, and (3) Other. We report the percentages of litigation by category, as a percentage of total cases with NPE plaintiffs. In tabulating the CKS database, we separated out 3,950 observations that are classified as PEs (labeled as "operating companies" by CKS). These cases are used to replicate our PE vs. PE analysis. In Panel B, we conduct the same analysis as in Table III, but using the CKS data. Because the CKS data cover only two years (2010 and 2012), we cannot include firm fixed effects in the specification; however, we do include 4-digit SIC code fixed effects to capture industry-specific variation. In the last column of Panel B, we report the baseline result after excluding IT firms (SIC Code 35 (e.g., Apple and IBM) and SIC Code 73 (e.g., Yahoo and Ebay)).

Panel A. NPE Classification Comparison

	RPX Database (2001-2012)			**CLS Database (2010 and 2012)**
Large Aggregator	Pure Patent Licensing	54.05%	62.44%	Patent holding company
			10.12%	Large aggregator
Small Innovator	Inventor(s)	5.62%	15.66%	Individual/family trust
	SPV by Inventor(s)	29.65%		
			1.31%	IP Holding company of operating
			3.22%	Technology development company
Other	Evolved from OpC (failed business)	5.32%	5.70%	Failed operating company/failed startup
	University/ Research Institute	1.65%	1.44%	University/College
	Small OpCo/Grey Case	0.24%		
	Part OpCo but more than 50 percent rev from IP	2.42%		
	Number of litigation actions (docket × court)	7,100	3,755	Number of litigation actions (docket × court)

Panel B. Analysis using Data from Cotropia, Kesan and Schwartz (2014)

	Sued by NPE	Sole LA	Sole SI	Both LA and SI	Sued by NPE (excluding IT)
Total Assets	0.0000	-0.0001**	-0.0001	-0.0000***	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Market Value	0.0082***	0.0067***	0.0021*	0.0007	0.0078***
	(0.0023)	(0.0022)	(0.0012)	(0.0007)	(0.0024)
B/M	-0.0041	-0.0085	0.0014	-0.003	-0.002
	(0.0122)	(0.0120)	(0.0047)	(0.0027)	(0.0132)
Past Return	-0.0016	-0.0007	-0.0004	0.0005	-0.0032
	(0.0025)	(0.0023)	(0.0014)	(0.0007)	(0.0027)
Number of Patents	0.0214***	0.0159***	0.0080***	0.0026***	0.0194***
	(0.0056)	(0.0047)	(0.0021)	(0.0009)	(0.0068)
Cash Level	0.0573***	0.0602***	0.0233**	0.0262***	0.0424**
	(0.0180)	(0.0185)	(0.0105)	(0.0097)	(0.0170)
Cash Shock	0.0181	0.0154	-0.0006	-0.0033	0.0157
	(0.0206)	(0.0197)	(0.0106)	(0.0090)	(0.0224)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	8,304	8,304	8,304	8,304	7,158
R^2	0.19	0.17	0.14	0.13	0.19

Appendix Table A5: Split-Sample Analysis of Baseline Results

This table reports a split-sample analysis using two dummies: Legal Team Size and Ongoing Cases. The outcome variable, Sued by NPE, equals 1 if the firm was litigated by an NPE that year. D(Legal Team Size) is a dummy variable which takes a value of 1 if Legal Team Size is above the sample mean value. The rest of the variables are defined as in the legend of Table III. The sample contains firm-year observations between 2001 and 2011. Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE	Sued by NPE
					Legal Team Size Definition I	Legal Team Size Definition II	Legal Team Size Definition III
Total Assets	0.0002*	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Market Value	-0.0056**	-0.0052**	-0.0039	-0.0050**	-0.0044*	-0.0044*	-0.0045*
	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)
B/M	0.0165**	0.0173**	0.0187***	0.0173**	0.0177***	0.0177***	0.0177***
	(0.0070)	(0.0070)	(0.0070)	(0.0070)	(0.0070)	(0.0070)	(0.0070)
Past Return	-0.0032**	-0.0032**	-0.0031**	-0.0032**	-0.0031**	-0.0031**	-0.0031**
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Number of Patents	0.0031	0.0031	0.0029	0.003	0.0031	0.0031	0.0029
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Cash Level	0.0984***	0.0844***	0.027	0.0835***	0.0428**	0.0426**	0.0394**
	(0.0160)	(0.0150)	(0.0190)	(0.0150)	(0.0200)	(0.0190)	(0.0190)
Cash Shock	0.0219**	0.0309***	0.0230**	0.0102	0.0233**	0.0216**	0.0200**
	(0.0090)	(0.0100)	(0.0090)	(0.0100)	(0.0110)	(0.0100)	(0.0100)
D(Legal Team Size)	0.0151*	0.0064	0.0038	0.0038	0.0196**	0.0186**	0.0279***
	(0.0090)	(0.0080)	(0.0080)	(0.0080)	(0.0090)	(0.0090)	(0.0100)
Ongoing Cases	0.0209***	0.0209***	0.004	0.0198***	0.0029	0.0029	0.0028
	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)
Cash Level × D(Legal Team Size)	-0.0279***				-0.0368***	-0.0368***	-0.0349***
	(0.0100)				(0.0110)	(0.0100)	(0.0110)
Cash Shock × D(Legal Team Size)		-0.021			-0.0065	-0.0014	0.0035
		(0.0170)			(0.0180)	(0.0190)	(0.0190)
Cash Level × Ongoing Cases			0.0980***		0.1034***	0.1036***	0.1031***
			(0.0240)		(0.0240)	(0.0240)	(0.0240)
Cash Shock × Ongoing Cases				0.0243	0.0043	0.0035	0.0026
				(0.0190)	(0.0190)	(0.0190)	(0.0190)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,420	53,420	53,420	53,420	53,420	53,420	53,420
R^2	0.47	0.47	0.47	0.47	0.47	0.47	0.47

Appendix Table A6: PE vs. PE Cases

In Column 1 of this table, we define Sued by PE to be equal to 1 if a firm *only* faces IP lawsuits from practicing entities (PEs) in a given year. The sample is obtained from Audit Analytics. We examine cases classified as IP cases (PACER code 830), and then exclude cases in which the plaintiff is classified as an NPE (as defined by RPX). This gives us the set of firms that face PE-led IP litigation in a given year. Audit Analytics reports material federal civil litigation and class action claims disclosed to the SEC by the SEC registrants. Case disclosure comes from the firm, which is responsible for determining whether the case is material for the company. Given the severe penalties involved in not disclosing information that is already public (through PACER), a dominant strategy for a CEO is often disclose not only material information but also potentially non-material information that could later be assessed as being within disclosure guidelines. Furthermore, because our interest lies in the public firms (which are SEC registrants, by definition), Audit Analytics provides a comprehensive database for cases we are interested in. In Column 2, we replicate the analysis after excluding the pharmaceutical industry (SIC Codes 2833, 2834, 2835, and 2836) from the sample. In Columns 3-4, we replicate the analysis from Columns 1-2, but using the data from Cotropia, Kesan and Schwartz (2014) (CKS). Firms sued by both PEs and NPEs in the same year are not grouped in the Sued by PE group, so that we may cleanly identify the effect of cash on PE litigation. (The results are unchanged if the firms sued by both PEs and NPEs in the same year are not excluded.) Because the CKS data cover only two years (2010 and 2012), we cannot include firm fixed effects in the specification; however, we do include 4-digit SIC code fixed effects to capture industry-specific variation.

	Sued by PE	Sued by PE	Sued by PE	Sued by PE
	Audit Analytics	Audit Analytics Excluding Pharma	CKS	CKS Excluding Pharma
Total Assets	0.0001	0.0001	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Market Value	0.0029	0.0022	0.0017	0.0010
	(0.0020)	(0.0020)	(0.0013)	(0.0011)
B/M	0.0032	0.0034	-0.0102	-0.0133*
	(0.0050)	(0.0050)	(0.0072)	(0.0069)
Past Return	-0.0001	-0.0003	0.0008	0.0009
	(0.0010)	(0.0010)	(0.0012)	(0.0014)
Number of Patents	0.0030	0.0023	0.0019	0.0023
	(0.0020)	(0.0020)	(0.0017)	(0.0018)
Cash Level	-0.0058	-0.0071	0.0080	0.0088
	(0.0100)	(0.0090)	(0.0086)	(0.0090)
Cash Shock	0.0089	0.0070	-0.0097	-0.0073
	(0.0070)	(0.0060)	(0.0080)	(0.0080)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	No
Industry FE	No	No	Yes	Yes
N	53,420	50,370	8,304	7,844
R^2	0.29	0.26	0.11	0.11

Appendix Table A7. PACER Nature of Suit Codes

This appendix lists the lawsuit codes as classified by PACER (https://www.PACER.gov/documents/natsuit.pdf).

Suit Type	PACER Suit Code	Nature of Suit
TORT	310	Airplane
	315	Airplane Product Liability
	320	Assault, Libel, & Slander
	330	Federal Employers's Liability
	340	Marine
	345	Marine Product Liability
	350	Motor Vehicle
	355	Motor Vehicle Product Liability
	360	Other Personal Injury
	362	Personal Injury- Medical Malpractice
	365	Personal Injury- Product Liability
	367	Personal Injury - Health Care/Pharmaceutical Personal Injury/Product Liability
	368	Asbestos Personal Injury Product Liability
	375	False Claims Act
	370	Other Fraud
	371	Truth in Lending
	380	Other Personal Property Damage
	385	Property Damage Product Liability
CONTRACT	110	Insurance
	120	Marine
	130	Miller Act
	140	Negotiable Instrument
	150	Recovery of Overpayment & Enforcement of Judgment
	151	Medicare Act
	152	Recovery of Defaulted Student Loans (Excl. Veterans)
	153	Recovery of Overpayment of Veteran's Benefit
	160	Stockholders's Suit
	190	Other Contract
	195	Contract Product Liability
	196	Franchise
LABOR	710	Fair Labor Standards Act
	720	Labor/Management Relations
	730	Labor/Management Reporting & Disclosure Act
	740	Railway Labor Act
	751	Family and Medical Leave Act
	790	Other Labor Litigation
	791	Employee Retirement Income Security Act
SECURITIES	850	Securities/Commodities/Exchange
ENVIROMENT	893	Environmental Matters

Appendix Table A8: PE vs. PE case coding

This appendix reports the criteria used to code case outcome variables for the PE vs. PE sample. We find docket numbers of PE vs. PE cases in Lex Machina and record "Patent Case Resolution." We then read the judgment to identify the nature of dismissal or the party that judgment favored. In cases where the judgment refers to stipulated dismissal, we code the outcome as "settlement." In Panel B, we report the distribution of PE vs. PE cases based on outcome.

Coded as	Criteria
Settlement	Likely Settlement: Stipulated Dismissal
Won by Plaintiff	Judgment: Consent Judgment : Claimant Win
Won by Defendant	Judgment: Consent Judgment : Claim Defendant Win
Dismissed	Judgement: Trial : Dismissed with prejudice
Dismissed	Judgement: Trial : Dismissed w/o prejudice
Not included	Stayed, Transfers or procedural dispositions

	PE vs. PE (%)	NPE vs. PE (%)
Dismissed	5	10
Lost by Plaintiff	10	5
Settled	73	83
Won by Plaintiff	12	2
Total dockets	1,149	6997 (839)