9-11-2019

Patent Litigation: Theory

Bernhard Ganglmair
ZEW – Leibniz Centre for European Economic Research

Christian Helmers
Santa Clara University

Brian Love
Santa Clara University School of Law, blove@scu.edu

Patent Litigation: Theory

Bernhard Ganglmair   Christian Helmers   Brian J. Love

11 September 2019

Roadmap

(1) Simple theory of litigation and settlement under symmetric information

- *Divisibility of costs*

(2) Why is there litigation in equilibrium?

(2) Asymmetric information theory
(2) Divergent expectations theory ("Klein-Priest hypothesis")

- *Case selection*

(3) What's so special about patent litigation?

- *Externalities*

Basic Framework – Notation

- One plaintiff sues one defendant over compensation (e.g., accident, patent infringement,. . .)
- Plaintiff's gross return from litigation is x
  - expected judgment (probability of winning times reward)
  - or settlement that takes place prior to trial
  - could also reflect impact on future cases; reputation; externalities
- Litigation costs c_P for plaintiff and c_D for defendant
  - attorney fees
  - effort, time, other opportunity costs
  - for simplicity: constant, but may be incurred over time

Bringing a Suit

- Plaintiff will choose to purse litigation if case has positive expected return

$$x > c_P$$

- No litigation with negative expected return

$$x < c_P$$

- We will reconsider a little later.
- For remainder (and for simplicity): each litigant bears their own costs, regardless of the outcome of trial (*American Rule*).

Private Litigation Spending

- Suppose expected recovery from litigation depends on the litigants' spending:

$$x = x(c_P, c_D)$$

  - Increasing in c_P
  - Decreasing in c_D
- Plaintiff's expected litigation returns are

$$\pi_P = x(c_P, c_D) - c_P$$

- Defendant's expected litigation returns are

$$\pi_D = -x(c_P, c_D) - c_D$$

- Equilibrium depends on a number of factors
  - *Contest function* x
  - Sequence of decisions
  - Observability of decisions

Private Litigation Spending – Example

- Tullock contest function:

$$x(c_P, c_D) = \frac{c_P}{c_D + c_P}$$

- Simultaneous litigation spending decisions:

$$c_P^* = c_D^* = \frac{1}{4} \qquad \pi_P^* = \frac{1}{4} \qquad \pi_D^* = -\frac{3}{4}$$

- For remainder: assume litigtion spending is exogenous

Out-of-Court Settlement

- If case goes to trial, plaintiff's and defendant's expected net payoffs are

$$\pi_P = x - c_P \qquad \pi_D = -x - c_D$$

- Total litigation cost $c_P + c_D$ is "money down the drain" $\longrightarrow$ bargaining surplus
- Binding settlement contract with transfer

$$S \in (x - c_P, x + c_D)$$

  leaves both litigants better off
- Some questions to answer:
  - For what amount will the case settle?
  - Will defendant agree to settle negative-expected-value suits?
  - When will the case settle? Shortly after filing or on the courthouse steps?
  - Why do some cases fail to settle?

Settlement with Symmetric Information

- Assume same beliefs about what will happen if the case goes to trial – symmetric information about stakes, costs, and all other relevant parameters

- Start with positive expected value suits: $x > c_P$

- Assumptions about the timing of litigation costs:
  - *lump-sum litigation costs*: all costs incurred at trial
  - *divisible litigation costs*: costs are incurred over time (both in pretrial negotiations and at trial)

Lump-Sum Litigation Costs: Plaintiff Makes Last Offer

- Trial in round T. Common discount factor δ. *Plaintiff makes last offer.*
- Solve by backward induction
- In $T-1$ (plaintiff's offer), defendant accepts any offer that is better than going to trial. Then:

$$S_{T-1} = \delta\left(x + c_D\right)$$

- In $T-2$ (defendant's offer), plaintiff accepts anything at or above δS_{T-1}. Then:

$$S_{T-2} = \delta^2\left(x + c_D\right)$$

- ...
- Case settles in the first round for

$$S_1 = \delta^{T-1}\left(x + c_D\right)$$

Lump-Sum Litigation Costs: *Defendant* Makes Last Offer

- Trial in round T. Common discount factor δ. **Defendant** makes last offer.
- Solve by backward induction
- In $T-1$ (defendant's offer), plaintff accepts any offer that is better than going to trial. Then:

$$S_{T-1} = \delta\left(x - c_P\right)$$

- In $T-2$ (plaintiff's offer), defendant accepts anything at or below δS_{T-1}. Then:

$$S_{T-2} = \delta^2\left(x - c_P\right)$$

- ...
- Case settles in the first round for

$$S_1 = \delta^{T-1}\left(x - c_P\right)$$

The party who makes the last offer succeeds in extracting all of the bargaining surplus

Lump-Sum Litigation Costs: *Defendant* Makes Last Offer

- Trial in round T. Common discount factor δ. **Defendant** makes last offer.
- Solve by backward induction
- In $T-1$ (defendant's offer), plaintff accepts any offer that is better than going to trial. Then:

$$S_{T-1} = \delta\left(x - c_P\right)$$

- In $T-2$ (plaintiff's offer), defendant accepts anything at or below δS_{T-1}. Then:

$$S_{T-2} = \delta^2\left(x - c_P\right)$$

- ...
- Case settles in the first round for

$$S_1 = \delta^{T-1}\left(x - c_P\right)$$

The party who makes the last offer succeeds in extracting all of the bargaining surplus

Lump-Sum Litigation Costs: Random Offer

- Suppose in each round, the litigants flip a coin to determine who makes the offer.
- In $T-1$, parties would settle on average for

$$S_{T-1} = \delta \left[x - \frac{c_P}{2} + \frac{c_D}{2} \right]$$

- ...
- Case settles in the first round for

$$S_1 = \delta^{T-1} \left[x - \frac{c_P}{2} + \frac{c_D}{2} \right]$$

  regardless of who makes the offer

- Note: if $c_P = c_D$, settlement amount equal to discounted expected judgment at trial

Divisible Litigation Costs

- Suppose litigation costs are equally divided among T rounds (and $\delta = 1$)
- When standing on the courthouse steps, plaintiff has credible threat to take case to trial if
$$x > \frac{c_P}{T}$$
- Coin flip: case settles on average for
$$S_{T-1} = x - \frac{c_P}{2T} + \frac{c_D}{2T}$$
- ...
- Case settles in the first round for
$$S_1 = x - \frac{c_P}{2} + \frac{c_D}{2}$$

Divisible Litigation Costs

- Same as for lump-sum costs?
- With lump-sum litigation costs, both litigants are indifferent between settling early and settling late. No inefficiency associated with delay. We find multiple equilibria *(any time is possible)*.
- With divisible litigation costs, there is unique (subgame perfect) equilibrium where the case settles in round 1 (Bebchuk 1996).
- With divisible litigation costs there is a cost of delay and strong economic incentives to settle early.
- Divisible litigation costs: plaintiff may be able to extract a settlement for negative-expected value claims, when $x < c_P$ (as long as $x > \frac{c_P}{T}$)

Shouldn't we always see settlement in equilibrium? (Coase Theorem?) Why do we see breakdown of settlement?

Divisible Litigation Costs

- Same as for lump-sum costs?
- With lump-sum litigation costs, both litigants are indifferent between settling early and settling late. No inefficiency associated with delay. We find multiple equilibria *(any time is possible)*.
- With divisible litigation costs, there is unique (subgame perfect) equilibrium where the case settles in round 1 (Bebchuk 1996).
- With divisible litigation costs there is a cost of delay and strong economic incentives to settle early.
- Divisible litigation costs: plaintiff may be able to extract a settlement for negative-expected value claims, when $x < c_P$ (as long as $x > \frac{c_P}{T}$)

Shouldn't we always see settlement in equilibrium? (Coase Theorem?) Why do we see breakdown of settlement?

Why is there litigation in equilibrium?

Asymmetric Information

- Private information:
  - Plaintiff may have first-hand knowledge of level of damages
  - Defendant may have first-hand knowledge of involvement in (or liability for) the accident
  - Both litigants know better the credibility of their own witnesses
- Defendant has private information about $x \sim [\underline{x}, \overline{x}]$
- Technical assumption: assume monotone hazard rate, so

$$\frac{1 - F(x)}{f(x)}$$

is everywhere decreasing

Screening Models

- *Uninformed party (plaintiff)* makes a take-it-or-leave-it offer S before costly trial (in $T-1$)
- "Screens" defendants into two groups:
  - those who accept when $S < \delta\,(x + c_D)$
  - those who reject when $S > \delta\,(x + c_D)$
- Cutoff defendant type:

$$\hat{x} = \frac{S}{\delta} - c_D$$

- $x > \hat{x}$ accept and $x < \hat{x}$ go to trial.
- Selection: **Cases that go to trial have on average lower judgments than those that settle out of court.**
- Note: this pattern is reversed if plaintiff has private information and defendant makes TIOLI offer.

Equilibrium Settlement Offer

- Plaintiff chooses $\hat{x}$ (each settlement offer corresponds to cutoff value) to solve:

$$\max_{\hat{x}} \underbrace{\int_{\underline{x}}^{\hat{x}} \delta\left(x - c_P\right) f(x) dx}_{\text{trial}} + \underbrace{\left[1 - F(\hat{x})\right] \delta\left(\hat{x} + c_D\right)}_{\text{settlement } S = \delta\left(\hat{x} + c_D\right)}$$

- (Unique) interim solution characterized by FOC

$$1 - F(\hat{x}) - \left(c_P + c_D\right) f(\hat{x}) = 0$$

- Interior solution exists (and some but not all cases go to trial in equilibrium) if litigation costs are not too high:

$$c_P + c_D < \frac{1 - F(x)}{f(x)}$$

- Solution $\hat{x}$ such that inequality. Changes in litigation costs affect settlement and win rates.

Some Additional Results (Spier 1992)

Consider a sequence of settlement offers:

- Lump-sum litigation costs:
    - plaintiff waits until very last moment to offer $S_{T-1} = \delta\left(\hat{x} + c_D\right)$
    - all settlement occurs on courthouse steps
    - finitely-repeated screening model where all costs are borne at trial is equivalent to simple model of TIOLI offer
- Divisible litigation costs
    - Optimal strategy involves some settlement in each round
    - More settlement in the first rounds than in the middle ("Approximate Settlement Distribution" in Lecture 1)
    - If final costs (at trial) are disproportionately large, then pronounced deadline effect (that gives rise to U-shaped pattern of settlement overall)

Signaling Models

- Informed party (defendant) makes a take-it-or-leave-it offer in $T-1$.
- This offer potentially signals her private information, and uninformed plaintiff forms Bayesian inferences when deciding how to respond
- Reinganum and Wilde (1986) provide an elegant fully-separating equilibrium:
  - defendant's offer perfectly reveals her type x
  - plaintiff mixes (randomizes) between accepting and rejecting the offer
- Defendant's equilibrium offer:

$$S(x) = \delta\left(x - c_P\right)$$

- Plaintiff with exactly same payoffs as at trial ($\rightarrow$ indifferent between accepting and rejecting)
- Probability of accepting is increasing in defendant's expected liability x – **higher liability, more settlement**

Selection of Cases

- *Defendant* with private information about x
  - cases that settle have higher expected liability x than cases that go to trial
  - cases that go to trial have lower win rate than the implied win rate for settled cases
- *Plaintiff* with private information about x
  - **Patterns are reversed**
- *Most extreme cases are litigated* (low liability with defendant's private info; high liability with plaintiff's private info)
- **Anything is possible** (Shavell 1996). There is no selection or win rate that is not feasible under any circumstances.
- FOC (screening model): $\hat{x}$ such that

$$c_P + c_D = \frac{1 - F(\hat{x})}{f(\hat{x})}$$

- Theory helps. *Example: different contest functions give rise to different litigation costs.*

Selection of Cases

- *Defendant* with private information about x
  - cases that settle have higher expected liability x than cases that go to trial
  - cases that go to trial have lower win rate than the implied win rate for settled cases
- *Plaintiff* with private information about x
  - **Patterns are reversed**
- *Most extreme cases are litigated* (low liability with defendant's private info; high liability with plaintiff's private info)
- **Anything is possible** (Shavell 1996). There is no selection or win rate that is not feasible under any circumstances.
- FOC (screening model): $\hat{x}$ such that

$$c_P + c_D = \frac{1 - F(\hat{x})}{f(\hat{x})}$$

- Theory helps. *Example: different contest functions give rise to different litigation costs.*

Selection of Cases

- *Defendant* with private information about x
  - cases that settle have higher expected liability x than cases that go to trial
  - cases that go to trial have lower win rate than the implied win rate for settled cases
- *Plaintiff* with private information about x
  - **Patterns are reversed**
- *Most extreme cases are litigated* (low liability with defendant's private info; high liability with plaintiff's private info)
- **Anything is possible** (Shavell 1996). There is no selection or win rate that is not feasible under any circumstances.
- FOC (screening model): $\hat{x}$ such that

$$c_P + c_D = \frac{1 - F(\hat{x})}{f(\hat{x})}$$

- Theory helps. *Example: different contest functions give rise to different litigation costs.*

Mechanism Design

- More general approach, encompassing both signaling and screening models

- Some cases will *necessarily* go to trial when litigation costs are not too high

- An "optimal" mechanism (mechanism that achieves the Pareto frontier):
  - selection effects from screening/signaling models hold
  - more liable defendants (higher x) are more likely to settle

Divergent Expectations

- Before information economics, non-Bayesian approach to the question of settlement break down
- The approach here: litigants may have different prior expectations about the outcome at trial.
  - plaintiff believes expected judgment is x_P
  - Defendant believes expected judgment is x_D
- Bargaining zone:

$$[x_P - c_P, x_D + c_D]$$

- Settlement fails when plaintiff is much more optimistic than defendant:

$$x_P - x_D > c_P + c_D$$

- Self-serving bias?

Priest-Klein Hypothesis

- Special case of divergent expectations theory
- Model in which there is a tendency for plaintiffs to prevail at trial with win rate of 50%
- This is the result of a selection effect:
  - Cases clearly in favor of plaintiff or defendant are settled
  - Only unclear or close cases (close to 50%) go to trial
- *Litigated cases are unrepresentative of all potential cases.*
- Two key assumptions needed:
  - Litigants obtain fairly accurate information about trial outcomes (high/low chance of winning for plaintiff)
  - Information they receive is statistically identical (*divergent expectations* through a noisy signal of the merits of the case x)

Criticism

- Shavell (1996) uses model with one-sided asymmetric information to show that anything is possible (here: *more* theory/assumptions may help)
- Gelbach (2018) takes this to the extreme with his *reduced-form approach*
  - generalized form of Priest and Klein is sufficiently flexible to present any litigation model
  - Shavell (1996) itself can be represented as a generalized Priest-Klein model
  - Shavell (1996): Priest-Klein driven by accuracy and symmetry. Gelbach: any win rate (also $\neq 50\%$) can be observed even with symmetric beliefs
  - For any settlement rate and any win rate, there exists a reduced form with a litigation rule that would generate those data $\rightarrow$ available data are insufficient to draw clear conclusions about what behavior generates the data
- For theorists: great, insights without specifics of litigation behavior
- For empiricists: forming testable hypotheses requires more substantive assumption (the model is too flexible)

Criticism

- Shavell (1996) uses model with one-sided asymmetric information to show that anything is possible (here: *more* theory/assumptions may help)
- Gelbach (2018) takes this to the extreme with his *reduced-form approach*
  - generalized form of Priest and Klein is sufficiently flexible to present any litigation model
  - Shavell (1996) itself can be represented as a generalized Priest-Klein model
  - Shavell (1996): Priest-Klein driven by accuracy and symmetry. Gelbach: any win rate (also $\neq 50\%$) can be observed even with symmetric beliefs
  - For any settlement rate and any win rate, there exists a reduced form with a litigation rule that would generate those data $\rightarrow$ available data are insufficient to draw clear conclusions about what behavior generates the data
- For theorists: great, insights without specifics of litigation behavior
- For empiricists: forming testable hypotheses requires more substantive assumption (the model is too flexible)

What is so special about patents?

What is Special About Patent Litigation?

- Lecture 1: Many institutional features that add to the complexity of litigation when patents are involved

- The possibility that a patent may be invalidated if a case is litigated:
  - drives a wedge between one party's settlement offer and the other party's willingness to accept the offer, and
  - gives rise to externalities

- Both can result in negotiation breakdown (and litigation) even when information is symmetric and beliefs are aligned.

“The Settlement of Patent Litigation” (Meurer 1989)

- Patentee (with possibly invalid patent) offers one potential rival a patent licensing contract to settle potential litigation
- Symmetric information: plaintiff does not have superior information about validity of the patent
- Litigation here: declaratory judgment of invalidity *(no infringement: circumvents question of bifurcation – Lecture 1)*
- Competitor can
  - accept the offer
  - litigate (with probability α the patent is invalid)
  - do nothing
- In equilibrium: some litigation even under symmetric information
- The value of the subject of litigation (the patent) depends on outcome of litigation and on whether settlement occurs (as opposed to, e.g., land and and the question of ownership)

Patent Litigation with Multiple Rivals

- Meurer (1989) assumes one potential rival
- Choi (1998) considers model with multiple potential entrants
- Patent holder must consider the effect of decision (settle or litigate) on future entrants.
  - Patent invalid: floodgates are open and industry profits dissipate (so: settle)
  - Patent found valid: patentee will enjoy greater protection (so: litigate)
- Equilibrium decisions. U-shaped litigation pattern
  - Litigate for high and low values of α
  - Do not bring a suit for intermediate values of α

Externalities

- In Meurer (1989), externality stems from effect of litigation and thus on value of outside option for settlement negotiations
- In Choi (1998), intertemporal externality affecting likelihood of future entry
- Related: antitrust concerns when settlement means that a weak patent (with high α) is not invalidated and a monopoly prevails *(litigants collude)*

Literature

- Bebchuk, L. (1996): "A New Theory Concerning the Credibility and Success of Threats to Sue." *Journal of Legal Studies* 25, 1–25.
- Choi, J. (1998): "Patent Litigation as an Information-Transmission Mechanism." *American Economic Review* 88, 1249–1263.
- Gelbach, J. (2018): "The Reduced Form of Litigation Models and the Plaintiff's Win Rate." *Journal of Law and Economics* 61, 125–157.
- Meurer, M. (1989): "The Settlement of Patent Litigation." *RAND Journal of Economics* 20, 77–91.
- Priest, G. and B. Klein (1984): "The Selection of Disputes for Litigation." *Journal of Legal Studies* 13, 1–55.
- Shavell, S. (1996): "Any Probability of Plaintiff Victory at Trial is Possible." *Journal of Legal Studies* 24, 379–426.
- Spier, K. (1992): "The Dynamics of Pretrial Negotiations." *Review of Economic Studies* 59, 93–108.
- Spier, K. (2007): "Litigation." In: Polinsky, A.M and S. Shavell (eds): Handbook of Law and Economics. Amsterdam: North-Holland.