INSTITUTT FOR FORETAKSØKONOMI

DEPARTMENT OF BUSINESS AND MANAGEMENT SCIENCE

FOR 24 2014

ISSN: 1500-4066

June 2014

Discussion paper

Patent Trolls, Litigation, and the Market for Innovation

BY

Axel Haus AND **Steffen Juranek**

Norges Handelshøyskole

NORWEGIAN SCHOOL OF ECONOMICS

Patent Trolls, Litigation, and the Market for Innovation

Axel Haus[a], Steffen Juranek[b,*]

[a]*Goethe University Frankfurt, Grueneburgplatz 1, 60323 Frankfurt, Germany*
[b]*NHH Norwegian School of Economics, Helleveien 30, 5045 Bergen, Norway*

Abstract

We examine the role of non-practicing entities (NPEs), often called patent trolls, in patent litigation. We present a theoretical model that predicts that cases with NPE patentees resolve faster. We test this prediction using a hand-collected data set of US patent litigation cases. We find that NPEs challenge larger and more technology intensive firms, and use more valuable patents from technology areas that have a less fragmented ownership base compared to the control group. Controlling for these factors, we find that NPE cases are indeed resolved faster. NPEs help to increase the speed of diffusion of technology into the economy; therefore, increasing the effectiveness of the market for innovation.

Keywords: litigation, patents, patent trolls, technology diffusion

JEL classification. K0, K41, O34

1. Introduction

The efficiency of the patent system is of crucial importance for the economy. A well-functioning system clarifies the boundaries of a patent and helps to resolve disputes quickly. Increasing the efficiency of the patent system decreases the costs of patent protection and the litigation risk; therefore, enhancing innovative activity. In recent years new patent intermediaries have emerged which raise questions concerning their role for the efficiency of the patent system (see Hagiu and Yoffie, 2013, for an overview). A special type of intermediaries are non-practicing entities (NPEs), often called patent trolls. NPEs hold patents mainly for licensing purposes. They neither use the patent for their own production nor for follow-up innovations. The number of patent litigation cases involving NPEs increased tremendously in recent years; NPEs account for more than half of all patent litigation cases in 2012 (Economist, 2013; Chien, 2013). Legal scholars, economists, and politicians debate intensely whether NPEs foster innovation by creating a market for innovation and assisting financially constrained innovators to enforce their patent rights (e.g., Shrestha, 2010; Myhrvold, 2010), or whether they harm innovation through excessive litigation (e.g., Bessen et al., 2012; Reitzig et al., 2007). This debate has even reached the highest legislative levels of the United States (Economist, 2013). Unfortunately, too little is known about NPEs to come to a definitive conclusion (Galasso et al., 2013).

*Corresponding author, Phone: +4755959863
Email addresses: haus@econ.uni-frankfurt.de (Axel Haus), steffen.juranek@nhh.no (Steffen Juranek)

This article contributes in filling this gap by investigating the behavior of NPEs. We start by analyzing the differences between litigation cases brought to court by NPEs and non-NPE patentees. Understanding potential differences, e.g., whether NPEs sue larger or smaller firms, or whether they are using more or less valuable patents, is important for the evaluation of NPEs because it helps to understand the impact of NPEs on original innovators.

In the next step, we turn to an analysis of the effect of NPEs on the duration of litigation. The analysis of the duration of patent litigation is of special importance for two reasons. Firstly, a faster disposal of civil suits enhances economic activity (Chemin, 2012); a more effective legal system is associated with positive effects for the economy. Thereby, we focus on an effect that has mainly been ignored in the debate. To the best of our knowledge, we are the first raising the question of the impact of NPEs on the effectiveness of the legal system by analyzing their influence on the duration of litigation. Secondly, it delivers insights to the licensing process in general. It is not only the case that patent disputes often result in licensing agreements (Anand and Khanna, 2000) but also that "virtually every patent license can be viewed as a settlement of a patent dispute (...) because negotiations take place in the shadow of possible litigation" (Shapiro, 2003, p. 392). Hence, faster resolved cases are related to a faster diffusion of technology because the technology can be used earlier by the licensee. By analyzing the effect of NPEs on the duration of litigation, we are able to draw conclusions on their effect on the speed of technology diffusion and the effectiveness of this market for innovation.

NPEs can be seen as firms consisting of patent professionals and lawyers with pooled expertise in patent law and litigation. We present a theoretical model that builds on the notion that highly specialized NPEs have lower marginal effort costs at the litigation stage. The model predicts that NPE cases are resolved faster. We test this prediction using a hand-collected data set of patent litigation cases filed between 2004 and 2007 in the United States. This detailed data set allows the identification of NPE patentees, infringer characteristics and the matching of patent and court characteristics. We show that NPE cases differ from standard patent cases. NPEs sue larger and more technology intensive infringers. They use more valuable patents from industries with less fragmented patent rights. These results back the hypothesis that NPEs assist small innovators exploiting the full value of their patents. After controlling for these case characteristics, we find that NPE cases are indeed resolved significantly faster. NPE cases need on average approximately 18 percent less time and 25 percent less docket events to resolve. Hence, the speed of technology diffusion increases significantly.

We contribute to several strands of the literature. The first strand is the analysis of the behavior of NPEs. Chien (2009) shows that NPEs sue multiple infringers. Bessen et al. (2012) argue that NPEs tend to fight against large infringers and focus on patents from the computer sector. Unfortunately, this study lacks a control group. Fischer and Henkel (2012) compare patents acquired by NPEs with patents acquired by practicing firms and show that NPE patents are of significantly higher value. Shrestha (2010) shows that the same is true among the group of litigated patents.

Secondly, our article relates to the theoretical analysis of litigation in general and patent litigation in particular.[1] Bebchuk (1984) and P'ng (1983) introduce models with asymmetric information to analyze the role of the litigation costs and the value at stake in the settlement decision. We follow Galasso and Schankerman (2010) and the preceding authors, and use also a framework with asymmetric information to analyze the effect of patent and infringer characteristics on the case duration.

Thirdly, several empirical studies on patent litigation are related to our study. Somaya (2003) shows that a higher patent value and a higher strategic value for the patentee decrease the settlement likelihood. Galasso and Schankerman (2010) show that less uncertainty about the court outcome and more fragmented patent rights decrease the case duration. With respect to patentee characteristics, Lanjouw and Schankerman (2001, 2004) show that patents owned by firms with small patent portfolios and individuals are less likely to be part of a patent suit.

Finally, a few articles discuss the duration of litigation in general. The duration of litigation is affected by the legal rules (Fournier and Zuehlke, 1996), value at stake and uncertainty (Fenn and Rickman, 1999), and the actions taken at court (Boyd and Hoffman, 2013). We complement these findings by delivering insights on the role of party characteristics.

The paper is organized as follows. In the next section, we shortly introduce NPEs and their role in the patenting and patent protection process. We present the theoretical foundation for our empirical analysis in Section 3. We describe our data in Section 4. Section 5 presents our results, and we conclude in Section 6.

2. Background

The ultimate purpose of a patent system is to encourage innovation by allowing a time-restricted monopoly in order to generate profits from an invention. The basic assumption underlying the system is that innovation generates long-term social welfare which compensates for the short-term welfare loss of a monopoly. Apart from a possible intrinsic motivation to invent, an innovator's goal is to maximize the net present value from her investments in innovation. Such an investment is only profitable if the innovator is able to protect her invention from imitation. One such protection mechanism is provided by the patent system.

Several steps are important in the patenting and patent protection process, which we shortly list below.

1. An innovator, who could be either an individual or a firm, invests in innovation. The innovation either fails, infringes an existing patent, or is a success.

2. In the case of a success, the innovator files a patent application or keeps the technology as a secret.

[1] See Cooter and Rubinfeld (1989) for an analysis of the role of asymmetric stake sizes and Priest and Klein (1984) for the role of uncertainty in the settlement decision.

In the case he receives a patent, the innovator keeps the patent and uses it for own production and/or licenses the patent to other producers. Alternatively, the innovator sells the patent.

3a. The patent holder defends the patent against infringers which may end in litigation.

3b. The patent holder tries to generate licensing revenues.

In the following, we discuss the potential influence of NPEs on this process. NPEs, sometimes also called patent trolls or patent sharks, are firms that specialize on the acquisition of patents, typically from individual inventors or small companies. After the acquisition, they use these patents to generate licensing revenues from operating firms. NPEs neither innovate themselves nor use the patent for own production.

The presence of NPEs potentially influences each of the five steps. Three arguments explain why NPEs are more efficient in protecting a patent (step 3a). Firstly, NPEs are groups of lawyers with a high level of legal expertise. They specialize in licensing and securing the value of their intellectual property rights, and the assertion of these rights. Thus, litigation is part of their business model. In our model, we assume that this specialization results in an advantageous cost structure in protecting a patent. Secondly, NPEs are the residual claimants of the patents payoffs and securing the payoffs is in the best interest of the NPEs. No additional costly incentive contract is required compared to employing a legal counsel. Thirdly, NPEs are less financially constrained in comparison to many small investors. Additionally, specialization effects may increase the licensing revenues of the patent (step 3b). Because of lower costs, NPEs market the technology secured by the patent more actively.

These arguments fit also to an outsourcing story where innovators outsource the patent protection by selling the patent to an NPE and becoming (exclusive) licensee. In order to protect the licensee revenues, it is in the best interest of the NPE to protect the patent and to generate additional revenues. Lower protection costs and additional licensing income generate value in such a transaction. NPEs create a market for patents which is likely to increase the value of the patent in step 2. From a social perspective, a higher value of a patent generated by the presence of NPEs in steps 2-3 increases the innovation incentives in the first step.

Additionally, there may exist another important positive effect which is at the center of this article. NPEs may make the litigation process in step 3a and the licensing process in step 3b more effective by increasing the speed of diffusion of the technology into the economy. Disputes are resolved faster, licensing agreements finalized quicker, and the technology can be used earlier by the licensee(s).

However, there exist also at least two drawbacks of NPE involvement. Firstly, NPEs may not only replace the original innovator but may also target firms that would not have been targeted by the original innovator. The main aim of the innovator is to secure its own business. In contrast, NPEs specialize on licensing which may lead to a more complete discovery of firms using the patent's underlying technology, especially in business areas that are not directly related to the business of the original innovator. The licensing fees increase the costs of these firms which reduces social welfare. Additionally, the presence of NPEs increase the litigation risk of any innovation in related technology fields which has adverse effects on the innovation decision in the first place. Indeed, NPEs seem to be very active in generating licensing revenues; Chien (2013) shows that the number of NPE cases in 2012 was more than six times higher than in 2005. However, it is unclear whether NPEs are responsible for the increased number and whether it is associated with negative consequences for the economy. NPEs could as well be only a substitute for the less specialized innovators. In this case, an increase of the number of cases would be just the consequence of specialization effects. Bessen et al. (2012) make an effort to evaluate the role of NPEs and analyze the effect of NPE lawsuits on stock performance and find yearly private losses of $ 80 billion during 2007 and 2010. They argue that only little was transferred to the original inventors and that NPEs therefore harm innovation.

Secondly, NPEs are suspected to extract profits from low quality patents. Therefore, the presence of NPEs may increase incentives to file applications for low quality patents in step 3 in order to generate revenues by selling intellectual property to an NPE. Hence, patents with unclear boundaries and validity are created. However, Fischer and Henkel (2012) show that NPEs patents seem to be of higher quality because they are cited significantly more often than other patents; a result that is also confirmed by our analysis.

Combining the arguments above, it remains unclear which effect dominates. Unfortunately, too little is known to come to a definite conclusion. Because of the impact on short-term and long-term incentives to innovate, the analysis of the net-effect of NPEs is very complex and the empirical measurement is inherently difficult (Hagiu and Yoffie, 2013). This article contributes to solving the puzzle by focusing on the effect of NPEs on 3a and 3b. We first show differences among infringers that are brought to court by NPEs compared to producing patent holders. In a second step, we analyze the effect of NPEs on the time patent cases require to resolve. This allows us to draw conclusions on their influence on the speed of licensing and the speed of diffusion of technology in more general.

3. Theoretical foundation

We use the model of Galasso and Schankerman (2010) as the basis of our modeling approach. We extend their model by introducing an additional stage in which the patentee and the infringer invest in legal advice at the litigation stage. We describe the model in detail in the following.

The patentee accuses the infringer of patent infringement. The infringer has private information about important facts of the infringement and knows that she has an ex-ante base probability of losing the case p. The patentee does not observe the infringers type and only knows that p is uniformly distributed over $[\underline{p} = \frac{1}{2}(1-\lambda), \bar{p} = \frac{1}{2}(1+\lambda)]$. A variation of the parameter λ only changes the variance of the distribution while keeping the mean constant at $\frac{1}{2}$.

In period $t = 0$, the patentee makes a take-it-or-leave-it settlement offer S to the infringer. The infringer either accepts or rejects the offer. If she accepts the offer, then the game ends. If she rejects the offer, then the trial takes place in $t = 1$. Both parties invest in legal counsel to influence their probability of winning, $x_P, x_I \geq 0$. The patentee‘s ex-post probability of winning becomes $p + x_P - x_I$. This investment setup is similar to the one used in Choi and Sanchirico (2004)[2]. Both parties have to bear the costs of their investments, $h_P \frac{x_P^2}{2}$ and $h_I \frac{x_I^2}{2}$. The cost parameters h_P and h_I are publicly known. In addition to their effort investments, both parties have to bear (fix) litigation costs L_I and L_P respectively. If the patentee wins the case, then the court awards the patentee damages equal to Z. For simplicity, we assume that $\lambda \leq 1 - 2Z\frac{|h_I - h_P|}{h_P h_I}$. This assumption ensures that the players do not have to take into account that ex-post winning probabilities may exceed one or fall below zero, and that one of the parties just accommodates the investment of the other party. Figure 1 summarizes the timing.

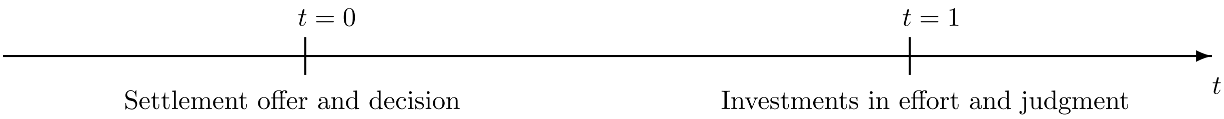

Figure 1: Timing of the game

In $t = 0$, the infringer accepts a settlement payment as long as it is lower than the expected trial award plus the litigation costs. Hence, making a settlement offer is equivalent to choosing a cutoff value $\tilde{p}$ from the viewpoint of the patentee. If the infringer is of type $p \geq \tilde{p}$, then she accepts the offer, but the infringer rejects it if she is of type $p < \tilde{p}$. By taking this decision into account at the litigation stage, the patentee maximizes her conditional expected payoff:

$$\max_{x_P} \; E(P_P|p < \tilde{p}) = \frac{1}{\tilde{p} - \underline{p}} \int_{\underline{p}}^{\tilde{p}} \left((p + x_P - x_I)Z - L_P - h_P \frac{x_P^2}{2} \right) dp. \tag{1}$$

The infringer knows her type and maximizes:

$$\max_{x_I} \; P_I = -(p + x_P - x_I)Z - L_I - h_I \frac{x_I^2}{2}. \tag{2}$$

In equilibrium the parties efforts amount to $x_P^* = Z/h_P$ and $x_I^* = Z/h_I$. Plugging these values in the payoff functions gives the (expected) equilibrium profits at the litigation stage:

$$E(P_P^*|p < \tilde{p}) = \frac{1}{\tilde{p} - \underline{p}} \int_{\underline{p}}^{\tilde{p}} (pZ - L_P - K_P)dp, \tag{3}$$

$$P_I^* = -pZ - L_I - K_I. \tag{4}$$

In Eqs. (3) and (4), we define $K_P = \frac{2h_P - h_I}{2h_P h_I} Z^2$ and $K_I = \frac{2h_I - h_P}{2h_P h_I} Z^2$. The payoff functions show the rent-seeking characteristics of the game. Litigation is a zero-sum game in which any investment in

[2]The assumption that the marginal productivity is independent of the opponent's choice may have an influence on the effort investment decision. We discuss this assumption shortly after Proposition 1.

influencing the winning probability is wasteful from a social point of view. In the case of equal marginal costs, both parties invest the same amount, and both parties are worse off in equilibrium compared to no investment. In contrast, if one of the parties is sufficiently more productive than the competitor, then the increase in the expected award may outweigh the additional costs.

The infringer takes the result from the litigation stage into account at the settlement stage in $t = 0$. The infringer accepts a settlement offer $S \leq pZ + L_I + K_I$. Because of a one to one relation of S and p, the cutoff value of p follows as $\tilde{p} = (S - L_I - K_I)/Z$. The patentee chooses the optimal cutoff type $\tilde{p} \in [\underline{p}, \bar{p}]$ in order to maximize her payoff:

$$\max_{\tilde{p}} \frac{1}{\bar{p} - \underline{p}} \left(\int_{\underline{p}}^{\tilde{p}} (pZ - L_P - K_P)dp + \int_{\tilde{p}}^{\bar{p}} (\tilde{p}Z + L_I + K_I)dp \right). \tag{5}$$

The optimization gives the optimal cutoff type:

$$p^* = \bar{p} - \frac{L}{Z} - \frac{K}{Z}, \tag{6}$$

where $L = L_I + L_P$ and $K = K_I + K_P = \frac{h_P + h_I}{2h_P h_I} Z^2$.

The cutoff type p^* distinguishes settlements and trials. The fraction $\frac{\bar{p} - p^*}{\bar{p} - \underline{p}}$ of all cases settle before trial in period $t = 0$, while the fraction $\frac{p^* - p}{\bar{p} - \underline{p}}$ proceeds to trial in period $t = 1$. Hence, the expected case duration is determined by

$$E(t^*) = 1 - \frac{L}{\lambda Z} - \frac{K}{\lambda Z}. \tag{7}$$

The first two terms of the right-hand side of Eq. (7) represent the results of Galasso and Schankerman (2010). Higher fixed litigation costs of the patentee make a trial less appealing and higher levels of asymmetric information increase the case duration. The last term depicts the effect arising from the investment decisions at the litigation stage. Because the investment game is essentially a rent-seeking game, the sum of K_I and K_P depicts the sum of the variable litigation costs. Higher variable litigation costs increase the willingness to pay of the infringer and/or lowers the settlement amount demanded by the patentee. Hence, higher variable litigation costs increase the fraction of settlements and consequently decrease a case's expected duration.

The remaining question is, how the marginal investment costs of the patentee influence the variable litigation costs. Taking the first derivative of K with respect to the marginal investment costs gives the answer:

$$\frac{\partial K}{\partial h_P} = -\frac{1}{2h_P^2} Z^2 < 0. \tag{8}$$

Higher marginal costs turn out to decrease the variable litigation costs; therefore, they increase the case's expected duration. Proposition 1 summarizes the result.

Proposition 1. *The case's expected duration increases with the marginal effort costs of the patentee.*

The introduction of different marginal costs allows us to form predictions regarding the behavior of NPEs. In the following, we assume that the NPEs have lower marginal litigation costs compared to the usual patentee. We base this assumption on specialization effects of NPEs which follow our reasoning in Section 2.

Note that we employed special assumptions on the cost function and the productivity of effort investment to derive the result above. The purpose of the model is to form a prediction about the effect of NPEs on the case duration. Therefore, we refrain from discussing the role of the cost function in detail, and focus on the existence of the case where litigation duration increases in the patentee's marginal investment costs. Note additionally that the model has only two stages, a settlement and a litigation stage. One should not take this notation at face value. In practice, there exist many opportunities for a settlement. A case may be settled before or after filing the case at a court. That means that even at court, a case may be settled before a judgment. However, our result is robust to the introduction of a multi-period model.[3] For the sake of simplicity we focused our reasoning on a two-period model. An alternative interpretation is that a longer a case takes the more often settlement negotiations failed.

4. Data set

We use patent litigation data collected from the Lex Machina database. The database contains intellectual property litigation cases filed in the United States. By hand-collecting the data we obtain detailed information on each case. The information allow us to identify NPEs and to derive patent, infringer and court characteristics. Because of the time-consuming data collection process, a full collection of data is not realizable. We focus on every tenth case filed between April 2004 and March 2007. This process results in a random sample of 779 observations.[4]

In order to check the representativeness of our sample, we compare our sample with the population for certain characteristics in Table 1. The table compares the percentages of terminated cases, their durations in days, the respective number of docket events, and the representation of the 7 out of 94 most frequent districts. Each of these seven districts are the only districts that account for more than 3 percent of all patent cases in the population (and in our sample). The comparison shows no considerable differences for each variable.

Because we cannot clearly follow cases that were transferred from one court to another, we drop these observations. The same is true for cases consolidated to a lead case. For those cases, we are not only concerned that information is missing, but also that these cases differ in their structure compared to the other cases. We also exclude cases that were dismissed by the court because of a lack of jurisdiction. For some cases, the documents, especially the complaints and answers, are not available. For these cases, we were neither able to extract the underlying patents nor the participant characteristics. Because these characteristics are essential for our analysis, we exclude these cases, too. We are left with a cleaned data

[3]Because the variable litigation cost affect the settlement in a similar ways as the fixed litigation costs the proof is identical to proof shown by Galasso and Schankerman (2010) in the Appendix 4 online.

[4]In the sampling process we sorted cases according to their filing date and chose every tenth case.

set of 559 cases.

We observe the parties' actions taken over time as well as the case outcomes. A case can be settled out of court or terminated by different kinds of judgments. In our sample, 89 percent of the cases settle out of court. We divide the cases into NPE and non-NPE cases. A case is associated to the NPE group whenever the patentee is classified as one by Patent Freedom, which is presumably the most comprehensive database on NPEs.[5] Patent Freedom defines an NPE as:

> *(...) any entity that earns or plans to earn the majority of its revenue from the licensing or enforcement of its patents.*

This classification results in 69 NPE cases, approximately 12 percent of all cases. This fraction is a reasonable number for the time span between 2004 and 2007, even though the fraction of NPE cases increased in the following years. The main variables used in the analysis are described below.

Duration: Two potential measures for duration are available in our sample; duration measured in days and measured in the number of docket events. Docket events are records of the proceedings of a court case, i.e., each event gets its own docket entry. Both measures are highly correlated (correlation: 0.632). We expect the number of docket events to have less noise compared to a measure of time. While dockets are necessary for the resolution of a case, the time in days could be influenced by other factors such as the workload or work assignment of the judge (e.g., Coviello et al., 2010).

Patent value: The patent file of Lai et al. (2011) contains information on all patents assigned between 1975 and 2010, including their industry classifications and citations. The file itself uses data from the US Patent and Trademark Office and is our main source of information about the patents. We use the information from the file to calculate the number of citations received from other patents. This measure is the most commonly used indicator for the value of a patent (Trajtenberg, 1990).

Patent age: We calculate the average patent age in years at the beginning of the case. We use this variable to take the effect of a potentially decreasing patent value over time into account.

Patent technology field: We use the IPC (International Patent Classification) to categorize the patents to the five broad technology classes defined by Hall et al. (2001). The patents are separated into the sectors *Chemical*, *Computers and Communication*, *Drugs and Medical*, *Electrical and Electronic*, or *Mechanical*.

Design patent: Design patents protect a special type of intellectual property: the ornamental design. A specific technical knowledge, for example, in engineering or chemistry, is not necessary. The distinction between design and utility patents is the following: "In general terms, a utility patent protects the way an article is used and works, while a design patent protects the way an article looks" (US Patent and Trademark Office, *Manual of Patent Examining Procedure (MPEP)*, Chapter 1502.01). We create a

[5]For some cases we observe multiple plaintiffs. For these cases we check the complaints of the case and identify the patentee. In most cases the additional plaintiff is a licensee or a subsidiary of the patentee.

dummy variable equal to one in order to identify a design patent. One may argue that design patents are associated with a lower degree of asymmetric information. Therefore, it is important to control for this characteristic.

Complementarity: In order to control for the relative value of a patent within a technology class we calculate the complementarity measure proposed by Galasso and Schankerman (2010) for each patent. Their analysis shows that the importance of a patent relative to the other patents in the same technology class is of high importance for the duration of a case. Specifically, the measure is defined as

$$Complementarity_{\tau t} = \frac{C^{\tau}_{p_{\tau t}}}{\sum\limits_{\substack{b\in\tau \\ t-5\leq T\leq t+5}} C^{\tau}_{b_{\tau T}}} \times 1000.$$

The index $p_{\tau t}$ denotes a patent in technology class τ (the 36 two-digit categories as defined in Hall et al. (2001)) with application year t. In the numerator, $C^{\tau}_{p_{\tau t}}$ denotes the non-self citations that $p_{\tau t}$ has received up to the year 2008 from patents in technology class τ. The sum in the denominator denotes the non-self citations received by all patents in τ that have application dates in a five-year window in either direction from the application of the litigated patent.

Fragmentation: Galasso and Schankerman (2010) also show that the fragmentation of the ownership structure of patent rights within a technology area affect the case duration. In order to control for these effects we identify the set of cited patents with an application year within five years in either direction of the suit for each patent in technology class τ that is litigated at time T. We then compute the fraction of citations to patents belonging to class n, w_{nT}. For each class, we compute the share of patents accounted for by the top four patentees in the same ten-year window, $C4_{nT}$. The fragmentation measure is defined as the weighted average concentration index:[6]

$$Fragmentation_{\tau T} = 1 - \sum_{n} w_{jnT} C4_{nT}.$$

The latter two variables measure the value of the patents that is generated by portfolio effects because of complementarities with other patents (see, e.g., Gans and Stern, 2010).

Individuals: By investigating the case documents, we are able to distinguish individuals from firms. In some cases the patentee sues a firm together with specific employees. In these cases, we group the respective parties and treat them as firms.

Forbes firm: We use the Forbes Global 2000 list from 2007 to obtain a measure for the size of the infringer. We create a dummy variable that equals one whenever the infringers name is on the list. We use the global edition of the list because the parties are not only from the US; we also observe foreign firms or subsidiaries of foreign firms.

[6] The primary fragmentation measure of Galasso and Schankerman (2010) uses information from the infringers' portfolio to generate the weights. However, for 50 percent of the infringers, we do not observe any patent in the relevant time window (compared to 25 percent in Galasso and Schankerman (2010)). Therefore, we decide to compute their proposed alternative measure and use the citations of the patents as the weights instead.

Portfolio size: In order to take an infringer's technology intensity into account, we calculate the patent portfolio size of each infringer. We rely again on the information provided by Lai et al. (2011). We identify the set of the infringer's patents within a five-year window in either direction of the filing date of the case.

5. Results

5.1. Baseline results

Many patent litigation cases involve more than one defendant and patent. Therefore, we build averages of infringer and patent characteristics, e.g., the average patent value.[7] However, we group infringers whenever a subsidiary or an employee of the infringer are co-defendants. Table 2 shows the descriptive statistics of our sample. The table delivers the values for the overall sample as well as for the two different groups of cases.

Even though the table shows no differences with respect to the duration measures, the two subsamples differ significantly with respect to patent and infringer characteristics. NPEs sue more and larger infringers, tend to focus on technology intensive firms and never take an individual to court in our sample. Furthermore, more patents with a higher value are asserted to the case compared to the control group. NPEs use less frequently design patents. The patents are more often from the computer and communication industry, and less often from the drugs industry. Additionally, the patents differ not only in their absolute value but also in the relative value measures of complementarity and fragmentation. The NPEs' patents are of higher importance to their industry, and the ownership structure of the cited patents is more concentrated. The focusing of NPEs on valuable patents and large firms gives the impression that NPEs indeed assist the original innovators because small, financially restricted innovators would not be able to sue these large firms in order to secure the full value of the patent.

In the univariate analysis, we find no significant effect from the presence of the NPEs on the duration of a case. However, because the NPEs seem to select themselves in different kinds of cases, we need to control for their characteristics in a multivariate analysis. Following Galasso and Schankerman (2010), we adopt a proportional hazard model with an exponential specification. Table 3 presents the results of the estimation using the number of docket events as the duration measure. A negative coefficient decreases the hazard rate, makes an ending less likely, and therefore, increases the duration. Therefore, a negative coefficient is associated to a positive marginal effect, that we also deliver for all of of our specifications. In all specifications, we control for the number of infringers. It is important to control for this number because some specific kinds of docket events are listed for each party in a case, and more parties are therefore mechanically related to a higher number of docket events.

[7] We analyzed the complaints in detail. In all of our patent litigation cases, there exists neither a main patent, nor a lead infringer.

The first specification in Table 3 basically reflects the result from the univariate tests. However, once we add infringer characteristics to the specification, the coefficient of the NPE patentee dummy becomes negative and significant at the 10 percent level ($p = 0.074$). The second specification also shows that the number and the size of the participants increase the duration, while the fraction of individual infringers decreases the duration. The reasons for this observation could either be explained by a lower case value or a higher degree of risk aversion.[8]

The effect of NPEs becomes more pronounced when we additionally control for patent characteristics. The coefficient becomes highly significant. Furthermore, the marginal effect is also very high. Controlling for case characteristics, the NPE cases need 20 docket events less to be resolved. This is a decrease of approximately 25 percent on average. The estimated coefficients of the control variables are in line with the literature and show that the absolute and relative value of the patents increase the duration. We summarize our main finding as:

Result 1. *The case duration is shorter whenever the patentee is an NPE.*

This result is in line with our model's prediction. Therefore, the lower marginal effort costs of NPEs may be an important driver of the case duration. The expectation of a tough fight at the court makes an early settlement more likely. However, we have to be cautious to draw this conclusion from the empirical analysis because we are not able to rule out that the NPE dummy variable is related to other unobservable characteristics.

Connecting this result to the result of Chemin (2012) that faster resolved cases enhance economic activity shows a positive effect of NPEs once the litigation process started. Additionally, our result allows to draw conclusions for the licensing process in more general. Shapiro (2003) argues that all licensing negotiations take place in the shadow of possible litigation. A perception that is further backed by the fact that patent disputes often result in licensing agreements (Anand and Khanna, 2000). The positive effect of NPEs on the duration of patent disputes is therefore connected to a faster diffusion of technology because the technology can be used earlier by the licensee; making this (licensing) market for innovation more effective.

5.2. Robustness checks

There is a potential concern that some of the NPEs are overrepresented and that actually special characteristics of these firms, other than being an NPE, drive the results. However, we observe only two NPEs (Acacia and Catch Curve) more than three times in our sample. We perform additional estimations where we introduce dummy variables for these two NPEs. The results do not change (Table 4).

Further, we vary the duration measure. Instead of using the number of docket events, we use the duration in days. We believe that time is more heavily influenced by judge and court characteristics than

[8] Individuals are usually assumed to be more risk averse than firms. Everything else equal, infringers with a higher degree of risk-aversion are willing to pay a higher settlement amount and the case duration decreases.

the number of docket events. For example, the workload of a judge directly influences the available time to handle a case. Additionally, the familiarity of the judge with patent cases is likely to decrease the duration. In order to take these additional effects into account and to control for the additional noise in the dependent variable, we add two further control variables. We use case load information from the Federal District Courts which are available on their website.[9] We add the number of case filings per judge in the respective district as a proxy for the workload of the judges. Furthermore, we generate a measure for patent intensity of the district court to control for specialization effects. We define patent intensity as the ratio of the number of patent case filings per judge and the number of (overall) case filings per judge. In general, the results are robust to the variation of the duration measure. However, the statistical significance level of the coefficient on the NPE dummy is lower ($p = 0.051$). Table 5 shows the estimates of the hazard rate estimation with days as the duration measure. For an average case an NPE patentee decreases the duration in days by approximately 18 percent.

In addition to the hazard-rate estimation, we also use a standard OLS estimation with the natural logarithm of the number of docket events as the dependent variable. We are aware that estimating the duration with a simple OLS procedure is associated with several problems (e.g., normality assumption, censoring). However, we provide the results for completeness. Table 6 shows that the duration decreasing effect of the NPE exists also in the OLS specification when we control for the infringer and patent characteristics.

6. Conclusion

The main contribution of this study is to shed light on the behavior of NPEs and their influence on the duration of litigation. We show that NPEs sue larger and more technology intensive firms compared to a usual patentee. In these litigation cases they use more valuable patents from industry classes with a higher concentrated patent ownership. These are important results because they back the hypothesis that NPEs assist original innovators by creating a market for their patents. Small, financially restricted innovators are not able to exploit the full value of their patents because they are not able to cope with large firms. By selling the patent to an NPE the innovator is able to increase the payoff from the patent.

Our model assumes that the specialization in licensing and protecting patents gives NPEs a comparative advantage in court. Based on this assumption, the model predicts a shorter duration of NPE cases. This prediction is confirmed by our empirical analysis. We interpret this result in the way that NPEs make the resolving of cases faster leading to a positive effect for the economy. Transferring this result to licensing agreements in general indicates that NPEs have a positive effect on the licensing process. The speed of the diffusion of innovations into the economy increases and the market for innovation becomes more effective. This positive effect stands in contrast to the negative perception of NPEs, illustrated by

[9]http://www.uscourts.gov/Statistics/FederalCourtManagementStatistics.aspx

the label “patent troll”.

We show that the involvement of NPEs in patent litigation cases speed up the litigation process. However, a major limitation of our study lies in the fact that we are only able to analyze the effect of NPEs once they have filed a case. We ignore a potential negative effect due to NPEs; NPEs may increase the number of patent cases. Since we focus on patent cases and the effect of the involvement of NPEs, and not on the effect of NPEs on the absolute number of cases, we are not able to evaluate the overall influence of the emergence of NPEs. In this respect, more empirical research is required.

Acknowledgements

The paper benefited significantly from comments and suggestion by conference and seminar participants at various events. In particular, we thank Robert Cooter, Guido Friebel, Bronwyn Hall, Michael Kosfeld, Suzanne Scotchmer, and Uwe Walz for their comments.

Anand, B. N., Khanna, T., 2000. The structure of licensing contracts. The Journal of Industrial Economics 48 (1), 103–135.

Bebchuk, L., 1984. Litigation and settlement under imperfect information. The RAND Journal of Economics 15 (3), 404–415.

Bessen, J., Ford, J., Meurer, M., 2012. The private and social costs of patent trolls. Regulation 34 (4), 26–35.

Boyd, C. L., Hoffman, D. A., 2013. Litigating toward settlement. The Journal of Law, Economics, and Organization 29 (4), 898–929.

Chemin, M., 2012. Does court speed shape economic activity? evidence from a court reform in india. The Journal of Law, Economics, and Organization 28 (3), 460–485.

Chien, C., 2009. Of trolls, davids, goliaths, and kings: Narratives and evidence in the litigation of high-tech patents. North Carolina Law Review 87, 1571–1615.

Chien, C., 2013. Patent trolls by the numbers. Santa Clara Univ. Legal Studies Research Paper 08/13.

Choi, A., Sanchirico, C. W., 2004. Should plaintiffs win what defendants lose? litigation stakes, litigation effort, and the benefits of decoupling. The Journal of Legal Studies 33 (2), 323–354.

Cooter, R., Rubinfeld, D., 1989. Economic analysis of legal disputes and their resolution. The Journal of Economic Literature 27 (3), 1067–1097.

Coviello, D., Ichino, A., Persico, N., 2010. Dont spread yourself too thin: The impact of task juggling on workers speed of job completion, mimeo.

Economist, June 2013. Obama goes troll-hunting. The Economist, 58–59.

Fenn, P., Rickman, N., 1999. Delay and settlement in litigation. The Economic Journal 109 (457), 476–491.

Fischer, T., Henkel, J., 2012. Patent trolls on markets for technology–an empirical analysis of npes patent acquisitions. Research Policy 41 (9), 1519–1533.

Fournier, G. M., Zuehlke, T. W., 1996. The timing of out-of-court settlements. The RAND Journal of Economics 27 (2), 310–321.

Galasso, A., Schankerman, M., 2010. Patent thickets, courts, and the market for innovation. The RAND Journal of Economics 41 (3), 472–503.

Galasso, A., Schankerman, M., Serrano, C. J., 2013. Trading and enforcing patent rights. The RAND Journal of Economics 44 (2), 275–312.

Gans, J. S., Stern, S., 2010. Is there a market for ideas? Industrial and Corporate Change 19 (3), 805–837.

Hagiu, A., Yoffie, D. B., 2013. The new patent intermediaries: Platforms, defensive aggregators, and super-aggregators. The Journal of Economic Perspectives 27 (1), 45–65.

Hall, B. H., Jaffe, A. B., Trajtenberg, M., 2001. The nber patent citation data file: Lessons, insights and methodological tools. Tech. rep., National Bureau of Economic Research.

Lai, R., D'Amour, A., Yu, A., Sun, Y., Fleming, L., 2011. Disambiguation and co-authorship networks of the u.s. patent inventor database (1975 - 2010), http://hdl.handle.net/1902.1/15705.

Lanjouw, J., Schankerman, M., 2001. Characteristics of patent litigation: A window on competition. The RAND Journal of Economics 32 (1), 129–151.

Lanjouw, J., Schankerman, M., 2004. Protecting intellectual property rights: Are small firms handicapped? The Journal of Law and Economics 47 (1), 45–74.

Myhrvold, N., 2010. The big idea - funding eureka! Harvard Business Review 88 (3), 40–50.

P'ng, I., 1983. Strategic behavior in suit, settlement and trial. Bell Journal of Economics 15 (2), 539–549.

Priest, G., Klein, B., 1984. The selection of disputes for litigation. The Journal of Legal Studies 13 (1), 1–55.

Reitzig, M., Henkel, J., Heath, C., 2007. On sharks, trolls, and their patent prey unrealistic damage awards and firms strategies of being infringed. Research Policy 36 (1), 134–154.

Shapiro, C., 2003. Antitrust limits to patent settlements. The RAND Journal of Economics 34 (2), 391–411.

Shrestha, S. K., 2010. Trolls or market-makers? an empirical analysis of nonpracticing entities. Colum. L. Rev. 110, 114–160.

Somaya, D., 2003. Strategic determinants of decisions not to settle patent litigation. Strategic Management Journal 24 (1), 17–38.

Trajtenberg, M., 1990. A penny for your quotes: Patent citations and the value of innovations. The RAND Journal of Economics 21 (1), 172–187.

Variable	Population		Sample		t-statistic
	Obs	Mean	Obs	Mean	
terminated	7698	0.978 (0.145)	779	0.977 (0.150)	-0.282
duration in days	7532	457.631 (449.031)	761	443.276 (433.206)	-0.843
docket events	7532	81.551 (145.686)	761	75.700 (125.690)	-1.068
CACD	7698	0.100 (0.299)	779	0.099 (0.298)	-0.070
TXED	7698	0.071 (0.257)	779	0.071 (0.256)	-0.034
CAND	7698	0.064 (0.244)	779	0.069 (0.254)	0.630
DED	7698	0.049 (0.217)	779	0.056 (0.230)	0.869
NYSD	7698	0.048 (0.214)	779	0.054 (0.226)	0.741
ILND	7698	0.055 (0.227)	779	0.050 (0.218)	-0.543
NJD	7698	0.046 (0.209)	779	0.044 (0.204)	-0.249

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Standard errors in parentheses.

CACD: Central District of California, TXED: Eastern District of Texas, CAND: Northern district of California, DED: District of Delaware, NYSD: Southern District of New York, ILND: Northern District of Illinois, NJD: District of New Jersey.

Table 1: Comparison of population and sample

Variable	Overall		NPE		Non-NPE		t-statistic
	Obs	Mean	Obs	Mean	Obs	Mean	
terminated	559	0.973 (0.162)	69	0.957 (0.205)	490	0.976 (0.155)	0.913
judgment	559	0.113 (0.317)	69	0.072 (0.261)	490	0.118 (0.323)	1.128
duration in days	559	498.252 (500.380)	69	503.797 (531.219)	490	497.471 (496.451)	-0.098
docket events	559	78.721 (125.388)	69	97.667 (160.627)	490	76.053 (119.562)	-1.342
no of infringers	559	1.692 (2.307)	69	2.464 (3.051)	490	1.584 (2.164)	-2.988***
avg forbes	559	0.103 (0.285)	69	0.275 (0.416)	490	0.079 (0.252)	-5.462***
avg individual	559	0.030 (0.161)	69	0 (0)	490	0.034 (0.171)	1.671*
avg portfolio	559	336.013 (1836.124)	69	1071.838 (2697.925)	490	232.397 (1657.626)	-3.593***
no of patents	559	2.007 (2.089)	69	2.696 (2.586)	490	1.910 (1.994)	-2.944***
avg value	559	33.128 (44.848)	69	55.438 (54.954)	490	29.986 (42.369)	-4.489***
avg patent age	559	5.830 (4.672)	69	6.771 (4.836)	490	5.698 (4.638)	-1.791*
percent design	559	0.094 (0.276)	69	0.014 (0.120)	490	0.105 (0.290)	2.563**
percent chemicals	559	0.066 (0.238)	69	0.032 (0.170)	490	0.070 (0.246)	1.255
percent computer	559	0.202 (0.392)	69	0.581 (0.476)	490	0.148 (0.347)	-9.203***
percent electronics	559	0.104 (0.289)	69	0.062 (0.226)	490	0.109 (0.297)	1.287
percent drugs	559	0.131 (0.333)	69	0.043 (0.205)	490	0.143 (0.346)	2.339**
percent mechanical	559	0.158 (0.351)	69	0.106 (0.300)	490	0.165 (0.357)	1.315
avg complementarity	559	0.042 (0.071)	69	0.055 (0.110)	490	0.040 (0.063)	-1.717*
avg fragmentation	559	0.847 (0.091)	69	0.798 (0.077)	490	0.854 (0.090)	4.954***

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Standard deviations in parentheses.

Table 2: Descriptive statistics

Variable	(1) Coeff.	(1) Marg. Effect	(2) Coeff.	(2) Marg. Effect	(3) Coeff.	(3) Marg. Effect
NPE patentee	0.177 (0.140)	-8.720	0.255* (0.143)	-12.089	0.485*** (0.154)	-19.465
avg forbes			-0.324* (0.170)	16.847	-0.358** (0.173)	17.103
avg individual			0.886*** (0.274)	-46.029	0.804*** (0.284)	-38.368
avg portfolio x 10^4			0.164 (0.255)	-8.498	0.290 (0.270)	-13.858
no of patents					-0.110*** (0.029)	5.230
avg value x 10^2					-0.504*** (0.127)	24.066
avg patent age					0.027*** (0.010)	-1.266
percent design					0.741*** (0.208)	-35.333
avg complementarity					-1.812*** (0.650)	85.451
avg fragmentation					-1.271** (0.615)	60.635
no of infringers	-0.186*** (0.030)	9.781	-0.188*** (0.030)	9.785	-0.168*** (0.030)	8.035
intercept	-3.878*** (0.155)		-3.931*** (0.157)		-2.450*** (0.554)	
technology field controls	no		no		yes	
year dummies	yes		yes		yes	
observations	559		559		559	

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Standard errors in parentheses.

Year dummies are dummy variables for the year of the case filing.

Table 3: Hazard rate estimation (docket events)

Variable	(1) Coeff.	(1) Marg. Effect	(2) Coeff.	(2) Marg. Effect	(3) Coeff.	(3) Marg. Effect
NPE patentee	0.226 (0.152)	-10.869	0.322** (0.157)	-14.828	0.489*** (0.152)	-19.538
avg forbes			-0.330* (0.172)	17.077	-0.336* (0.174)	15.955
avg individual			0.887*** (0.274)	-45.946	0.787*** (0.284)	-37.430
avg portfolio x 10^4			0.143 (0.257)	-7.414	0.307 (0.270)	-14.597
no of patents					-0.119*** (0.030)	5.679
avg value x 10^2					-0.482*** (0.131)	22.912
avg patent age					0.026*** (0.010)	-1.225
percent design					0.731*** (0.208)	-34.761
avg complementarity					-1.855*** (0.669)	88.186
avg fragmentation					-1.244** (0.618)	59.127
no of infringers	-0.191*** (0.031)	10.001	-0.194*** (0.031)	10.078	-0.168*** (0.031)	7.986
intercept	-3.875*** (0.155)		-3.928*** (0.157)		-2.444*** (0.557)	
technology field controls	no		no		yes	
year dummies	yes		yes		yes	
most frequent NPE dummies	yes		yes		yes	
observations	559		559		559	

Significance levels: $*: 10\%$ $**: 5\%$ $***: 1\%$

Standard errors in parentheses.

Year dummies are dummy variables for the year of the case filing.

Table 4: Hazard rate estimation (docket events)

Variable	(1) Coeff.	(1) Marg. Effect	(2) Coeff.	(2) Marg. Effect	(3) Coeff.	(3) Marg. Effect
NPE patentee	0.139 (0.136)	-46.172	0.165 (0.141)	-54.000	0.302* (0.155)	-91.600
avg forbes			-0.184 (0.166)	64.027	-0.187 (0.168)	63.400
avg individual			0.465* (0.270)	-162.076	0.626** (0.277)	-212.129
avg portfolio x 10^4			0.216 (0.271)	-75.136	0.267 (0.276)	-90.465
no of patents					-0.046* (0.026)	15.501
avg value x 10^2					-0.151 (0.117)	51.041
avg patent age					0.001 (0.010)	-0.378
percent design					0.437** (0.206)	-148.175
avg complementarity					-1.058* (0.609)	358.605
avg fragmentation					-0.398 (0.615)	134.928
no of infringers	-0.066*** (0.023)	23.052	-0.068*** (0.023)	23.597	-0.055** (0.024)	18.536
per judge filings x 10^5	-6.990 (24.544)	2442.672	-3.683 (24.783)	1283.007	-16.706 (24.752)	5661.063
patent intensity	-4.163** (1.749)	1454.682	-3.810** (1.771)	1327.317	-2.622 (1.815)	888.538
intercept	-6.118*** (0.196)		-6.019*** (0.201)		-5.432*** (0.556)	
sector controls	no		no		yes	
year dummies	yes		yes		yes	
observations	559		559		559	

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Standard errors in parentheses.

Year dummies are dummy variables for the year of the case filing.

Table 5: Hazard rate estimation (time in days)

Variable	(1) ln docket events	(2) ln docket events	(3) ln docket events
NPE patentee	-0.091	-0.218	-0.419**
	(0.173)	(0.177)	(0.180)
avg forbes		0.528***	0.540***
		(0.189)	(0.172)
avg individual		-0.533*	-0.638**
		(0.284)	(0.282)
avg portfolio x 10^4		0.052	-0.025
		(0.233)	(0.213)
no of patents			0.078***
			(0.025)
avg value x 10^2			0.364***
			(0.134)
avg patent age			-0.011
			(0.012)
percent design			-0.734***
			(0.236)
avg complementarity			1.860**
			(0.815)
avg fragmentation			0.749
			(0.711)
no of infringers	0.145***	0.150***	0.130***
	(0.031)	(0.028)	(0.028)
intercept	3.057***	3.035***	2.187***
	(0.179)	(0.182)	(0.628)
sector controls	no	no	yes
year dummies	yes	yes	yes
observations	544	544	544
R^2	0.008	0.083	0.171

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Standard errors in parentheses.

Year dummies are dummy variables for the year of the case filing.

Table 6: OLS estimation