Empirical Evidence on the Behavior and Impact of Patent Trolls: A Survey*

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Abstract

We survey the empirical literature on non-practicing entity (NPE) litigation behavior and its consequences. We document both aggregate trends and cross-sectional differences amongst various types of NPEs. Survey evidence illustrates a number of ways in which NPEs can potentially act opportunistically, and indicates at least some instances and consequences of observed NPE opportunism. Large-sample empirical work has recently begun corroborating and amplifying the findings from survey evidence. NPEs on average behave as "patent trolls." Indeed, NPEs hold and frequently litigate patents that are likely to be at least partially invalidated; moreover, NPEs, target cash irrespective of its relation to alleged infringement. Cash-targeting is neither the main driver of practicing entity (PE) intellectual property (IP) litigation, nor of non-IP litigation against publicly traded firms. The empirical evidence suggests, however, that not all NPEs exhibit trolling behavior—the cash-targeting observed in the data is primarily the behavior of large patent aggregators, rather than small inventors. NPE patent trolling has a real negative impact on targeted firms, without any increase in innovation, technology transfer, or other counterbalancing benefits measured thus far.

JEL Classification: D2, K1, O31.

Keywords: Patent trolls, NPEs, PAEs, Innovation, Patents.

1 Introduction

In the last decade, patent litigation has risen sharply (see Figure 1)—and, at time of this writing, 2015 was on pace to set (another) record for the highest number of patent lawsuits filed in a single year (Ciccatelli (July 20)). The majority of the recent growth in patent litigation has been driven by *non-practicing entities* (*NPEs*, also sometimes called *patent assertion entities* (*PAEs*))—firms that assemble patent portfolios not for the sake of developing products, but for the sake of enforcing intellectual property (IP) rights (again, see Figure 1).

From theory alone, it is unclear whether the rise of NPE litigation is good or bad for innovation. On one hand, NPEs can theoretically serve as efficient financial intermediaries specialized in enforcing IP, thus enhancing inventors' incentives to invest in innovation (McDonough (2006); Hagiu and Yoffie (2013); Haus and Juranek (2014); Lemus and Temnyalov (2015); see also Choi and Gerlach (2014)). On the other hand, NPEs can act as "patent trolls," extracting rents from other firms by exploiting the fact that imperfections in the legal system make credible threat of an infringement suit sufficient to induce many targeted firms to settle, irrespective of whether the asserted patents are actually valid and infringed (Hovenkamp (2013); Lemley and Melamed (2013); Scott Morton and Shapiro (2014); Cohen et al. (2015b)).

Because theory cannot conclusively predict NPEs' net impact on innovation, it is essential to examine empirical evidence on NPEs. Luckily, a growing body of literature has begun to understand NPE litigation behavior, and how NPE litigation impacts the economy. In this chapter, we review the empirical evidence on NPEs—from survey to large-sample. First, in Section 2, we describe a number of surveys that have provided evidence on the scope and effects of NPE litigation. Then, in Section 3, we review the large-sample evidence assessing the quality of NPEs' patents and lawsuits. Finally, in Section 4, we discuss the empirical evidence on how NPEs impact innovation. Section 5 concludes.

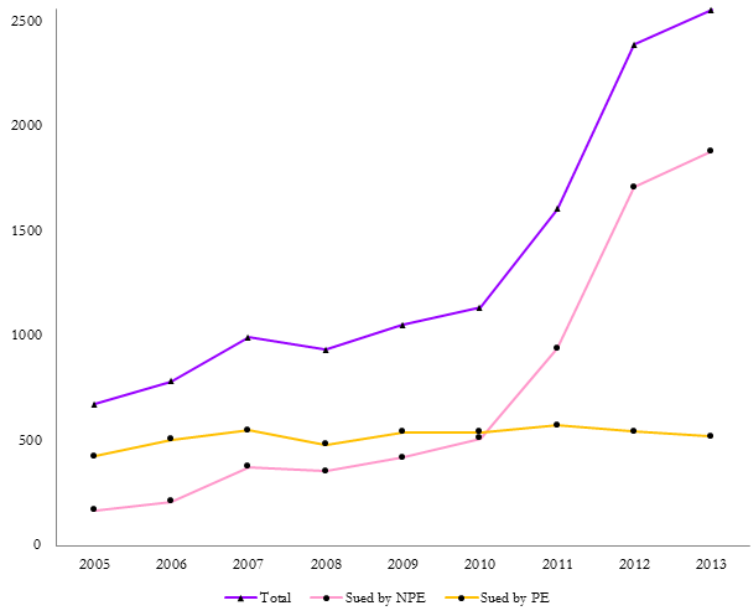

Figure 1: NPE, PE, and Total Patent Litigation against Publicly Traded Firms (2005–2013). This figure is based on data from RPX Corporation (collected from Public Access to Court Electronic Records (PACER)) recording all patent cases in the public record brought against publicly traded firms from 2005–2013. The total number of cases is tracked in purple, and split into PE cases (orange) and NPE cases (pink).

2 Survey Evidence

A primary justification for the patent system is that patent disclosure stimulates future invention; a good patent system encourages innovation by allowing inventors to prevent competitors from entering the market for a certain period of time until the innovator earns enough excess return to recoup his R&D investments. If the inventor is not positioned to commercialize the invention, patents can serve as a mechanism for the inventor to license or transfer his idea to someone who can make use of it. In this case, NPEs can emerge as economic agents to serve an intermediation function, by helping to deliver good ideas to companies who can put them to good use. Feldman and Lemley (forthcoming) surveyed 181 companies to investigate whether companies licensing patents from NPEs indeed offer more new products to marketplace. They found that nearly all (more than 90% of) respondents report adding new products or features derived from NPE-licensed technology less than 10% of the time. More importantly, only 2% of respondents indicated that they developed new

products from NPE-licensed technology more than 25% of the time. Feldman and Lemley's (forthcoming) evidence consequently suggests NPE-originated requests for *ex post* licensing or settlement have led to few, if any, new product advancements.[1,2,3]

Chien (2013b) reported that most defendants in NPE litigation are small: 66% of the defendants in patent assertion litigation have less than $100 million annual revenue. In fact, Chien (2013b) found that a significant number of the companies targeted by NPEs are startups. As startups are among the primary providers of new jobs and innovation, it is important to understand how NPEs influence startup activity. Chien (2014) thus focused on startups directly, surveying over 300 venture capital firms and venture-backed startups. Chien (2014) found that a non-trivial number of startup companies face NPE litigation early-on: 75% of venture capitalists and 20% of venture-backed startups with patent experience have been impacted by an NPE demand (see also Chien (2013a)). The numbers are much higher in tech industries—90% of technology related venture capitals have been impacted by NPE litigation. Survey respondents overwhelmingly agree (71%) that patents are vital for innovation in their industries. Nevertheless, 78% of respondents felt strongly that the ability of companies to monetize their patents through NPEs does not help innovation, and 83% agreed or agreed strongly that NPEs are hurting innovation.[4] Chien's (2014) survey also reports on the strategic timing of NPE litigation: NPE litigation against startups was

[1]Feldman and Lemley (forthcoming) found that *ex post* licensing, more generally, does not appear to contribute to substantial innovation or technology transfer. Feldman and Lemley (forthcoming) noted, however, that their evidence does not characterize a general relation between patenting activity and future new product developments—both universities and small inventors often strike deals with other companies before patents are issued (or even before patents are filed), and these *ex ante* deals can lead to commercial products.

Meanwhile, there is some evidence that *ex post* patent trade and licensing may have been socially valuable before the growth of pure patent aggregators (Galasso et al. (2013); see also Galasso and Schankerman (2010)).

[2]There are at least three licensing strategies Feldman and Lemley (forthcoming) did not study directly: (1) initiating contact with patent holder without the NPE involvement, (2) cross-licensing between competitors and (3) direct acquisition of patents. Future research can test whether these alternative approaches yield different outcomes, relative to NPE-mediated patent licensing.

[3]Additionally, a growing body of evidence on the economics of science and innovation suggests that patents can at times discourage valuable follow-on innovation, in general (Williams (2013); see also Sakakibara and Branstetter (2001); Lerner (2009); Williams (2015)).

[4]A small fraction (5%) of the startups surveyed reported having sold their patents to NPEs to obtain benefits.

initiated at times when the targets were least able to defend themselves—often "on the eve of a funding or acquisition event." The results of Chien (2014) also illustrate that NPE patent assertions have significant non-monetary impacts on startups, including delays in hiring new employees and delays in meeting product milestones.[5]

A survey by Feldman (2014) largely corroborated the findings of Chien (2014). Feldman's (2014) survey evidence is based on 200 respondents from members of National Venture Capital Association and their portfolio companies. Feldman (2014) found sharp evidence against the narrative that "the possibility of monetizing a startup company's patents [via NPEs] if the company fails [...] spurs investment [by venture capital firms]." Like Chien (2014), Feldman (2014) found that a large proportion (70% of respondents) of venture capitalists have portfolio companies that receive patent demands. The majority of respondents (i.e. 59% of the venture capitalists and 66% of the startup companies) reported that most demands come from NPEs. Consistent with the Chien's (2014) finding that few startups (5%) have sold their patents to NPEs to obtain benefits, Feldman (2014) reported that most (64%) venture capitalists do not consider NPEs as potential buyers of failed portfolio companies' patents. Meanwhile Feldman (2014) noted that the approximate cost of preparing for and defending against patent demands exceed $50,000 per company; more than 40% of respondents estimated those costs to exceed $100,000. Moreover, 74% of venture capitalists and 58% of the startup companies reported that patent demands had a significant impact on a company, such as distracting management from core business activities, expending resources previously dedicated for core activities, or altering business plans.[6]

[5]Chien's (2014) respondents also noted that low-quality patents lead to predatory litigation not only by NPEs but also by larger companies with anti-competitive motives.

[6]Anecdotal evidence reported by Feldman (2014) includes a case in which 40% of a chief technical officer's time was redirected to fighting two patent infringement lawsuits filed within three weeks of each other.

3 Large-Sample Evidence on NPE Behavior

Survey evidence is extremely powerful for understanding the forms and scope of NPE litigation. However, to understand NPE litigation behavior in aggregate—and how that behavior impacts the innovation and production landscape—we need large-sample empirical evidence. Luckily, in recent years, broad evidence on NPE litigation has become available.

3.1 Data Sources

When conducting research on NPE-related litigation, researchers rely on a variety of data sources. Most of the available data are based on publicly available sources (e.g., Public Access to Court Electronic Records (PACER) and the USPTO Patent Application Information Retrieval (PAIR) database), although they differ in terms of ease of access and the coding of important characteristics and data attributes.[7]

Many researchers rely on data from RPX Corporation (or PatentFreedom, a similar firm that has recently been acquired by RPX), which tabulates information on NPE behavior. The RPX data goes back as far as 1977, capturing (from PACER) every lawsuit filed by more than 4000 NPEs. Unfortunately, however, the RPX data is proprietary. IP-specific PACER data is also disseminated through three fee-based sources: DocketNavigator (`www.docketnavigator.com`), LexMachina (`www.lexmachina.com`), and MaxVal IP (`www.maxval.com`).[8] Recently, a completely public NPE litigation data source has become available through the hard work of three legal scholars: Cotropia et al. (2014) (whose data is publicly available at `www.npedata.com`) have collected and hand-coded detailed information on the complete set of NPE lawsuits occurring in 2010 and 2012. Given that all the avaiable sources on NPE litigation actions are derived from the same underlying public data, they are (unsurprisingly) quite highly correlated; for instance, the correlation between the RPX and Lex Machina data

[7]Schwartz and Sichelman (forthcoming) provide a detailed account of the data sources frequently utilized in the literature on intellectual property licensing and litigation.

[8]These data sources not only allow convenient access to docket-specific information but also disclose pending Patent Trial and Appeal Board (PTAB) and International Trade Commission (ITC) actions.

is 99.79%.

A common critique of data used for assessing NPE litigation concerns the coding of plaintiff types. It is difficult to clearly delineate which firms should be treated as NPEs: If NPEs are simply defined as entities that assert patents but do not produce commercial products, than both universities and large patent aggregators qualify—but it is unlikely that universities and large aggregators have the same motivations (see, e.g., Lemley and Melamed (2013); Allison et al. (2015)). A finer classification is required if we want to draw clean inferences from the data. RPX's NPE-type classifications allow researchers to observe, for example, whether a plaintiff is "pure patent licensing/enforcement company," a "partly operating company but more than 50% revenue is coming from licensing," an "individual inventor," or a "special purpose entity by inventor."[9] Cotropia et al. (2014), meanwhile, classify each plaintiff as either an "operating company," "university," "individual inventor," "patent aggregator," "technology development company," "failed start-up," "IP holding subsidiary of an operating company," or a "patent holding company."

A second critical data issue is related to the measurement of patent quality. Both academic work and surveys of practitioners indicate that patent quality has declined over time and that "bad" patents have fueled much of the recent rise in patent litigation (Jaffe and Lerner (2011)).[10] However, while the importance of patent quality has been noted repeatedly, the literature has not converged on effective measures of patent quality. As we discuss in Section 3.3.1, the most commonly used citation-based metrics may be inappropriate quality metrics in areas with many weak patents.

[9]Schwartz and Sichelman (forthcoming) note that RPX may be "fairly aggressive" in labeling plaintiffs as NPEs. However, Chien (2013b) found no more than 7% disagreement when she compared a subsample of about 1000 of RPX's codings to her own hand-codings.

[10]UPSTO grants 78% of all original patent applications, whereas the analogous figure is 61% in Japan and 55% in the European Union. Farrell and Shapiro (2008) note that an average US patent application gets only about 15–20 hours of patent examiner time; a substantial proportion of these patents later fully evaluated in court are held invalid.

3.2 Aggregate Trends

As Figure 1 indicates, there has been a sharp rise in patent litigation over the past decade. The growth in patent litigation come has been driven almost entirely by NPEs. Indeed, the correlation between the time series of total patent litigation and NPE litigation is 99.89%, while the correlation between total patent litigation and practicing entity (PE) litigation is only 14.65%.[11]

A number of different authors have documented the rise of NPE litigation: Chien (2009) showed that the increase in NPE patent litigation varies significantly across industries. Jeruss et al. (2013) found, with a random sample of 500 cases from 2007-2011, that "patent monetizers" make up nearly 40% of all cases brought, and are far more likely to end their cases in settlements. Ewing and Feldman (2012) documented the emergence of large patent aggregators, and their unprecedented size and scope. Ewing and Feldman (2012) also gave examples of the lengths that aggregators go to in order to pursue litigation (e.g., Ewing and Feldman (2012) found an NPE that had over 1,300 shell companies created within its structure). Meanwhile, the Executive Office of the President (2013) released a large study on NPEs, finding that NPE litigation activity skyrocketed between 2006 and 2012.[12]

One caveat on the measurement of NPE lawsuit prevalence is worth noting, however: As Cotropia et al. (2014) observed, a large part of the increase in the number of NPE litigation events between 2010 and 2012 was driven by a rule change imposed by the 2011 America Invents Act (AIA). Specifically, under the AIA, plaintiffs were required to separate lawsuits against unrelated parties.[13] Because the AIA systematically split up many lawsuits that would previously have been bundled into a single suit (especially in the case of NPEs, who

[11]These correlations are based on the data used in Figure 1, which records all patent cases in the public record brought against publicly traded firms from 2005–2013..

[12]The Executive Office of the President (2013) also attempted to estimate the prevalence of NPE *demand letters*, i.e., letters from NPEs demanding that allege firms to have infringed and demand either licenses via lump sum or ongoing transfer fees.

[13]Cotropia et al. (2014) found that although the raw number of patent lawsuits filed by non-operating companies increased during the 2010–2012 period, the number of unique plaintiffs initiating litigation did not change significantly. Additionally, the distribution among types of plaintiffs was unchanged in almost all litigant categories.

frequently sue multiple parties), counts of patent lawsuits filed before and after 2012 are not exactly comparable. Nevertheless, even following the AIA, NPE litigation has continued to rise sharply.

3.2.1 Cross-Country Evidence

Helmers et al. (2013) analyzed 300 patent lawsuits filed at the Patents Court division of the High Court (PHC) in the United Kingdom (UK) between 2000 and 2010. Helmers et al. (2013) found that NPEs are involved in only 8% of their UK patent lawsuit sample.[14] Helmers et al. (2013) observed that NPE litigation makes up a much lower percentage of patent litigation in the UK than it does in the US. In addition, unlike in the US, UK NPE litigation does show present an increasing time-trend. Helmers et al. (2013) found that PEs and NPEs in the UK assert patents that are roughly similar in age at the time of assertion, but that NPE-owned patents are far more likely to cover high-tech subject matter. This evidence contrasts the patterns found in the US: Love (2014) found that patents asserted by US NPEs are, on average, asserted about twelve years post-filing, while PEs assert patents are about three years younger on average.

The findings of Helmers et al. (2013) support the impression that differences between the UK and US litigation systems can explain why the US has seen a sharp rise in NPE litigation that has been absent in the UK. Helmers et al. (2013) argued the UK's loser-pays legal regime seems not only to deter NPEs from filing suit but also to encourage accused infringers to defend claims filed against them. Furthermore, UK NPE lawsuits rarely end in settlement—and are rarely won by NPEs—so in the UK, attorney's fees are awarded to alleged infringers more often than damage awards (or settlement payments) are received by plaintiffs.[15]

[14] If suits filed by individuals, universities, and IP subsidiaries are included, the percentage rises slightly, to 11%.

[15] In this volume, Love et al. (forthcoming) present corroborating evidence based on both UK and German patent litigation data.

3.3 The Quality of NPE Lawsuits

3.3.1 NPEs' Patents

Some argue that the growth of patent litigation is driven by an increase in the issuance of overly broad or otherwise invalid ("bad") patents (see, e.g., Jaffe and Lerner (2011)).[16] That said, he literature has thus far presented conflicting evidence on the quality of NPEs' patents.

Shrestha (2010) examined a sample of 51 NPEs, and the patents those NPEs chose to litigate. Comparing the observed sample of NPE-litigated patents to other litigated patents, Shrestha (2010) found the NPE patents to be of *higher* quality, in the sense that they were more highly-cited and of wider technical breadth. It is not clear that the quality measurements Shrestha (2010) used are appropriate in the shadow of bad patents, as overly broad patents would likely show high citation counts and be of wide technical breadth. Moreover, the NPEs in Shrestha's (2010) study were identified using media coverage of NPE litigation cases; this likely introduced selection bias into the analysis, as newspapers are more likely to cover higher-profile, larger-stakes, and more substantive cases. Newspaper-identified cases are likely to involve patents that look quite different than the "representative" patent held—or even litigated—by NPEs, so the Shrestha (2010) study may not even provide a robust estimate of NPE patent quality with respect to the metrics Shrestha (2010) uses. Using 392 NPE patent acquisitions, Fischer and Henkel (2012) found evidence suggesting that NPEs acquire patents of significantly higher quality that are more likely to be infringed upon. Unfortunately, like the Shrestha (2010) sample, the Fischer and Henkel (2012) sample is based on large, publicized acquisition events, and so is unlikely to be representative of the average patents held (or acquired) by NPEs. Risch (2012) examined the patents of the ten most-litigious NPEs, and found their asserted patents to be roughly similar in quality to that of other patent asserters.

[16] In their book, Bessen and Meurer (2008a) argued that bad patents that survive reduce consumer welfare by enabling extraction of rents from innovators—and thus lowering productivity. Leslie (2006) argued that bad patents impede competitors seeking to enter markets and stunt further innovation. Scotchmer (1991) suggested that overly broad patent protection may eventually lead to distorted incentives to develop next generation products. And Lemley and Sampat (2012) contended that invalid patents can result in supra-competitive pricing and diminished quantity which may eventually lower incentives to innovate (see also Lemley and Melamed (2013)).

However, the Risch (2012) sample of NPEs is extremely small and nonrandom—and thus unlikely to be representative.

The literature suggesting high NPE patent quality is predominantly based on small and highly selected samples. By contrast, recent large-sample empirical evidence points in the opposite direction. Analyses based on the universe of NPEs suggest that NPEs in fact obtain and litigate *lower-quality* patents. Feng and Jaravel (2015) showed that NPE patent portfolios are disproportionately made up of patents that were granted by "lenient" patent examiners, that is, examiners who spend relatively little time reviewing and narrowing patent claims. Miller (2013) estimated that 59% of the patents owned by NPEs have at least one claim that is invalid. Using a sample of roughly 1,200 expired patents, Love (2014) found that NPEs litigate a given patent significantly more often than practicing entities do, and (on average) litigate patents significantly closer to expiration than PEs do. We found evidence corroborating Love's (2014) findings: Using data on over 7,000 patent lawsuits between 2001 and 2012, we found that NPEs assert patents that are significantly older than PEs' asserted patents, and NPEs are over three times more likely to sue on a given patent than PEs are (Cohen et al. (2015b)). Finally, as we discuss in Section 3.3.4, Allison et al. (2015) found that in cases that reached decisions, NPEs are significantly more likely than PEs to have their patents invalidated.

The literature assessing the quality of NPEs' patents is growing—and in recent years has been suggesting more strongly that NPEs in fact hold and assert "bad" patents. But patent quality is only part of the potential issue. Even conditioning on a given patent quality level, *patent lawsuit quality* can vary, as agents can still differ in terms of the opportunism with which they assert their patents. Thus, in the following sections we examine the extent to which NPEs appear to litigate opportunistically.

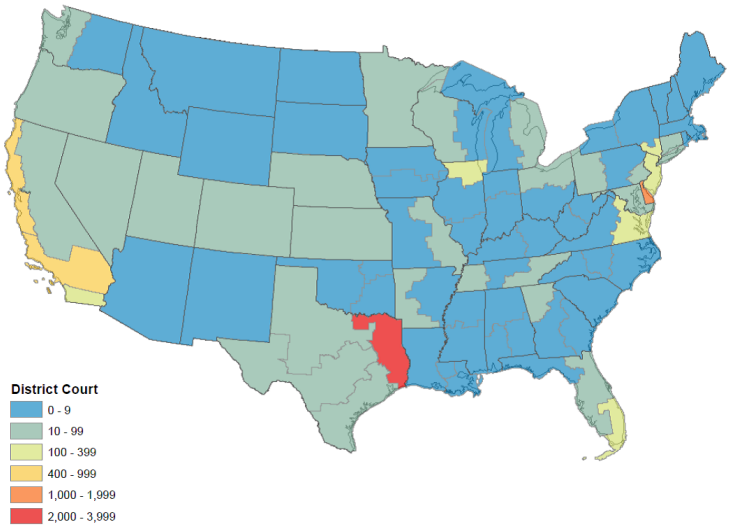

Figure 2: Geography of NPE Patent Litigation in the US (2005–2013).
This figure is based on data from RPX Corporation (collected from Public Access to Court Electronic Records (PACER)) recording all patent cases in the public record brought by NPEs against publicly traded firms from 2005–2013. The data has been tabulated according to the US Federal District court in which the case has been brought, and the heat map shows the resulting geographic distribution.

3.3.2 Empirical Evidence on Forum Shopping

An extreme form of "forum shopping" (i.e., "choosing the most favorable jurisdiction or court in which a claim might be heard" (Garner and Black (2004))) has emerged within the patent litigation space. As patent lawsuits are handled by federal district courts, they could in principle be adjudicated in any one of the 94 federal district courts. Figure 2 shows the geographic distribution of patent litigation from 2001–2011. If patent litigation were uniformly distributed across federal district courts, each area in Figure 2 would be shaded identically. Of course, firm-, population-, and patent-density all are highly non-uniform, and so we expect a non-uniform distribution of patent cases. Nevertheless, no reasonable combination of material attributes would lead to the surprising fact—belied in Figure 2—that a sizably disproportionate fraction of patent cases are brought in the Eastern District of Texas (specifically, the 25,000-resident town of Marshall), which has little to no industry footprint and no prior complex legal specialty in IP (Leychkis (2007)).

Figure 2 masks a more interesting pattern: forum shopping is utilized significantly more

	Operating Company	NPE	Total	Comparison of Proportion p-val	χ^2 Independence Test p-val
TX Eastern Dist.	56	71	127		
	8.20%	26.90%	13.40%	0.01	4.34e-14***
D Eastern Dist.	101	21	122		
	14.80%	8.00%	12.90%	0.34	0.00467***
CA Northern Dist.	64	17	81		
	9.40%	6.40%	8.60%	0.68	0.145

Table 1: Comparison of the Prevalence of Forum Shopping among PEs ("Operating Companies") and NPEs (excerpted from Table 2a of Allison et al. (2015)).
The top row for each district reports litigation frequency; the bottom row reports litigation in the district as a percentage of all patent litigation brought throughout the entire US over the years 2008 and 2009. The third and fourth columns present metrics of statistical significance of the difference in percentages between NPEs and PEs.

frequently by NPEs than by operating firms, even within the space of patent disputes. For instance, we ran a Wilcoxon test comparing the geographic distributions NPE and operating firm patent lawsuits (Cohen et al. (2015b)), finding a significant difference ($z = 2.35$), with NPEs differentially more concentrated in East Texas. Allison et al. (2015) found corroborating evidence on forum shopping: Of the patent lawsuits that eventually reach judgments, only about 8% of those brought by PEs are filed in East Texas, whereas over three times that percentage—nearly 27%—of NPE cases are filed in East Texas (see Table 1).

Moore (2001) and Leychkis (2007) both posited potential reasons why NPE litigation has been concentrated in Marshall, TX. Leychkis (2007) in particular identified three main possibilities: (1) experienced judges; (2) special rules that facilitate quick trials; and (3) plaintiff-friendly juries. The most compelling cause appears to be the high win rate of plaintiffs on jury trials. Patentees won 90% of all jury trial cases in the Eastern District of Texas, in comparison to a 68% win-rate nationally (Leychkis (2007)). Moreover, it appears that Marshall, TX courts award higher-than-average payouts to plaintiffs in patent suits (Leychkis (2007)). However, the available evidence thus far cannot explain why PEs do not forum shop as frequently as NPEs do.[17]

While it is unclear what ultimately drives the different forum shopping behaviors of NPEs and operating companies, perhaps from a forward-looking perspective that question is moot.

[17]While there are some potential mitigating factors that impact PEs' lawsuits and do not affect NPEs (e.g., the threat of patent-infringement countersuits), these factors would still need to be quite large to overcome the 30% higher win-rate afforded in Marshall.

Figure 1 shows that nearly 100% of the growth in IP litigation is coming from NPEs. The natural follow-on question is then: *What is the prospect that the structural incentives to forum shop in East Texas will be stamped out?* The most natural channel for eliminating forum shopping may be legislative (as neither NPEs, nor "the town itself" are incentivized to change the current equilibrium). However, the legislative channel should be viewed with caution. As a telling anecdote, nearly a decade ago, Leychkis (2007) ended his article with: "However, judging by the recently introduced bills to amend the venue statute and designate specialized patent judges in a limited number of districts, the need for reform is recognized on Capitol Hill, and therefore the days of Marshall, Texas and its world-famous Fire Ant Festival dominating the patent litigation news are likely numbered."

3.3.3 Empirical Evidence on Litigation Targeting

Using data from both RPX and Cotropia et al. (2014), we have found that NPEs appear to target their lawsuits in an opportunistic manner (for all the results discussed in this section, see Cohen et al. (2015b)).[18] First and most prominently, we found that cash (measured either as defendants' cash-on-hand, or in terms of defendants' year-on-year cash shocks) is the principal determinant of NPE litigation targeting, controlling for all other firm characteristics. The impact of cash holdings and cash shocks on being targeted by NPEs is large and significant (see Table 2, which we reproduce from Cohen et al. (2015b)). The 0.0857 ($t = 5.60$) coefficient on Cash Level in Column 4 implies that a standard-deviation increase in cash balance increases the chances of being sued by 12.55%—close to a fourfold increase over the unconditional average of 4.42%.

Looking at firms' business-segment level disclosures, we found moreover that NPEs appear to target cash indiscriminately. Indeed, NPEs are just as likely to target profits from firm segments *unrelated* to allegedly infringed patents as they are to target profits from related

[18]Sichelman (2014) presented an examination of an early draft of the work that we describe here. The current version of our work (Cohen et al. (2015b)) incorporates the suggestions of Sichelman (2014), and shows robustness to the various empirical concerns Sichelman (2014) raised (most importantly, replicating all results obtained using RPX data on the publicly available dataset of Cotropia et al. (2014)).

	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 2: NPE Cash Targeting (reproduced from Table II of Cohen et al. (2015b)).
In this table, we use a linear probability model to estimate the probability of being sued by an NPE as a function of firm characteristics. The analysis is based on data from RPX Corporation (collected from Public Access to Court Electronic Records (PACER)), consisting of firm–year observations between 2001 and 2011. The outcome variable, Sued by NPE, is a dummy equal to 1 if the firm was litigated by an NPE in a given year. The remainder of the control variables' construction is described in detail in our working paper (Cohen et al. (2015b)). Standard errors, clustered by firm, are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

segments. Targeting profits unrelated to alleged infringement can hardly be thought of as "policing profitable infringement." Using several different empirical measures, we also found that NPEs target firms against which they have a higher *ex ante* likelihood of winning.

The cash-targeting behavior we have observed is driven by large "patent aggregators," i.e., NPEs that aggregate thousands of patents and bring cases against a large number of defendants. Small inventors, by contrast, do not appear to target cash directly. As we discuss in Section 3.3.4, cash-targeting is neither a general feature of IP litigation, nor of litigation more generally—it appears to be unique to NPE IP litigation, and driven by large aggregators within the class of NPEs.

3.3.4 Comparing NPEs to PEs

PEs behave differently from NPEs, in general. The key predictors of NPE litigation targeting do not appear to be drivers of PE litigation; in particular, the impact of cash on PE targeting is slightly negative (Cohen et al. (2015b)). Of course, this finding does not speak

to the quality of NPEs' lawsuits directly, as PEs have motivations for litigation beyond those of NPEs (e.g., competitive responses and retaliative litigation). Nevertheless, our comparison between NPEs and PEs *does* show that the cash-targeting behavior NPEs exhibit is not a general feature of IP litigation—it is specific to NPEs.[19]

Allison et al. (2015) provided more direct comparisons of NPE and PE patent lawsuits: First, as we discussed, in Section 3.3.2, Allison et al. (2015) observed that PEs bring significantly fewer IP lawsuits in East Texas than NPEs do.[20] Allison et al. (2015) found moreover that NPEs "have an outsized influence in the computer and electronics industries" relative to PEs, and that NPEs lose patent cases about twice as often as PEs do. Perhaps most strikingly, Allison et al. (2015) found that NPEs are significantly more likely than PEs to have their patents

1. invalidated through summary judgment (42.3% of times it was ruled upon in NPE cases, compared to 26.9% of PE cases),

2. invalidated based on prior art (42.1% of times it was ruled upon in NPE cases, compared to 27.3% of PE cases), and

3. invalidated based on inadequate disclosure (75% of times it was ruled upon in NPE cases, compared to 16.8% of PE cases).[21]

The stories here are a bit more nuanced than the aggregate statistics show, as Allison et al. (2015) found them to be driven by certain categories of NPEs. The NPE loss-rate in court varies significantly by technology, industry, court, and NPE entity type. Nevertheless, the

[19] We have shown moreover that cash is not a first-order determinant of non-IP litigation targeting; hence, the cash-targeting we observe is really unique to NPE IP litigation (Cohen et al. (2015b)).

[20] Allison et al. (2015) examined only the lawsuits that eventually reach judgments; we have corroborated their findings on forum shopping using the full universe of patent lawsuits brought by NPEs and PEs (Cohen et al. (2015b,a)).

[21] Ashtor et al. (2013) found related evidence using a database from PricewaterhouseCoopers comprised of 1,751 patent cases reported in Westlaw from 1995–2011: The proportion of *decided* NPE cases relative to all IP cases has remained relatively stable over time, although there has been significant increase in case filings by PAEs, suggesting that PAEs are disproportionately willing to settle their instead of waiting for final case decisions. Furthermore, NPEs assert a higher number of patents per case than PEs, on average (3.85 vs. 2.22).

Allison et al. (2015) NPE–PE comparison provides strong evidence for the view that NPE lawsuits are of lower quality than PE lawsuits, on average.

4 Impact of NPE Litigation

We close by examining the evidence on how NPE litigation impacts innovation.

4.1 Reduction of Innovation at Targeted Firms

A growing body of evidence indicates that NPE litigation reduces innovation at targeted firms. In seeking to understand the impact of NPE litigation on targeted firms, however, there is a clear selection issue: it is possible that the firms that NPEs target share some common unobservable characteristic that drives both NPE targeting and *ex post* outcomes.

To alleviate selection concerns, in our own work (Cohen et al. (2015b)) we compared post-litigation R&D across two groups of firms, *both of which were targeted by NPEs*. Specifically, we compare targeted firms that "lost" to NPEs (either in-court or through settlement) and targeted firms that "won" (either in-court, or through judgment).[22] We examined how R&D expenditures differ (pre- and post-litigation) scross the two groups of firms.

Table 3 reports difference-in-differences results illustrating that—even conditioning on being selected for litigation—losing to an NPE has a large and negative impact on future R&D activities. Firms that lose to a large aggregator NPE invest significantly less in R&D in subsequent years ($115 million less, $t = 2.40$), relative to *ex ante* comparable firms that are also targeted by large aggregators but win their lawsuits.[23] Similar analyses in a regression framework with additional controls confirms the differences-in-differences findings (Cohen et al. (2015b)); Smeets (2015) presents further consistent evidence.

[22]Following Allison et al. (2010), we excluded "stays," "transfers," and "procedural dispositions."

[23]Table IX of Cohen et al. (2015b) also shows that no such R&D reductions arise following losing a patent lawsuit to a PE.

					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)

Table 3: Impact of NPE Litigation on R&D Behavior (excerpted from Table IX of Cohen et al. (2015b)).

In this table, we show 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 compare two groups of firm–case outcomes controlling for selection by examining only firms that are targeted by NPEs. The Treated subsample consists of those firms that lost to NPEs or ending up settling before final adjudication. The Untreated subsample consists of those firms that had NPEs' cases against them dismissed, or that won against NPEs in a final court decision. We compare the change in R&D expense, before and after litigation filing, comparing those defendant firms that were involved in cases "Settled or Won by NPE" to those involved in cases "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). t-statistics of these differences are reported in parentheses below the differences. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels.

In an industry-level study, Tucker (2014) examined the impact of patent trolling on the sales and development of medical imaging technology. Tucker (2014) compared sales of digital medical picture archival and communications systems (PACS)—which are known to reduce reduce neo-natal mortality (Miller and Tucker (2011))—before and after Acacia (a large patent aggregator) initiated litigation against healthcare IT firms making PACS. Tucker (2014) found in comparison to similar products made by the same firms, but out of scope of the Acacia patents, sales of the PACS involved in litigation declined by one-third. Tucker (2014) cleanly identified the mechanism for the sales reduction: there was no suppression in underlying demand; rather, innovation was reduced. As Tucker (2014) reported, "[n]o new variations of existing products or new models of imaging software were released by the affected vendors during the period of litigation."[24]

4.2 Costs to Targeted Firms

Except in the case of the Tucker (2014) studies, we have little evidence on the exact mechanism driving reduced innovation at targeted firms—and that mechanism may vary across industries and technology classes. Nevertheless, the observed reductions in R&D and other investment is not surprising given the substantial costs incurred by targets of NPE litigation.

Using data on NPE litigation against public firms, Bessen et al. (2011) estimated the impact of NPE litigation filing on targeted firms' stock returns. Bessen et al. (2011) found a mean loss of .32%—smaller than that of an average patent lawsuit (at least relative to the estimates of Bessen and Meurer (2008b)). However, the implied economic magnitude is large: Bessen et al. (2011) estimated that targeted firms on average lose $122 million per lawsuit (in 2010 dollars)—far *more* than in average patent lawsuits—corresponding to over $80 billion per year. Bessen and Meurer (2014) found similar impacts of NPE litigation on privately held firms: Using a survey of private firms conducted by RPX, Bessen and Meurer (2014)

[24] As Tucker (2014) posited, "[a]n explanation for this lack of innovation is that the vendors did not want to run the risk of being found guilty of "willful infringement," leading to liability for treble damages.

estimated that just the *direct* costs of NPE litigation to private firms averaged roughly $14.6 billion per year between 2005 and 2011.[25]

4.3 Pass-Through of NPE Proceeds to End Inventors

Of course, if NPEs promote substantial transfers to individual inventors (either directly, through lawsuits, or indirectly, through increased licensing), then that could theoretically offset the costs of NPE litigation and associated reduction of innovative effort at targeted firms. However, the only available estimates of the pass-through from NPEs to end inventors suggest that those transfers may be small.

Bessen et al. (2011) identified fourteen publicly-traded NPEs, and examined how much of those NPEs' targets' losses were capitalized into the NPEs' own values. The fourteen-NPE sample covers a total of 574 lawsuits against public firms between 2000 and 2010, which Bessen et al. (2011) estimated to be responsible for roughly $87 billion in defendant losses (again, measured as reductions in defendants' stock values, in 2010 dollars). The publicly-traded NPEs' total revenues were on the order of $7.6 billion in the same sample period—so Bessen et al. (2011) concluded that less than 10% of the defendant firms' losses were transferred to NPEs. Transfers to inventors and direct R&D investment by the publicly traded NPEs was even lower over the same period, about $3.7 billion, or roughly 5% of defendant losses. Looking at private firms' direct costs, and again considering a set of publicly traded NPEs, Bessen and Meurer (2014) found a more direct correspondence between defendants' losses and NPEs' gains: About 75% of direct costs appeared to be transferred to NPEs. However, most of the transfer goes to NPE operating costs; only about 15% is spent on within-NPE R&D, and only 5% of the transfer is passed on to end inventors.

Because Bessen et al. (2011) and Bessen and Meurer (2014) work with SEC disclosure

[25] As with any survey evidence, there is some possibility of respondent selection bias in the RPX survey: As Schwartz and Kesan (2014) pointed out, it is possible that the firms choosing to respond to the survey were exactly those firms facing the highest litigation costs. Bessen and Meurer (2014) responded to this critique by benchmarking their litigation cost estimates against outside values. But even if the Bessen and Meurer (2014) sample were highly selected, it is not clear that a more representative sample could have litigation costs so much lower as to balance against the high direct costs Bessen and Meurer (2014) observed.

data for the small (and selected) sample of NPEs that are publicly traded, we must be careful in how much we extrapolate from their estimates (Schwartz and Kesan (2014)).[26] Certainly, it would be better to have measurements on direct transfers—in particular, the sizes of settlements—and to analyze a larger set of NPEs. Unfortunately, however, settlement values are typically not public, in large part because NPEs often insist on nondiscloure agreements. Thus, it is not clear how one could get more precise measurements than Bessen et al. (2011) and Bessen and Meurer (2014) used.[27]

At minimum, the results of Bessen et al. (2011) and Bessen and Meurer (2014) provide something of a lower bound on NPEs' value in terms of increasing innovation. In the subsample Bessen and Meurer (2014) considered, the estimated average costs public NPEs' lawsuits imposed on private firms is roughly $1.5 billion; about $228 million (15%) of those costs were subsequently directed towards either in-house R&D or external inventors.[28] For this to be an efficient transfer, we would have to believe that the inventors who benefit from NPE transfers are at least six times as effective at innovation as defendant firms are. Even if we were to imagine that Bessen et al. (2011) and Bessen and Meurer (2014) underestimated typical rate of NPE pass-through to end inventors by a factor of 2, we would still have to believe that those inventors are at least three times as productive as defendant firms.[29]

The findings of Bessen et al. (2011) and Bessen and Meurer (2014) suggest that NPE litigation is unlikely to provide substantial incentives for small innovators. While there is certainly more work to be done in gaining more general estimates of NPE pass-through,

[26] As Schwartz and Kesan (2014) pointed out, the publicly traded NPEs are not completely representative of NPEs, more generally; in particular, several of the NPEs in the Bessen and Meurer (2014) study are especially large NPEs with their own R&D divisions, whereas most private NPEs are much smaller. Even excluding these large NPEs, however, Bessen and Meurer (2014) found that almost 80% of the transfer to NPEs goes to operating costs.

[27] It seems unlikely that NPEs would be forthcoming in surveys, given their widespread preference for nondisclosure agreements.

[28] Here, we use the Bessen and Meurer (2014) estimates both because they more precisely estimate direct costs and because they are more generally favorable to NPEs.

[29] Incidentally, the logic here applies even if the principal benefit of NPEs to inventors is not direct cash transfers, but rather increased licensing opportunities. As we showed (Cohen et al. (2015b)), the ability of inventors to extract licenses from large firms is directly mediated by the size of NPEs' pass-through to end inventors.

these impressions are consistent with both the results of Feldman and Lemley (forthcoming) (described in Section 2) and our own findings (Cohen et al. (2015b)). Indeed, our own work suggests that NPEs seem to be doing very little to incentivize small inventors: We conducted a simple empirical exercise in which we measured innovation in the technology areas with the most NPE litigation; in those technology areas, both direct and indirect benefits of NPE litigation for small inventors should be largest, but we found no observable increase in small inventor innovation (Cohen et al. (2015b)).

5 Conclusion

In this chapter, we have documented the body of empirical evidence on the behavior and impact of NPEs. NPEs have driven the sharp rise in patent litigation over the last decade. Moreover, both surveys and large-sample evidence suggest that NPEs frequently act opportunistically, targeting cash and litigating weak patents. Mounting evidence also suggests that NPE litigation is having a large, negative effect on US innovation. That said, not all NPE litigation is clearly problematic—in particular, most of the NPE patent trolling that has been observed seems to be driven by large aggregators.

Future research should seek to understand where, if anywhere, NPEs can have strong positive impacts on innovation, and where NPE activity should be curtailed. Empirical evidence could also give insight into other types of patent intermediation that might dominate the current NPE organizational form. Lastly, it is essential that policy responses to NPEs not be guided by anecdotes. Rather, policy responses to NPEs must be based on empirical evidence—in particular, consistent bodies of large-sample empirical evidence, wherever possible.

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