Patent Trolls

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ABSTRACT

We provide both theoretical and empirical evidence on the evolution of Non-Practicing Entities (NPEs) in the intellectual property space. Heterogeneity in innovative ability, given a cost of commercialization, results in NPEs that choose to act as "patent trolls," chasing operating firms' innovations even if those innovations are not clearly infringing on the NPEs' patents. We support these predictions using a novel, large dataset of patents targeted by NPEs. We show that NPEs on average target firms that are flush with cash (or have just had large positive cash shocks). Furthermore, NPEs target firm profits arising from exogenous cash shocks unrelated to the allegedly infringing patents. We next show that NPEs target firms irrespective of the closeness of those firms' patents to the NPEs' – NPEs typically target firms that are busy with other (non-IP related) lawsuits or that have high probability of settlement. Lastly, we show that NPE litigation behavior has a negative real impact on the future innovation of targeted firms.

JEL Classification: D2, K1, O31.

Key words: Patent trolls, NPEs, Innovation, Patents

Clearly defined property rights are essential for well-functioning markets. In the case of intellectual property, however, property rights are complex to define – unlike ownership of physical assets, the space of ideas is difficult to cleanly delineate. A solution employed by the U.S. and many other countries is the *patent* – a property right allowing an idea's owner sole commercialization of his or her idea for a period of time. As such, a patent holder can block commercialization of inventions arguably similar to the patented invention. In the United States, the legal system is the arbiter of patent infringement; thus, legal action (or threat of legal action) is the main lever through which entities challenge alleged intellectual property (IP) 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 prosecute 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 imperfections in the legal system implicitly reward large, well-funded organizations that can overwhelm small innovators, infringing at will on small innovators' IP. Opponents cast NPEs as organizations that simply raise the costs of innovation by exploiting an equally imperfect legal system that will rule in their favor sufficiently often - even if no infringement has actually occurred - that the credible threat of the legal process allow the NPEs to extract rents from producing, innovative firms. Reflecting this debate, there have been (as of today) ten bills introduced in Congress proposing to regulate the licensing of patents to NPEs.[1]

We inform the ongoing debate on NPEs by providing the first large-sample evidence on precisely which corporations NPEs target in litigation, when NPE litigation occurs, and the impact of NPE litigation on the innovative

[1] Innovation Act (H.R. 3309), Patent Transparency and Improvements Act (S. 1720), Patent Quality Improvement Act (S. 866), Patent Abuse Reduction Act (S. 1013), Patent Litigation Integrity Act (S. 1612), Innovation Protection Act (H.R. 3309), Patent Litigation and Innovation Act (H.R. 2639), SHIELD Act (H.R. 845), Stopping the Offensive Use of Patents Act (STOP Act) (H.R. 2766), End Anonymous Patents Act (H.R. 2024).

activity at targeted firms. We first develop a parsimonious model of an innovative economy in which the role and incentives of NPEs endogenously result in patent trolling. We assume heterogeneity across agents in innovative ability. Together with a cost of commercialization and a litigation mechanism that imperfectly enforces infringement, invention heterogeneity leads some patent holders to endogenously choose to litigate other commercializing firms instead of commercializing their own inventions. The litigation decision of these patent holders depends on a comparison of the expected profitability of litigation to the expected profitability of commercialization. Low-type innovators will nearly always litigate. Furthermore, especially high-type innovators will commercialize, but will be litigated often: Even if the high-type's patent portfolio is dissimilar to the low-type's (so the probability of successful litigation is low), the potential payoff of litigation could be high enough to induce suit. Thus, our model predicts that targeted firms should be those who have large pools of resources to fund pay-offs (cash-rich firms), as well as firms that have a high probability of settling or losing the case for any reason (even if they have less cash).

An interesting implication of the model is that endogenous emergence of patent trolls causes socially inefficient outcomes by ensuring that some welfare-increasing innovations are not brought to market. These social losses come from two sources: first, those agents who have a profitably commercializable innovation, but have a high enough probability of getting sued to be deterred from production; second, innovators that decide not to commercialize because the ex-ante expected profitability of becoming a patent troll is higher than that of commercialization.

Using proprietary data, we provide strong empirical evidence for the model's main predictions. We link patent-level data on NPEs and their activities to *all* publicly traded firms. Using this linked data, we show that NPEs behave opportunistically, on average acting as patent trolls. First, NPEs target firms that are flush with cash (controlling for all other characteristics) - additionally, they also target firms that have recently come into a lot of cash. To get an idea of magnitude, a one standard deviation increase in cash level increases the

probability of being sued by 11% (t=6.97). Relative to a mean of 2%, this magnitude is large, at over a fivefold increase in the probability.

In fact, NPEs even target conglomerate firms who are getting all of their cash from segments having nothing to do with their allegedly infringing patents (i.e., NPEs are likely sue a firm regarding a tech patent that has both tech and lumber who are getting all of their cash from lumber). Profitability in unrelated businesses has almost an identical magnitude in predicting being sued by an NPE as does profitability in the related segment.

Consistent with the model, we also find that NPEs target firms relative to whom they have a higher ex-ante likelihood of winning. We use a number of measures for this ex-ante likelihood. First, NPEs are significantly more likely to target firms that are busy dealing with a number of other litigation events outside of intellectual property. Being currently tied-up with outside litigation roughly doubles the probability (t=2.89) of being sued by an NPE. In addition, controlling for all other characteristics, a firm with a larger legal team has a significantly lower probability of being targeted by NPEs, consistent with the larger legal team serving as a deterrent.

Of course the true prediction of the model is on the entire ex-ante expected profitability of litigation for the NPE. To capture this, we interact our measures of expected payouts (cash) and expected probability, to get a measure of expected profitability. We find that NPEs are targeting specifically those firms who have large ex-ante expected profitability of litigation. In particular, the interaction terms between expected payouts and probability are all large and significant. They suggest that nearly all of the targeting done by NPEs is concentrated in firms who both have large pools of proceeds for potential payouts, and who ex-ante expected to be more likely to payout in some form (settle the case or lose in court). To further explore this, we construct a measure of ex-ante expected outcome if the firm were to go to court. This measure relies on the assumption that defendants often make predictions about the likely outcome based on what they observe from other firms in the same industry around their location. We find that the interaction term of this expected

outcome and expected payout is again large and significant, providing further evidence that NPEs target firms that they expect to payout especially when these targets have deep pockets.

We then examine the real impacts of NPEs' litigation activity. Comparing firms that are sued by NPEs and go to court (so controlling for selection of being sued by the NPEs), firms that lose in court see significantly lower patenting and citations to their marginal patents after the suit (as opposed to firms that get the cases dismissed), suggesting a real negative impact of NPEs on innovation. These firms have exactly identical patenting (and quality of patents) pre-litigation event. To test this even further, we show that patents of both firms developed pre-litigation continue to accrue citations at exactly the same rate after the litigation, in stark contrast to the divergent quality of patents developed between the firms post-litigation. This suggests that it really is the litigation event initiated by the NPE that causes the decrease in innovation.

Taken as a whole, our evidence appears most consistent with the view that NPEs on average behave as patent trolls. Alternative interpretations simply do not seem to explain our entire body of evidence. For instance, firms taking actions against anticipated litigation might be consistent with our results on cash-targeting; however, this view is completely at odds with our finding that firms that significantly *reduce* their legal representation are the main targets of NPEs. Meanwhile, the idea that NPEs solely target firms that infringe profitability on NPE intellectual property is largely inconsistent with our finding that profitability in unrelated operating segments generates an increased probability of being sued nearly identical to that found in targeted patents' segments.

The remainder of the paper proceeds as follows. Section I provides a background and literature review. Section II develops a model of the economics of innovation and the evolution of endogenous patent trolls. Section III then describes the proprietary data on NPEs utilized in the paper, while Section IV presents the main empirical results on which firms are targeted by NPEs. Section V shows evidence on the real impacts on innovation of NPEs litigation

behavior. Section VI concludes.

I. Background

The amount of patent related litigation has increased ten-fold since 2000. According to a recent Government Accounting Office (2013) report, three factors contributed to this pattern: (1) the number of patents, especially software related patents, with unclear property rights have increased over time; (2) courts have been awarding large monetary awards in infringement lawsuits (even for ideas that make only small contributions to a product), which creates an incentive for patent owners to file infringement lawsuits; and (3) markets place a larger valuation for patents than it did before.

Large scale NPE patent litigation is a recent development, thus the empirical literature is limited, but growing rapidly (see Bessen et al. (2011), Bessen et al. (2012), Chien (2012)). Our paper contributes to this literature by providing facts which public corporations NPEs choose litigate, when they litigate them, and the impact of the litigation on the innovative activity at these firms. Our work is also related to the literature, which examines the choice between settlement vs. pursuing a court decision. Spier (2005) provides an excellent review of economics of litigation. Previous surveys include Cooter and Rubinfeld (1989), Hay and Spier (1998), and Daughety (2000).

While we solely focus on the intellectual property domain, our paper is also related to well develop literature on the effect litigation risk on several firm activities.[2]

[2] Prior research investigates the impact of litigation risk on several characteristics, including litigation risk and cash holdings (Arena and Julio, 2010), equity-based compensation (Jayaraman and Milbourn, 2009), IPO underpricing (Lowry and Shu, 2002; Weiss-Hanley and Hoberg 2010), institutional monitoring and board discipline (Cheng, Huang, Li, and Lobo, 2010; Laux, 2010), conservatism in debt contracting (Beatty, Weber, and Yu, 2008), audit fees (Seetharaman, Gul and Lynn, 2002), and auditors' resignation decisions (Shu, 2000). Papers that investigate the relation between managers' financial reporting and disclosure decisions and litigation risk include Skinner (1994, 1997), Francis, Philbrick and Schipper (1994), Johnson, Kasznik, and Nelson (2000), Rogers and Van Buskirk (2009), among others.

2. Economics of Innovation and Litigation

We begin with a simple setup in which there are two inventors.[3] Each inventor i has an invention $\theta_i \in$ R. Each inventor can choose between *commercializing*, *suing*, or *exit*.[4]

Commercializing an invention θ yields profits $\pi(\theta)$, at (fixed) cost k. We assume that inventions are ordered by quality so that π is increasing.

Suing costs c. If one inventor sues and the other commercializes, then the suing inventor wins his suit with probability $p_{\theta_i}(\theta_j) \equiv p(|\theta_i - \theta_i|)$. We assume p is continuous, and that suits over identical inventions are always successful, i.e. $p(0) = 1$. In principle, distinct inventions should never be determined infringing—fully effective courts would ensure that $p(\theta) = 0$ for all $\theta \neq 0$. However, we assume some friction in courts' evaluations of patent similarity, so that $p(\theta) > 0$ for all $\theta \in$ R. Nevertheless, we assume that courts can make relative similarity judgments correctly, so that p is decreasing.

If an inventor i wins a suit against the other inventor, j, then i is awarded $w\left(\pi(\theta_j)\right)$. Here, we assume that $w \in (0, \infty)$, so that we express the award as a (possibly larger-than-1) fraction of the commercial profits $\pi(\theta_j)$. Suing yields no profits if both inventors choose to sue, or if one inventor chooses to exit.

II.1 The Born Troll

First, we consider the case in which one o the inventors, t is a "born troll," whose invention

is not valuable enough to commercialize on its own. That is, we assume t hat $\pi(\theta_t) < k$.

In this case, t will always choose either to sue or to exit. In this context, the other investor, $r \neq t$, will never choose to sue.

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[3] This is easily extended to a continuum of investors, but all of the important dynamics can be illustrated with the two inventor case. We present the model with a continuum of inventors in the appendix.

[4] We focus only on pure-strategy equilibrium.

We suppose that $r \neq t$ has a potentially profiable invention: $\pi(\theta_r) \geq k$, or equivalently, $\theta_r \, \pi^{-1}(k)$. We then consider $\theta_t < \pi^{-1}(k) < \theta_r$, so that $p_{\theta_t}(\theta_r)$ is decreasing in θ_r. There are three cases to consider:

1. If $\theta_r < \pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right)$, then $w\big(\pi(\theta_r)\big) \cdot p_{\theta_t}(\theta_r) < c$, so that suit is never profitable for t. In this case, r can commercialize without fear of suit, and will choose to do so.[5]
2. If $\pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right) < \theta_r$ and $\theta_r < \pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right)$, then $c < w(\pi(\theta_r)) \cdot p_{\theta_t}(\theta_r)$ — suit is profitable — and $\pi(\theta_r) - k < w(\pi(\theta_r))\, p_{\theta_t}(\theta_r)$ — commercialization is not profitable for t, given that it gets sued. In this case, inventor r has a profitable invention but chooses not to commercialize; this is socially inefficient.[6]
3. If $\pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right) < \theta_r$ and $\pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right) < \theta_r$, then $c < w(\pi(\theta_r)) \cdot p_{\theta_t}(\theta_r)$ — suit is profitable — and $w\big(\pi(\theta_r)\big)p_{\theta_t}(\theta_r) < \pi(\theta_r) - k$ — commercialization is profitable for t even given suit. In this case, r will choose to commercialize, and t will sue him.

If $wp_{\theta_t}(\theta_r) \geq 1$, then $\theta_r < \pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right)$ a priori, so commercializing cannot be profitable in the presence of suit. Thus, we assume $wp_{\theta_t}(\theta_r) < 1$ in the sequel.

Now, the suit occurs in equilibrium if and only if

[5] The range of inventions θ_r which are commercialized without drawing suit expands, holding p˙ fixed, as the cost of commercialization, k, falls; the cost of suit, c, rises; or the returns from the suit w fall.

[6] Note that this result is preserved even if we allow mixed strategies. Indeed, if r can mix between suing and exiting, then he will sue just frequently enough to ensure that r is indifferent between commercializing and not commercializing.

$$\theta_r > max\left\{\pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right), \pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right)\right\} > \pi^{-1}(k) \quad (1)$$

Thus, there is a range of inventions θ_r for which

$$\theta_t < \pi^{-1}(k) < \theta_r < max\left\{\pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right), \pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right)\right\} \quad (2)$$

Any inventions θ_r in the range (2) for which $\theta_r < \pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right)$ — that is, any inventions θ_r for which $\theta_r > p_{\theta_t}^{-1}\left(\frac{1}{w}\frac{c}{k}\right)$ — are commercialized (case 1 above). There are commercialized inventions that do not draw suit even though they are "closer" to θ_t than the inventions that do draw suit. Because θ_t is a low-value invention, the inventions most similar to θ_t are not worth trolling.

Now, as c $\rightarrow$ 0, the $\theta_r < \pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right)$ condition must bind in (1). Thus for any sufficiently valuable invention that is commercialized—no matter how unlikely to be confused with θ_t—it is possible to make the costs of suit c low enough that t will sue r.

An increase in $wp_{\theta_t}(\theta_r)$ towards 1 increases crowd-out on both the low and high margins: The range of inventions θ_I for which $\theta_r < \pi^{-1}\left(\frac{c}{wp_{\theta_t}(\theta_r)}\right)$ shrinks, so fewer inventions can be commercialized without fear of suit. Meanwhile, the range of inventions θ_I for which $\pi^{-1}\left(\frac{k}{1-wp_{\theta_t}(\theta_r)}\right) < \theta_r$ also shrinks—inventions that were previously profitable (given suit) become unprofitable (given suit). Thus, increases in ω, the returns from suit, and pointwise dominant increases (i.e. rightward shifts) in $p_{\theta_t}(.)$, the probability of successful suit, are socially inefficient. It is not clear, however, that such shifts will produce *more* suits in aggregate because inventions that might have drawn suit are crowded-out.

II. 2 The Opportunistic Inventor

Now, we suppose that both inventors have potentially profitable inventions, but that one of the inventors, t, has an much less valuable than that of the other inventor, r. We focus on one particular region of interest, in which t chooses not to commercialize and instead sues r.

Specifically, we assume:

$\theta_r > \theta_t > \pi^{-1}(k)$ (both inventions are potentially profitable);

$\pi(\theta_r) - k - w\big(\pi(\theta_r)\big)\, p_{\theta_t}(\theta_r) > max\{w\big(\pi(\theta_t)\big)\, p_{\theta_r}(\theta_t) - c, 0\} =$

$max\{w\big(\pi(\theta_t)\big)\, p_{\theta_t}(\theta_r) - c, 0\}$

(commercialization is the most profitable option for r, even given the possibility of suit and the option of suing t); and

$w\big(\pi(\theta_r)\big)\, p_{\theta_t}(\theta_r) - \mathrm{c} > \pi(\theta_r) - k$ (if r commercializes, then suing is unambiguously the most profitable option for t).

With these r always commercializes and t always sues r instead of commercializing: Despite having a socially valuable invention, the high expected returns from suing a much more profitable inventor lead t to become an "endogenous troll."

III. Data

We obtain information on NPEs from PatentFreedom, an online membership community of companies in which members both access and contribute to the information about who own and enforce patents. As of January 2014, PatentFreedom had detailed information on more than 720 NPEs and 2100 subsidiaries, which hold more than 63,000 United States patents and applications. According to PatentFreedom, roughly 69% of these patents are acquired externally (purchased) by the NPE and their subsidiaries, whereas 19% are them

are originally assigned to them.[7]

The data also provide detailed information on 11,838 litigations for which PatentFreedom obtains litigation related information from the Public Access to Court Electronic Records (PACER) database. In 10,933 of these cases NPEs act as a plaintiff. Because we are interested in public firms, we focus on 3,683 cases in which the defendant is a publicly traded firm.

We obtain firm level patent information from the database used in Kogan et al. (2012).[8] This database contains utility patents issued by the USPTO between 1/1/1926 and 11/02/2010, along with citation data on these patents. We obtain information on 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, contracts litigation, labor litigation, torts litigation and intellectual property litigation.

To identify involvement in non-intellectual property related litigation events, we use Audit Analytics Litigation database. Audit Analytics data cover the period from 2000 to 2012 and report information on litigation for Russell 1000 firms from legal disclosures filed with the SEC. Audit Analytics collects details related to the specific litigation, including the original date of filing, location of the litigation, information on plaintiffs and defendants, judges, and if available, the original claim and settlement amounts.

We obtain local ethnicity data as drawn directly from the 1990 and 2000 U.S. Census, and which are available at the state level. The ethnicity information in these Censuses is based on self-identification questions in which residents choose their origin(s) or descent(s). We supplement this data by financial statement data reported in Compustat Annual files. In Table I Panel A, we present summary statistics on the firms included in the tests.[9] Consistent with the overall trend that the amount of patent litigation has increased over time –

[7] See https://www.patentfreedom.com/about-npes/background/ (accessed on March 5, 2014). The remaining 12% are a blend of originally assigned and acquired patents.

[8] We thank the authors for graciously providing us both patent and citation data.

[9] Appendix Table 1 contains the detailed data description on specific data fields utilized in our study.

we find that the number of public firms sued by NPEs has concordantly increased as shown in Panel B. Panel B shows the firm-years sued. As a docket (case) can have multiple defendants, and the same the same defendant can be sued multiple times in a year, these firm-years encompass our 3,683 cases.

IV. Results

IV.1 Ability to Pay for Monetary Damages

We begin by testing the central prediction in our model, namely that NPEs target firms with ability to pay the damages or settlement fees. We use both level of cash balances (*Cash Level*) on the balance sheet and also change in cash (*Cash Shock*), as proxies for the potential proceeds (w from Section II). We additionally include several firm- and time-level control variables including: market value of the firm, book to market ratio,[10] prior year's stock market performance of equity shares, the total number of patents filed by the firm in the recent past, along with time and firm fixed effects. In Table II, we report the OLS regression results of the following specification:

$$Sued\ by\ NPE = f(Total\ Assets, Market\ Value, \mathrm{BM}, Past\ Return, PatentStock, Cash\ Level, Cash\ Shock)$$

The outcome variable, *Sued by NPE*, is a dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year. *Cash Level* is total amount of cash reported on balance sheet as of the *beginning of previous fiscal year*. Cash Shock is a dummy variable that takes a value of 1 if change in cash in the most current fiscal year compared to previous fiscal year 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 being targeted by NPEs. Likewise, we include year fixed effects to control for variation in litigation activity specific to a given year along with any time

[10] Tobin's Q proxy for investment opportunities.

trends in litigation propensity. We report various specifications to show the incremental value of each covariate on overall fit of the model to data. Column 5 represents our preferred specification, which includes firm level characteristics (market value of firm, book to market, asset size, prior stock performance of equity), year and firm fixed effects, as well as our variables of interest, cash level and cash shock. We use log transformation of all variables to minimize the effect of outliers.[11] We use standard errors that are clustered at the firm level to broadly allow for any time series dependency in probability of being sued over the course of sample period.

Table II provides strong evidence consistent with the central prediction of the model. Namely, firms with large cash balances and firms experiencing a shock to their cash holdings are more likely to be targeted by NPEs. For instance, controlling for other determinants, along with firm and time fixed effects, the coefficient on *Cash Level* in Column 3 of 0.1048 (t=6.80) is large and significant, as is the coefficient in Column 4 on *Cash Shock* of 0.0167 (t=2.06). To get an idea of magnitude, we use the coefficient estimates in the full specification in Column 5. Given that the average firm-level cash holding of \$0.30 billion, the 0.1065 (t=6.87) coefficient on *Cash Level* implies that a one standard deviation higher cash balance increases the chances of getting sued by 11.10%. Given the unconditional probability of being sued for patent infringement is approximately 2.18%, this represents over a 5-fold increase over the average firm. In terms of *Cash Shock*, the coefficient of 0.0213 (t=2.56) implies that the probability of getting sued following a cash shock nearly doubles. Both of these estimates show that the economic impact of cash balances and shocks to these cash balances on being targeted by NPEs is quite large.

In terms of control variables, the probability of being sued by an NPE is positively correlated with R&D activity level as measured by number of patents filings in the past 5 years (0.0064, t=2.66) and negatively correlated with past stock market performance (-0.0013, t=1.85). Once including firm fixed effects,

[11] We obtain nearly identical results in magnitude and significance when we don't use log transformation (see online appendix – Table 1).

and controlling for the *Cash Level*, smaller market capitalization firms are slightly more likely to be targeted by NPEs (-0.0049, t=2.13).

In sum, the interpretation of the coefficients on *Cash Level* and *Cash Shock* reveal the strong impact of cash on NPEs decision of which firms to target. In particular, in Column 5, both of these effects are estimated including firm and time fixed-effects, and fine controls for firm size, past returns, and patent stock. Thus, the large coefficients can be interpreted as a firm being likely to be targeted when it has an abnormally high cash level or shock to that cash level relative to all other firms' relative cash levels and shocks to their cash levels.

IV.2. Likelihood of Settling Earlier

The patenting process begins with the inventor's application to United States Patent and Trademark Office (PTO). PTO assigns the application to a patent examiner, whose job is to compare an application's claims to the prior art to determine whether the claimed invention is novel and nonobvious.[12] If the examiner decides to grant the claims in the application, PTO issues a patent to the applicant.[13] The patentability of a patent's claims can be challenged in administrative proceedings before PTO and its validity can be challenged in one of the 94 federal district courts by presenting a prior art, which was potentially overlooked by the PTO examiner before granting the patent.

Since a patent is a right to exclude others from practicing the invention, patent owners of prior art can sue anyone who uses, makes, sells, offers to sell, or imports the patented invention without legal permission. If a patent infringement lawsuit is not dismissed in the initial stages, it proceeds to the discovery phase, in which both the accused infringer (defendant) and the patent owner (plaintiff) supply documents that potentially points out how the allegedly infringing product is made. If a party does not offer products or services using the patents,

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

[13] In 2013, the average between application and examiner initial report was 18.2 months and on average it takes 29.1 months for PTO to issue a patent. For other information on USPTO related statistics, see http://www.uspto.gov/about/stats/

then they often file fewer documents to disclose. This is typically the case for the NPEs who do not use the patent to produce a product. In other words, going into the discovery phase is often a costly process for defendants as it takes considerable time and money to build a case. If the case is not settled through the discovery phase, the judge interprets the claims to decide whether the patent is found to be both valid and infringed. If a judge rules in favor of the plaintiff (NPE), he can award the patent owner monetary damages and/or issue an injunction to prohibit further infringement.

Our model suggests that NPEs will take be opportunistic in picking which patents to litigate, maximizing the expected profitability of winning. While Section V.1 explored the profitability conditional on winning, in this section we examine measures of the probability of winning. We introduce three measures to assess an NPE's likelihood of winning a case, either through the firm's likelihood of settling with the NPEs or through increasing the probability of wining in court.[14]

Our first measure of ex-ante NPE probability of success (p) rests on the idea that firms differ with respect to their readiness to stave off litigation events. Firms anticipating litigation events coming are more likely show evidence of in-advance preparation and these defense mechanisms are likely to deter NPEs as such defense mechanisms are likely to prolong the court (or settlement) process. We use number of "excess lawyers" as our measure of firm litigation defense readiness. Because the number of lawyers can vary with respect to several firm characteristics, we first estimate a model to estimate the number of lawyers a firm would employ given its observable characteristics. Specifically, we regress log number of lawyers on how much intellectual property the firm possesses (*Log (Patent Stock)*) and whether the firm has an in-house counsel, *In-house counsel*, a department of lawyers housed inside the firm to handle most frequently

[14] A large literature has examined the choice between settlement vs. pursuing a court decision. For a recent review of economics of litigation, see Spier (2005). Cooter and Rubinfeld (1989), Hay and Spier (1998), and Daughety (2000) are other surveys on this issue. For our purposes, it is not important what tool the NPE uses to target its litigant, but instead our model and empirics focus on which firms they choose to litigate.

encountered legal issues in firm. Firms performing badly in equity markets have been found to be slightly more likely to be sued (Dyl (1999); Simmons and Hoyt (1993); Gande and Lewis (2009)), and we thus include past performance. Finally, we include firm fixed effects to capture time invariant unobserved firm level characteristics that can be related to number of lawyers, and year fixed effects to capture variation in demand for lawyers specific to a given year.

Panel A of Table III shows the results of the model we estimate to predict expected number of lawyers a firm hires given the covariates. As expected, the number of lawyers is negatively correlated with past equity return and positively correlated with number of R&D activity, as measured by Patent Stock. We calculate *Excess Lawyers* by subtracting the predicted number of lawyers from the actual number of lawyers. We view this *Excess Lawyers* measure as a potential deterrent to NPEs, decreasing their ex-ante success probability of, and thus motivation for, targeting a given firm.

The second measure causing variation in the subjective probability of winning is based on the premise that defendants often make predictions about the likely outcome based on what they observe from other firms in the same industry around their location. IP litigation shows considerable cross-sectional variation across states (see Figure 1) If, say, most of the video game producers from California were litigated in Marshall, Texas (location of US District Court, Eastern District of Texas) and most of these cases were finalized in favor of NPEs, then firms' posterior probability will incorporate both the likelihood of being sued in Marshall, TX and the judicial outcome conditional on the trial taking place there.

To capture the likelihood of getting sued in state C if the firm from industry J is located in state F, we use the ratio of number of firms in industry J in state F sued in state C prior to time t, to number of firms in industry J in state F sued in all states prior to time t, *i.e.* $\left(\frac{n(j,c,t-1)}{\sum_{\forall c} n(j,c,t-1)}\right)$. This probability is the same (at any given point in time) for all firms in the same industry which operate in the same state.

To capture judicial outcome probability, we need to understand how firms

evaluate their chances of winning a case, say in Texas vs. Ohio. Anecdotal evidence suggests that, because plaintiffs choose the court to file the litigation, defendants often worry about judicial bias against them. For example, Lerner (2013) notes that "fi Marshall, TX juries have the reputation of being particularly unsympathetic to Asian companies as defendants, who dominate the video-game market". We build on this intuition and form an indicator variable for each state couple (e.g. California-Texas), based on comparison of Asian ethnicity represented in the corresponding states. If Asian ethnicity is more represented in firm location (F) then court location (C), then this indicator variable takes a value of 1 (e.g. $I(Asian(C,t-1) < Asian(F,t-1))$). When we combine the likelihood of getting sued in state C if the firm is located in state F with this judicial bias dummy variable, we get the following formula to measure litigation risk for every firm in a given industry in a given state, e.g. our litigation measure does not vary within state-industry:[15]

$$Likely\ Outcome\ (j,f,t) = \sum_{\forall C \neq F} \frac{n(j,C,t-1)}{\sum_{\forall C} n(j,C,t-1)}\ x\ I(Asian(C) < Asian(F)).$$

In Table III, Panel B, the outcome variable equals 1 if the case ended in favor of NPE or settled outside of the court. We regress this variable on *Likely Outcome* after controlling for industry and year fixed effects (Column 2) and for firm and year fixed effects (Column 3). The sample comprises all concluded litigations involving public and private firms for which we have location information on both court and firm.

Panel B of Table III shows that *Likely Outcome* is positively associated with the case ending favorably for the NPE. This holds even as ethnicity is slow moving along with our judicial outcome measure adding only one year of new cases to the window-length), thus we are identifying mainly off of a shocks of new

[15] Much of the literature measures litigation risk using an industry-based proxy, either alone or in conjunction with other variables. A common proxy is based on membership in the biotechnology, computers, electronics, and retail industries. This proxy originates from Francis, Philbrick and Schipper (1994). While the industry measure alone does a relatively poor job of predicting litigation, supplementing this variable with measures of firm characteristics (such as size, growth, and stock volatility) improves the measure (Kim and Skinner, 2014).

case outcomes (within-firm in Column 3). The coefficient in Column 3, for instance, suggests that a one standard deviation increase in our litigation risk proxy (0.1275, t=1.97), increases the probability of the NPE winning the case by 5.12% (relative to 77% unconditional winning probability). We use this *Likely Outcome* measure to create our second measure of probability of outcome from the NPE's perspective.[16]

The last measure utilizes the within-firm resource constraint on time and proceeds spent battling litigation. Based on this, we predict that a firm is less likely to focus as much attention on the marginal case if it is occupied with other types of litigation. We thus use existence of non-IP related litigation (*Ongoing Cases Dummy*) as our first measure of an NPE target toward firms, given the impact on the firms' being more likely to settle or less focused in court (with NPEs then having, holding all else fixed, a higher subjective probability of winning).

Armed with these three measures, we then test a second prediction of the model: that conditional on the potential proceeds if the NPE wins a given suit (w, in our model), NPEs should target firms to whom they have a higher ex-ante probability of a successful litigation outcome. To formally test this, we supplement our main specification reported in table 3 by these three measures of this ex-ante probability form the NPEs perspective: *Ongoing Cases, Likely Outcome*, and *Excess Lawyers:*

$$\begin{aligned} \textit{Sued by NPE} = f(&\textit{Total Assets}, \textit{Market Value}, \text{BM}, \textit{Past Return}, \\ &\text{PatentStock}, \text{Cash Level}, \textit{Cash Shock}, \\ &\textit{Excess Lawyers}, \textit{Likely Outcome Dummy}, \textit{Ongoing Cases Dummy}) \end{aligned}$$

The results of these tests are reported in Table IV. The coefficient estimate on *Excess Lawyers* is negative (-0.1157, t=-2.06), consistent with a deterrent effect of the large legal representation team. The coefficient implies that

[16] We use both the categorical version of Likely Outcome (value>median) and the continuous version, and obtain nearly identical results in magnitude and significance. We report the categorical version in Tables 4 and 5 for ease of interpretation, but show results with the continuous version in the appendix (see online appendix – Table 2).

a one standard deviation in excess lawyers is associated with 0.5% lower chance of being targeted by an NPE. While the coefficient of *Likely Outcome* is positive (as expected), it is not statistically significant (t=1.48). We find that the sign of *Ongoing Cases* is positive and significant. Given the firm fixed effects, the coefficient of 0.0167 (t=2.87) from Column 4 implies that at times firms have a slate of ongoing cases they have a 1.67% higher chance of getting targeted by NPE (controlling for *Cash Level* and *Cash Shock*). Overall these results suggest that NPEs are likely target firms with higher likelihood of settling earlier.

Of course, the true prediction of the model is on the overall expected profitability for the NPE of targeting a given firm, which is the product of w (proceeds) and p (probability of winning). Empirically, this equates to interaction terms between our measures of w, proceeds (*Cash* and *Cash Shock*), and p (*Excess Lawyers*, *Ongoing Cases, and Likely Outcome).* We run exactly these tests in Table V. The specification is identical to Tables II and IV, with the dependent variable being if the given firm was targeted by litigation from an NPE.

The first two columns of Table V suggest that NPEs are less likely to target firms with large legal representation team for the same level of proceeds from the case. The interpretation of each measure in columns 3-6 is that as the NPE is significantly more likely to bring suit as the ex-ante expected total profitability of bringing litigation increases for the NPE. The positive and significant coefficients on the interaction terms of (*Cash Level*Likely Outcome)* and (*Cash Shock*Likely Outcome)* are especially interesting given the results in Table IV, that *Likely Outcome* itself was not unconditionally a significant predictor of bringing suit. The sum of these results mean that even if NPEs think they are more likely to win a suit against a firm from a certain industry and region, they will *only* bring suit against the firm if it also is flush with cash. The positive and significant coefficients on (*Cash Level*Ongoing Cases)* and (*Cash Shock* Ongoing Cases)* similarly indicate that NPEs are especially likely to target firms busy with other cases that are also flush with cash. Lastly, in Column 5, even when all interaction terms are included together, four of the six

coefficients remaining statistically significant, while all of them keep their predicted coefficient.

The sum of the evidence in Tables II-IV provides strong support for the main predictions of the model of endogenous patent troll formation that we develop. In particular the evidence suggests that NPEs are behaving precisely as we'd predict endogenous patent trolls to: they target firms who are flush with cash, have had recent positive shocks to cash, who are likely to be busy with other cases, from regions and industries they case-precedence in winning, and who have less access to broad legal teams. In the following section we explore a particularly egregious case of this where the cash that the NPEs target is exogenous to the patent claim they propose to litigate.

IV.3. Unrelated Profits

While the evidence presented in the previous section suggests that NPEs exhibit opportunistic behavior in suing patent infringing firms, it does not suggest that they go after profits unrelated to patents that are infringed. This is because firm level data do not allow us to extract infringed-patent related profits from total profits. In this section, we utilize business segment disclosures to do exactly this.

This fine empirical specification also allows us to address an identification issue that we could not with the aggregated cash variables at the firm level. In particular, although all of the results in Table II are consistent with the endogenous patent troll behavior we model in Section II, an alternative explanation could be that firms endogenously understand that they infringed on a patent, and so raise cash as a precautionary savings device pre-emptively. To be clear, for this to explain all of the results a number of things must be true. First, firms must raise cash (and have abnormal shocks to cash) precisely before times they are sued, controlling for the number of patents (amount of R&D activity) in which they have engaged. Second, from Tables III and IV firms need to raise cash curiously for precautionary savings to pre-empt litigation at the same time they are actively decreasing the number of lawyers that represent them. This

seems counter to the pre-emptive thesis, and instead is much more consistent with NPEs acting as patent trolls and targeting cash-rich firms who have recently reduced legal teams, thus increasing the NPEs conditional chances of a successful litigation outcome.

Irrespective, we are able to provide even cleaner empirical evidence for patent troll behavior using the finely reported segment data. In particular, starting in 1976, all firms are required by Statement of Financial Accounting Standard (SFAS) No. 14 (Financial reporting for segments of a business enterprise, 1976) and No. 131 (Reporting desegregated information about a business enterprise, 1998) to report relevant financial information of any industry segment that comprises more than 10% of total annual sales.

Using these filings, we extract information on industry classification, sales, and cost of goods sold for each segment of all conglomerates between 2000 and 2010. We then use the concordance between international patent classification code (IPC) and 4 digit U.S. Standard Industrial Classification (SIC) to identify the segments of conglomerates associated with the given patent that is subject to litigation.[17]

After identifying segments related to the allegedly infringed patent, we break each firm at the segment level into two groups: related segments vs. unrelated segments. We then compute gross profits earned by each segment group by subtracting cost of goods sold from sales for each segment group.[18] We note that not all conglomerates report business 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 segment of the three segments it operates in. Therefore, our final sample contains only conglomerates that we have cost of goods sold and revenue data on at least two segments (one related and one unrelated).

[17] The concordance file we use is developed by Silverman (2002), which is later improved by Kerr (2008). This concordance has been used in several other studies including McGahan & Silverman (2001) and Mowery and Ziedonis (2001).

[18] While we would ideally prefer to use cash at the segment level (identical to the tests in Tables II-V), it is not reported, and so we use profitability (revenues-costs) at the segment level instead to proxy for w (profitability of suit) in the model.

We then estimate the following model to test whether the probability of being sued for conglomerates is correlated with profits obtained from *unrelated* segments, even after controlling for profitability of related segments. We include conglomerate fixed effects to control for conglomerate-level unobserved litigation time invariant litigation probability. We also include average profitability of the industry in which the given segment operates in that particular year to control for industry wide litigation events.

The results are shown in Table VI. Column 1 runs the basic model, while Column 2 includes conglomerate fixed effects. Both columns tell the same story. First, *Related Segment Profitability* is a large and significant predictor of being targeted by NPEs, consistent with the results in Tables II-V. While it is not surprising that *Related Segment Profitability* is positively related to the firm being sued, *Unrelated Segment Profitability* is nearly identical in magnitude and significance. In other words, NPEs do not seem appear to care where the proceeds come from – their probability of suing the firm rises by nearly the same amount even if the proceeds are coming from segments exogenous to the patent being litigated. In particular, the coefficient in Column 2 on *Unrelated Segment Profitability* of 0.0051 (t=2.96) implies that controlling for the profitability of segment related to the patent allegedly being infringed, a one standard deviation increase in 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 dollar shock in related profitability (t=2.95).

In sum, the results in Table VI provide stronger evidence for NPEs behaving as patent trolls. In the framework of the model, one can view the patent portfolio of the firm as the unit of comparative static (and to which theta is defined), and thus an entity will still find it optimal to sue a firm even when the theta of the entity only roughly matches the theta (now that the firm has both related and unrelated patents to the entity), if the increase in profitability of litigation is large. We see exactly this occurring: NPEs target firms' proceeds even if those proceeds are generated through segments completely unrelated to the patent that the NPEs claim to have been infringed.

V. Impact of Patent Trolling on Real Outcomes

Our results up to this point suggest that NPEs behave as patent trolls in their litigation behavior: namely, they opportunistically target firms based not on the merit of the case (overlap between patents) but rather on the ease of extracting rents from the firm. Our model predicts that this leads to socially inefficient outcomes, where either firms decide not to pursue profitable innovations (given it is ex-ante more profitable in expectation to be a troll), or that firms who would otherwise commercialize, decide not to given the high likelihood of being litigated. Further, in terms of comparative statics, the higher the expected cost of litigation to the potential innovating firm, the less likely the firm will be to commercialize.

We test these predictions in this section. While it is difficult to measure the shadow innovation that would have occurred were there not be NPEs acting opportunistically, we attempt to do so in the following manner. We first compare all firms that are targeted by NPEs. In this sense, we match on the selection criteria of NPEs. Given this selection, we then separate firms into those whose cases are dismissed, versus those firms who lose the case in court. We then test whether having the case dismissed vs. losing the case leads firms to different directions in terms of their research and development productivity. Specifically, we focus on how tangible outcomes such as additional patents and citations to these patents in the future differ from past outcomes.

We obtain firm level patent information from database used in Kogan et al. (2012).[19] We use this data to analyze *change* in annual flow of firm-level patents (as measured by new patent applications), and *change* in the number of

[19] The database, constructed using Google Patents (www.google.com/patents) is comprised of all utility patents issued by the USPTO between 1/1/1926 and 11/02/2010. We choose to use the Kogan et al. database over the frequently used NBER's U.S. Patent Citations Data File for two reasons: (1) NBER database ends at the end of 2005. The additional 5 years allow us to investigate the outcome effects when NPE litigations have become more intensive, and (2) the Kogan et al. database is more comprehensive in terms of number of patents it can attribute to public firms (Table 1 of Kogan et al. (2012) suggests that they were able to match 24% more patents compared to what is available in NBER database).

patent citations as outcome variables. These variable choices are motivated by a large past literature studying the efficiency and outcomes of innovation.[20]

Table VII, Panel A reports the results of our treatment effects model in which we compare the outputs of the two types of firms that have been targeted by NPEs: (1) firms that are litigated but the case is dismissed, and (2) firms that are litigated and lose the litigation. These two types of firms are interesting to compare as they match up in terms of attractiveness to be litigated but one pays the tangible cost of being litigated whereas the other one pays nothing. From Panel A of Table VII, it is clear that there are no observable differences driving whether a firm has the case dismissed vs. losing the court case to the NPE. In particular, the only significant predictor of being dismissed is having fewer patents (which has small economic significance). Thus, ex-ante this group of targeted firms by NPEs does in fact appears quite similar on observable characteristics.

Our sample contains 580 cases, of which 63 are dismissed. We then conduct an analysis comparing dismissed vs. losing firms in terms of patent accumulation and citations to these patents surrounding the litigation event. While the pre-trends in both patent accumulation and citations to these patents are identical, we see striking differences following the litigation event. Specifically, in the years following the litigation event firms whose cases were dismissed produced 69.09 *more* new patents (t=3.11), and these new patents received 54.66 *more* citations (t=1.85) compared to the group of firms that suffered the cost of NPE litigation.[21] Again, this large difference in patent production and quality of produced patents does not exist until the litigation event initiated by the NPEs.

As a placebo test to confirm that this result is driven by the NPEs action of litigation, and not by a general decline in the losing firms' (vs. dismissed

[20] See, for example, Griliches (1981), Griliches (1984), Pakes (1985), Jaffe (1986), Griliches, Pakes, and Hall (1987), Connolly and Hirschey (1988), Griliches, Hall, and Pakes (1991), Hall (1993a), Hall (1993b), and Hall, Jaffee, and Trajtenberg (2005)) showing that patents, and patent citations, are indications of R&D productivity.

[21] We focus on two year after following the initial filing of the litigation, as time between filing date to initial discovery phase could take up to a year.

firms') technological patent portfolio,[22] we also compare new citations to the two sets of firms' vintage patent portfolios that were patented *before* the litigation event. If the decline in innovation is acting solely through the litigation action taken by the NPE, we should see no difference in citations to these patent portfolios, even post-litigation event. Panel C of Table VII reports this test, and it is precisely what we see in the data. The sum of evidence in this section strongly supports the notion that NPE's actions are having a real and negative impact on innovation of firms in the US.

VI. Conclusion

We provide the first large-sample evidence on the litigation behavior of NPEs: We show precisely which corporations NPEs litigate, when they litigate them, and the impact of litigation on the innovative activity at targeted firms. We build a parsimonious model of an innovative economy to better understand NPEs' roles and incentives. In the model, we find that agents endogenously choose to become patent trolls. We present strong empirical evidence supporting the model's main predictions – NPEs on average behave as patent trolls. They target firms flush with cash, or who have just had positive cash shocks. In fact, NPEs even target conglomerate firms that are getting all of their cash from segments having nothing to do with their allegedly infringing patents (i.e., suing a firm regarding a tech patent that has both tech and lumber who are getting all of their cash from lumber). Profitability in unrelated businesses has almost an identical magnitude in predicting being sued by an NPE as does profitability in the related segment.

Additionally, NPEs target firms they expect are more likely to lose in litigation (either in court or through settlement with the NPE). NPEs, target firms that are tied up with litigation outside of the intellectual property space, as

[22] For instance, it might be that the dismissed firms happen to have more commercializable technology (such as wireless remote technology), while the losing firms have a patent portfolio in decline (such as wired hard-cable).

well as firms that have abnormally small legal teams. Lastly, we find that the litigation behavior of NPEs has negative real consequences on the firms they sue. In particular, targeted firms that lose to NPEs in court innovate less in the future and have lower-quality innovations following suit.

The stakes of how to organize intellectual property disputes are massive. If the US becomes a less desirable place to innovate because of the unchecked actions of NPEs, innovation and human capital - and the returns to that innovation and human capital – will likely flee overseas. Alternatively, innovators will also leave if they feel they are not are protected from large, well-funded interests that might infringe on their intellectual capital without recourse. The results in this paper provide evidence consistent with the view that NPEs on average behave as patent trolls, chasing cash and having a negative impact on future innovation. Given our findings, the marginal policy response should be to more carefully check the power of NPEs, or, in the framework of our model, increase the cost of bringing suit against commercializers of innovative ideas.

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Appendix Table I. Variable Definitions

	Definition	Source
NPE Litigation	A dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year.	Patent Freedom
Patent Stock	Number of patents the firm filed in the past 5 years	(Kogan et.al.(2012))
Likely Outcome	Cross product of an indicator variable that proxies for race based judicial bias and ratio of cases litigated in state C.	Patent Freedom; U.S. Census 1990&2000.
Number of Law Firms	Number of unique law firms represented a public firm in the ongoing cases.	ALM Legal Intelligence
In House Council	A dummy variable that takes a value of 1 if the firm employs an in house counsel.	ALM Legal Intelligence
Ongoing Cases	Number of ongoing litigation the firm is engaged in a given year.	Audit Analytics
Market Value of Equity	Market value of the equity as of the end of previous fiscal year.	Compustat
Total Assets	Total assets (at) of the firm as of the end of previous fiscal year.	Compustat
Book to Market	Ratio of book value of equity to market value of equity as of the end of previous fiscal year. Book value of equity is sum of stockholders equity (SEQ), Deferred Tax (TXDB), Investment Tax Credit (ITCB) minus Preferred Stock (PREF).	Compustat
Past Return	Past Return is the twelve-month return prior to fiscal year end.	CRSP
Cash Level	Level of Cash (ch) as of the beginning of previous fiscal year.	Compustat
Cash Shock	A dummy variable that takes a value of 1 if change in cash in the most current fiscal year compared to previous fiscal year is among the top 90% of cash changes.	Compustat

Table I: Summary statistics, 2000—2010

Appendix 1 contains the definitions of variables we use. Panel A presents summary statistics on the firms included in the tests. Panel B tabulates the number of firms by incidences of being subject to a litigation filed by an NPE.

Panel A. Summary statistics on firm characteristics

	Mean	*Median*	*St. Dev*	*P05*	*P25*	*P75*	*P95*
Market Value of Equity	4050.06	338.44	17294.53	13.21	76.76	1491.83	16468.02
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
Litigation Dummy	0.32	0.00	0.43	0.00	0.00	0.84	1.00
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 Council	0.03	0.00	0.17	0.00	0.00	0.00	0.00
Ongoing Cases Dummy	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. Number of Sued Firm-Years

Year	Not Sued	Sued	Total
2000	5,601	11	5,612
2001	5,363	43	5,406
2002	5,357	48	5,405
2003	5,086	71	5,157
2004	4,876	85	4,961
2005	4,620	142	4,762
2006	4,474	235	4,709
2007	4,362	186	4,548
2008	4,182	230	4,412
2009	4,081	331	4,412
2010	3,899	337	4,236
Total	51,901	1,719	53,620

Table II: Probability of Getting Sued and Cash

In this table we report the OLS regression results of the following specification:

$$Sued\ by\ NPE = f(Total\ Assets, Market\ Value, \text{BM}, Past\ Return, \text{PatentStock}, \text{Cash Level}, Cash\ Shock)$$

The outcome variable, *Sued by NPE*, is a dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year. *Total assets* of the firm are as of the end of previous fiscal year. *Market Value of the equity* is measured as of the end of previous fiscal year. Book to market (*BM*) Ratio is the ratio of book value of equity to market value of equity as of the end of previous fiscal year. Book value of equity is calculated as sum of stockholders equity (SEQ), Deferred Tax (TXDB), Investment Tax Credit (ITCB) minus Preferred Stock (PREF). *Past Return* is the twelve-month return prior to fiscal year end. *Patent Stock* is the total number of patents the firm applied in the past 5 years. *Cash Level* is total amount of cash reported on balance sheet as of the *beginning of previous fiscal year*. Cash Shock is a dummy variable that takes a value of 1 if change in cash in the most current fiscal year compared to previous fiscal year is among the *top 90% of cash changes*. We use log transformation for *Total Assets, Market Value, BM, Patent Stock,* and *Cash Level*. The sample contains firm-year observations between 2000 and 2010. Standard errors, clustered by firm, are reported in parenthesis. ***, **, and * denotes statistical significance at 1, 5 and 10% level.

	Sued by NPE	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*
Total Assets	0.0001**	0.0002**	0.0001*	0.0002**	0.0001
	0.0000	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market Value	0.0130***	-0.0014	-0.0046**	-0.0016	-0.0049**
	(0.0010)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
B/M	0.0166***	0.0243***	0.0158***	0.0244***	0.0156**
	(0.0040)	(0.0064)	(0.0061)	(0.0064)	(0.0061)
Past Return	0.0015**	-0.0011*	-0.0012*	-0.0012*	-0.0013*
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Patent Stock	0.0131***	0.0075***	0.0065***	0.0075***	0.0064***
	(0.0019)	(0.0025)	(0.0024)	(0.0025)	(0.0024)
Cash Level			0.1048***		0.1065***
			(0.0154)		(0.0155)
Cash Shock				0.0167**	0.0213**
				(0.0084)	(0.0083)
Firm FE	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	53,620	53,620	53,620	53,620	53,620
R2	0.07	0.37	0.42	0.37	0.42

Table III: Measures of Likely Outcome and Excess Lawyer

In Panel A, we measure the number of "excess lawyers" based on a model that predicts number of lawyers used by comparable firms. We regress log number of lawyers on how much intellectual property the firm possesses (*Log (Patents Stocks)*), whether the firm has an in-house counsel, *In-house counsel*, a department of lawyers housed inside the firm to handle most frequently encountered legal issues in firm, most recent market performance of the firm's equity and firm fixed effects.

In Panel B, we regress the outcome of patent litigation on our *likely outcome* proxy. The outcome variable equals 1 if the case ended in favor of NPE or settled outside of the court. The *likely outcome* proxy combines two pieces of information. The first piece is the probability of getting sued in state C if the firm from industry J is located in state F. To calculate this probability, we use the ratio of number of firms in industry J in state F sued in state C to number of firms in industry J in state F sued in all states prior to time *t, i.e.* $\left(\frac{n(j,C,t-1)}{\sum_{\forall C} n(j,C,t-1)}\right)$. The second piece of information is the ex ante probability of NPE's winning the case due to a potential ethnicity bias of juror pools. To capture the judicial bias by an indicator variables that compares Asian ethnicity in state F and all other states ($e.g., I(Asian(C) < Asian(F))$. Thus, our litigation proxy takes the following form: $Likely\ Outcome(j,f,t) = \sum_{\forall C \neq F} \frac{n(j,C,t-1)}{\sum_{\forall C} n(j,C,t-1)}\ x\ I(Asian(C) < Asian(F))$. Using this *likely outcome* proxy, we report its correlation with favorable case outcomes for NPEs using OLS.

Panel A. Estimating number of *Excess Lawyers*

	Log (# of Lawyers)	*Log (# of Lawyers)*	*Log (# of Lawyers)*	*Log (# of Lawyers)*	*Log (# of Lawyers)*
Patent Stock		0.1275***			0.0859***
		(0.0079)			(0.0050)
In-house counsel			1.8738***		1.7565***
			(0.0406)		(0.0373)
Past Return				-0.0043***	-0.0050***
				(0.0009)	(0.0010)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
N	85,487	85,487	85,487	85,487	85,487
R2	0.03	0.12	0.37	0.03	0.41

Panel B. Validation of *Likely Outcome* Proxy

	In Favor of NPE	*In Favor of NPE*	*In Favor of NPE*
Likely Outcome		0.0964**	0.1275*
		(0.0487)	(0.0669)
Year FE + Intercept	Yes	Yes	Yes
State FE	Yes	Yes	No
Industry FE	Yes	Yes	No
Firm FE	No	No	Yes
N	17,368	17,368	17,368
R2	0.16	0.17	0.22

Table IV: Probability of Getting Sued and Ex-Ante Loss Likelihood

In this table we report the OLS regression results of the following specification:

$$Sued\ by\ NPE = f(Total\ Assets, Market\ Value, \text{BM}, Past\ Return, \text{PatentStock}, \text{Cash Level}, Cash\ Shock, Excess\ Lawyers, Likely\ Outcome\ Dummy, Ongoing\ Cases\ Dummy)$$

The outcome variable, *Sued by NPE*, is a dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year. *Total assets* of the firm are as of the end of previous fiscal year. *Market Value of the equity* is measured as of the end of previous fiscal year. Book to market (*BM*) Ratio is the ratio of book value of equity to market value of equity as of the end of previous fiscal year. Book value of equity is calculated as sum of stockholders equity (SEQ), Deferred Tax (TXDB), Investment Tax Credit (ITCB) minus Preferred Stock (PREF). *Past Return* is the twelve-month return prior to fiscal year end. *Patent Stock* is the total number of patents the firm applied in the past 5 years. *Cash Level* is total amount of cash reported on balance sheet as of the *beginning of previous fiscal year*. Cash Shock is a dummy variable that takes a value of 1 if change in cash in the most current fiscal year compared to previous fiscal year is among the *top 90% of cash changes*. *Excess Lawyers* is the residual number of lawyers left after deducting model (Table 3A) estimated number of lawyers from actual number of lawyers firm works with. *Likely Outcome Dummy* takes a value of 1 if the *likely outcome* measure is above median *likely outcome* for that year. *Likely Outcome* proxy combines two pieces of information: (1) the probability of getting sued in state C if the firm from industry J is located in state F and (2) ex ante probability of NPE's winning the case due to a potential ethnicity bias of juror pools (see Table 3B for details). *Ongoing Cases Dummy* take a value of 1 if the firm is engaged non-intellectual property related litigation in that particular year. We use log transformation for *Total Assets, Market Value, BM, Patent Stock,* and *Cash Level*. The sample contains firm-year observations between 2000 and 2010. Standard errors, clustered by firm, are reported in parenthesis. ***, **, and * denotes statistical significance at 1, 5 and 10% level.

	Sued by NPE	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*
Total Assets	0.0002*	0.0001	0.0001	0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market Value	-0.0047**	-0.0049**	-0.0053**	-0.0052**
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
B/M	0.0163***	0.0160***	0.0145**	0.0150**
	(0.0061)	(0.0061)	(0.0061)	(0.0061)
Past Return	-0.0012	-0.0013	-0.0012	-0.0013
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Number of Patents	0.0063***	0.0064***	0.0064***	0.0062***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
Cash Level	0.1070***	0.1061***	0.1052***	0.1059***
	(0.0154)	(0.0155)	(0.0155)	(0.0153)
Cash Shock	0.0216***	0.0213**	0.0213**	0.0216***
	(0.0084)	(0.0083)	(0.0083)	(0.0083)
Excess Lawyers	-0.1144**			-0.1157**
	(0.0562)			(0.0561)
Likely Outcome Dummy		0.0052		0.0049
		(0.0032)		(0.0031)
Ongoing Cases Dummy			0.0166***	0.0167***
			(0.0058)	(0.0058)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	53,427	53,427	53,427	53,427
R2	0.42	0.42	0.42	0.42

Table V: Total Profitability and Being Sued by NPEs

This table reports split sample analysis using Litigation Dummy and *Other Cases Dummy.* The outcome variable, *Sued by NPE*, is a dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year. Legend of Table IV discusses the independent variables. The sample contains firm-year observations between 2000 and 2010. Standard errors, clustered by firm, are reported in parenthesis. ***, **, and * denotes statistical significance at 1, 5 and 10% level.

	Sued by NPE	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*
Total Assets	0.0002*	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market Value	-0.0059***	-0.0054**	-0.0053**	-0.0054**	-0.0040*	-0.0053**
	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0022)
B/M	0.0138**	0.0146**	0.0143**	0.0143**	0.0161***	0.0146**
	(0.0061)	(0.0061)	(0.0060)	(0.0061)	(0.0061)	(0.0061)
Past Return	-0.0013	-0.0013	-0.0011	-0.0012	-0.0011	-0.0012
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Number of Patents	0.0064***	0.0064***	0.0062***	0.0063***	0.0062***	0.0063***
	(0.0024)	(0.0024)	(0.0023)	(0.0024)	(0.0024)	(0.0024)
Cash Level	0.1193***	0.1051***	0.0694***	0.1042***	0.0419**	0.1042***
	(0.0161)	(0.0155)	(0.0151)	(0.0154)	(0.0177)	(0.0155)
Cash Shock	0.0211**	0.0228**	0.0213***	-0.0014	0.0221***	0.004
	(0.0084)	(0.0095)	(0.0083)	(0.0082)	(0.0083)	(0.0096)
Excess Lawyers	0.0121	0.0016	0.0026	0.0015	0.001	0.0011
	(0.0079)	(0.0072)	(0.0070)	(0.0070)	(0.0070)	(0.0071)
Likely Outcome Dummy	0.0049	0.005	-0.0056*	0.0029	0.0049	0.005
	(0.0032)	(0.0031)	(0.0031)	(0.0030)	(0.0031)	(0.0031)
Ongoing Cases Dummy	0.0164***	0.0164***	0.0162***	0.0164***	-0.0022	0.0148***
	(0.0058)	(0.0058)	(0.0058)	(0.0058)	(0.0058)	(0.0057)

Table V: (continued)

	Sued by NPE	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*	*Sued by NPE*
Cash Level x Excess Lawyers	-0.0274***					
	(0.0106)					
Cash Shock x Excess Lawyers		-0.0036				
		(0.0164)				
Cash Level x Likely Outcome Dummy			0.0946***			
			(0.0225)			
Cash Shock x Likely Outcome Dummy				0.0659***		
				(0.0193)		
Cash Level x Ongoing Cases Dummy					0.1084***	
					(0.0239)	
Cash Shock x Ongoing Cases Dummy						0.0352**
						(0.0175)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	53,427	53,427	53,427	53,427	53,427	53,427
R2	0.42	0.42	0.42	0.42	0.42	0.42

Table VI: Probability of Getting Sued: Related vs. Unrelated Cash Flows

In this table we report the probability of a conglomerate getting sued by an NPE as a function of "related" and "unrelated" segments gross profitability. The unit of observation is conglomerate-segment-year. *Sued by NPE*, is a dummy variable that takes a value of 1 if the firm has been litigated by an NPE in that particular year. To identify segments that are related to litigated patents, we use USPTO to 4 digit SIC concordance developed by Silverman(2002). We use financial statements disclosed in segment filings to collect segment level sales and cost of good sold information. Using these, we calculate segment profitability as the difference between sales and cost of good sold. *Industry Profitability* is the average profitability of all firms in the same 4 digit-SIC. Sample includes all conglomerates between 2000 and 2010, which have more than one-segment with sufficient profitability data to execute the test. Standard errors, clustered by conglomerate-segment level, are reported in parenthesis. ***, **, and * denotes statistical significance at 1, 5 and 10% level.

	Segment Sued by NPE	*Segment Sued by NPE*
Related Segment Profitability	0.0110**	0.0065***
	(0.0049)	(0.0022)
Unrelated Segment Profitability	0.0110***	0.0051***
	(0.0026)	(0.0017)
Industry Profitability	-0.0004***	0.0001
	(0.0001)	(0.0001)
Intercept and Conglomerate FE	No	Yes
N	29,756	29,756
R2	0.02	0.37

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Table VII: Real Outcomes

Panel A table reports the probit estimates of a treatment effects model to compare number of patent applications and citations to these patents for two types of firms that have been targeted by NPEs: (1) Firms that are litigated but the case is dismissed, and (2) Firms that are litigated and firms loose the litigation. Panel B reports the difference between new patent applications (or citations to these patents) one year following the litigation event and one year prior to litigation event. Standard errors, clustered by firm, are reported in parenthesis. ***, **, and * denotes statistical significance at 1, 5 and 10% level.

Panel A. Probit (Dismissed vs. Lost by The Firm)

	P(Dismissed)
Total Assets	-0.0002
	(0.0003)
Market Value	0.1154**
	(0.0582)
B/M)	0.4340
	(0.3234)
Past Return	-0.2282
	(0.1552)
Patents Stock	-0.0529**
	(0.0236)
Cash Level	0.0534
	(0.1035)
Cash Shock	0.1369
	(0.1358)
Excess Lawyers	-0.9739
	(0.8009)
Litigation Risk	-0.0264
	(0.1522)
Other Cases	0.1139
	(0.1943)
Year FE	Included
N	580
R2	0.053

Panel B. Treatment Effects Model

	Sample Comparison	Difference	z-stat
New Patents	Dismissed vs. Settled+NPE Won	69.09	3.11
Citations	Dismissed vs. Settled+NPE Won	54.66	1.85

Panel C. Placebo Test

	Sample Comparison	Difference	z-stat
New citations to patent portfolios that were patented *before* the litigation event	Dismissed vs. Settled+NPE Won	4.65	0.40

Figure 1: Intellectual Property Litigation by State