# Screening for Patent Quality: An Economic Framework for Policy Analysis

Mark Schankerman (London School of Economics)

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[Based on Schankerman and Schuett, "Screening for Patent Quality: Examination, Fees and the Courts", CEPR Paper 11688, 2017]

# Motivation

The West's intellectual-property system. . . is a mess, because it grants too many patents of dubious merit.

The Economist, 12 Jan 2013

- Much recent debate about proliferation of low-quality patents
- Poster child illustrates themes: Amazon's "one click shopping" patent
  - Widely licensed and highly profitable
  - Most believe it would not be upheld by courts
  - But licensing disputes were settled, patent never challenged in court
- How to improve screening? Key instruments:
  - Patent examination
  - Fees: pre-grant (application) and post-grant (issuance, renewal)
  - Court review in case of validity challenge

# Policy-driven research questions

- How serious is the patent-quality problem?
- Patent offices spend a lot on examination/search. Should examination be intensified? Or should we move to a registration system?
- Should we change the structure of fees (frontload or backload)?
- Current USPTO fees:
  - Patent application with $\leq$ 3 claims $\rightarrow$ \$1,740 in pre-grant fees
  - If patent renewed to full term $\rightarrow$ \$13,560 in post-grant fees

# Some preliminary considerations

- Use grant rates to assess application quality?
  Answer: They reflect application quality and patent office effectiveness. Need a model to allow us to distinguish.
- Use patentee win rates in court challenges to assess grant quality?
  Answer: Selection into litigation. Again we need to model selection.
- Why worry about examination? Few patents are litigated so examining all carefully is wasteful ("rational ignorance"); rely more on courts.
  Answer: Low quality patents impose social costs (even if not litigated): they raise prices and R&D transaction costs.

# This paper

- We develop a model of patent screening in which the inventor has private information about validity
- A competitor updates beliefs about inventor's type based on observed decisions (grant, payment of fees, license contract)
- Patent office and courts receive an informative signal about validity:
  - Patent office: all applications screened, but imperfect signal
  - Courts: perfect signal, but requires challenge by competitor
- This setup allows us to analyze all key instruments together ($\rightarrow$ interaction) in a framework with endogenous challenges
- We parameterize a simulated version of the model to match key features of US patent and litigation data, and use it to conduct policy experiments

# Preview of results

- Theory:
  - Frontloading fees improves screening and welfare
  - In the absence of patent examination, we cannot deter invalid applications without also deterring valid ones
  - Decision to challenge is inefficient: challenger's incentives not aligned with society's
- Simulations:
  - 75% or more of applications are made on inventions that would be developed even without patent incentive.
  - Patent office screens out 30%, implying 65-80% of granted patents invalid.
  - Frontloading, and using additional fee revenue to increase examination intensity, increases welfare.

# Outline

1. Model
   - No courts
   - Court challenges
   - Welfare
2. Simulations
   - Perfect Courts
   - Imperfect Courts

# Basic setup

- Inventor endowed with privately observed idea $\theta \in \{L, H\}$:
  - $\theta = H$: high R&D cost $\kappa_H$ (probability $\lambda$)
  - $\theta = L$: low R&D cost $\kappa_L$ (probability $1 - \lambda$)
- R&D investment $\kappa_\theta$ is required to develop idea into invention
- Each inventor $(I)$ has a single competitor $(C)$
- Once developed, invention can be freely copied unless patented (no imitation cost or secrecy)

# Profits and consumer surplus

| | Inventor | Welfare |
|---|---|---|
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- $\pi$: competitive profit, $\Delta$: patent premium, $S$: consumer surplus, $D$: deadweight loss

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- Classic tradeoff: patents increase inventor's profit but cause deadweight loss
- Assume
  - Low types would develop without patents, not high types: $\kappa_H = k > \pi \geq \kappa_L = 0$
  - High types would develop with patent protection: $\pi + \Delta \geq k$
  - Social returns exceed private returns: $2\pi + S - D \geq \pi + \Delta$

# Patentability

- We assume that only inventions of type $H$ are patentable
- In line with rationale given by courts and legal scholars for nonobviousness requirement in patent law: ▸ Quotes

"The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent."

SCOTUS in Graham v. John Deere, 383 U.S. 1 (1965)

- Social planner wants to give patents only to type $H$ ($\kappa_H > \pi$)
- Problem: type-$L$ inventors also benefit from patent. Patent office and courts must enforce patentability requirement

# Obtaining patents

- Inventor observes $\theta$ and decides whether to invest $\kappa_\theta$
- To apply for a patent, inventor must pay a pre-grant fee $\phi_A \geq 0$
- The patent office examines the application for patentability:
  - Valid types ($\theta = H$) always pass the examination
  - Invalid types ($\theta = L$) pass with probability $1 - e$ and are rejected with probability $e$
  - $e \in [0, 1]$ is the patent office's examination intensity
- If granted a patent, the inventor must pay a post-grant fee $\phi_P \geq 0$ for the patent to become effective (activation)

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# Inventor behavior in the absence of courts

- Suppose there were no courts $\rightarrow$ challenges not possible
- Type $H$:
  - Invests, applies, and activates iff

$$\Delta - (k - \pi) - \phi_P - \phi_A \geq 0 \quad \text{(H)}$$

- Type $L$:
  - Always invests because $\kappa_L = 0 < \pi$
  - Applies for patent and activates iff

$$(1 - e)(\Delta - \phi_P) - \phi_A \geq 0 \quad \text{(L)}$$

# Two key observations

1. Application fees screen better than activation fees.
   - Keeping the sum of the fees constant, type $H$ is indifferent over all mixtures of fees
   - Type $L$ prefers $\phi_P$, which is only paid conditional on passing examination
2. If $e = 0$ or $\phi_A = 0$, we cannot deter type $L$ without also deterring type $H$.
   - Patent is worth the same to both types ($\Delta$)
   - Type $H$ needs to cover additional $k - \pi$
   - Achieving full screening requires

$$(1 - e)\Delta \leq \Delta - (k - \pi),$$

This implies we need some degree of examination and some level of pre-grant fees (instruments are complements, in this sense).

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# Licensing and challenge

- We introduce courts and endogenize $\Delta$ through a model of licensing
- If the inventor holds a patent, he can make a take-it-or-leave-it offer to the competitor to license the invention at fee $F$
- If the competitor rejects the offer, she decides whether to challenge the patent in court at costs $l_C$ and $l_I$
- Courts are mistake-free in determining validity (in baseline model): Uphold $H$ patents, revoke $L$ patents
- If the patent is upheld, the inventor offers a new contract with $F = \Delta_C$

# Adding courts

- One might expect court challenges to change the picture. Type $L$ patents have lower expected payoff than type $H$, so could ex post fees screen out low types?
- This argument does not work
  - Suppose only high types activate. Then activation signals validity $\rightarrow$ competitor does not challenge
  - But then low type would want to activate!
- The equilibrium must involve mixed strategies for low type $\rightarrow$ semi-separating:
  - type $H$ charges $F^H = \Delta_C$
  - type $L$ randomizes over either application decision or license fees (focus on latter):

$$F^L = \begin{cases} \Delta_C & \text{with probability } y \\ l_C & \text{with probability } 1 - y \end{cases}$$

  - Competitor challenges with prob. $x$ if offered $F = \Delta_C$

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# The optimal structure of fees

Welfare maximization when full screening is impossible:

## Proposition

*If there are socially excessive challenges, then welfare is maximized by setting $\phi_P = 0$ and $\phi_A$ such that $\Pi^H = 0$, thus minimizing challenges after $F = \Delta_C$.*

- Optimal fees are (a) frontloaded and (b) as high as possible subject to investment by type $H$
- Intuition: raising and frontloading fees...
  - decreases the rate of bad applications
  - decreases challenges for a given application rate of low types
- $L$-type sometimes preempts challenges by charging $F = l_C$. Fees cannot address this problem of too few challenges.

# Are private incentives to challenge excessive or insufficient?

- Challenge socially desirable if and only if

$$(1-\hat{\lambda})D \geq l_I + l_C$$

- Countervailing inefficiencies with private challenge decision:

1. When $F = l_C$, inventor revealed as invalid, but no challenge though socially desirable ($\hat{\lambda} = 0$ and $D > l_C + l_I$).
2. When $F = \Delta_C$, for $\Delta_C > (l_C/(l_C + l_I))D$, challenges occur although undesirable
   Private gains from challenge exceed social gains (remove deadweight loss).
   Holds in linear demand Cournot model
3. Competitor does not take into account inventor's litigation cost
4. Free-riding is a countervailing effect, not in the model.

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# Parameterizing the model

- Use homogeneous-goods Cournot model, linear demand $P(Q) = a - Q$ and unit cost $c$, where invention reduces cost by $s\%$
- Assume $l_C = l_I = l$
- Using equilibrium relationships in the model, the patentee win rate and litigation rate uniquely pin down $\lambda$ and $e$:

$$\lambda = \frac{LR \cdot GR(9 - 4WR)}{5}$$
$$e = \frac{5(1 - GR)}{5 - LR \cdot GR(9 - 4WR)}$$

- With additional information (demand elasticity, R&D per patent) we can compute other parameters.

# Perfect Courts

## Baseline Simulation Results: Perfect Courts

| $\lambda$ | $e$ | $l\ (10^6)$ | $y$ | $x$ | Premium | $\kappa_L\ (10^6)$ | $\kappa_H\ (10^6)$ | $MCE$ |
|---|---|---|---|---|---|---|---|---|
| 0.14 | 0.29 | 1.26 | 0.15 | 0.45 | 0.11 | 1.52 | 4.43 | 126 |

- Baseline parameters:
  $s = 0.025, \eta = -2, R = \$2.4(10^6), l_{\text{min}} = \$350(10^3)$
  Grant rate = 0.75, Litigation rate = 0.015, Validation rate = 0.58
- Robust results for $R = 2, 3$ m, $s = .01, .05$, $\eta = -1, -3$
- Premium denotes simulated value of the patent premium $\frac{\Delta}{\Delta+\pi}$

# External Validation of Simulation Results

1. Simulated litigation cost of $1.26 million is consistent with AIPLA survey evidence
2. Simulated patent premium of 11% is consistent with 5-15% estimates from patent renewal models
3. Survey information by Mansfield (1986) indicates 15-20% of patented inventions would not have been developed without patent rights. Very similar to our $\lambda$.
4. Frakes & Wasserman (2015) estimate elasticity of grant rate wrt examiner time per patent of $-0.3$ to $-0.5$. Our simulated $\lambda$ and $e$ imply elasticity of $GR$ wrt to $e$ of $-0.33$.

# Simulating counterfactual policy reforms

- Now we take the baseline model, impose policy reforms then calculate changes in parameters, along with expected changes in welfare, profits, and consumer surplus
- **Experiments: Perfect Courts**

| Experiment | $e$ | $y$ | $x$ | $\%\mathbb{E}\Delta W$ | $\%\mathbb{E}\Delta\pi$ | $\%\ \mathbb{E}\Delta CS$ |
|---|---|---|---|---|---|---|
| Status quo | 0.29 | 0.15 | 0.45 | | | |
| Frontloading | 0.56 | 0.24 | 0.45 | 1.90 | -5.88 | 5.72 |
| Halve litigation costs | 0.29 | 0.06 | 0.69 | 4.92 | 0.78 | 8.24 |
| Shut down courts | 0.29 | 1.0 | 0 | -0.74 | 42.0 | -22.3 |
| Registration system | 0 | 0.14 | 0.45 | -3.10 | 4.76 | –6.50 |

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# Imperfect Court Setting

- Relax the assumption that the courts are "perfect":
  1. High-quality imperfect court: $e_{court} = \frac{2}{3} \cdot 1 + \frac{1}{3} \cdot e_{pto}$
  2. Low-quality imperfect court : $e_{court} = \frac{1}{3} \cdot 1 + \frac{2}{3} \cdot e_{pto}$
- Simulation results and policy experiments are very similar to perfect courts. Main differences:
  1. With low quality courts, fraction of good applications is higher but still only $\lambda = 0.26$
  2. More imperfect courts make trolling behavior (low quality patentees pre-empting challenge) less likely, but this means that they are more likely to charge high royalties.

# Conclusions

- Improving patent screening is important: many problems associated with the patent system derive from low quality
- We develop a model of patent screening with private information on validity
- Allows us to analyze the effects of various screening tools in an integrated framework with endogenous challenges
- Key results:
  - Examination is crucial for screening because (unlike challenges) all patent applications are examined
  - Frontloading fees improves screening and welfare; a 'registration system' decreases both
  - Reducing litigation costs increases welfare (e.g. post-grant review in US since AIA of 2011)
- Use framework to analyse impact of litigation insurance (mandatory or voluntary), "loser pays" legal rules etc.

# Additional Slides

# Rationales for the nonobviousness requirement

In theory, this standard prevents issuance of patents on inventions that (. . . ) are likely to be forthcoming even without patent incentives.

Eisenberg (2004, p. 885)

The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent.

Graham v. John Deere Co., 383 U.S. 1, 11 (1965)

The non-obviousness test makes an effort, necessarily an awkward one, to sort out those innovations that would not be developed absent a patent system.

Kitch (1966, p. 301)

# Extensions

1. Heterogeneous invention values (continuum of values and development costs)
    - We show that two results are robust:
        1. Cannot screen out low types of a given value without both examination and pre-grant fees
        2. For given incentive for high types, frontloading fees reduces the set of low types that apply
2. Endogenous inventions and the patentability criterion
    - When mix of high and low cost inventions is endogenous, government may still want to encourage only high cost inventions if they tend to be (sufficiently) high valued.
    - Cost as an imperfect signal of value: probability of high value $>$ with high cost than with low cost