

# Lecture 4 - Patents and Intellectual Property Rights

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# Patents and IPRs

## IPRs: economic problem

### i Object of analysis

IPRs make a non-rival good partially excludable, creating private incentives for costly innovation.

- ▶ Knowledge is (partly) **non-rival** and often **hard to exclude**
- ▶ Without protection, imitation can dissipate rents  $\Rightarrow$  weak private incentive to incur fixed R&D cost
- ▶ **Policy objective**
  - ▶ Provide incentives for invention while limiting static distortions in product markets

## IPRs: instruments

- ▶ Main IPR types:
  - ▶ Patents
  - ▶ Trademarks
  - ▶ Copyrights
  - ▶ Design rights

## Scotchmer: ideas model

### Ideas model (Scotchmer): primitives

Following Scotchmer (2006)

- ▶ An “idea” is a pair  $(\nu, F)$
- ▶  $\nu$ : per-period consumer surplus under competitive supply (value parameter)
- ▶  $F$ : fixed cost to develop the idea into an innovation (R&D cost)
- ▶ **Interpretation**
  - ▶  $\nu$  captures the size of social gains from making the idea usable
  - ▶  $F$  is the up-front resource cost required for development

### Ideas model (Scotchmer): social value under discounting

Assume social value lasts forever and the product is competitively supplied.

- ▶ Per-period social value:  $\nu$
- ▶ Discounted social value:

$$\sum_{t=0}^{\infty} \frac{1}{(1+r)^t} \nu = \frac{\nu}{r}$$

## Breadth: product space

### Patent breadth: product space (definition)

- ▶ Breadth determines how close a substitute can be without infringing
- ▶ Reduced-form implication:
  - ▶ Narrower breadth  $\Rightarrow$  more close substitutes enter
  - ▶ Broader breadth  $\Rightarrow$  fewer close substitutes enter
- ▶ Interpretation
  - ▶ Allowing close substitutes increases the elasticity of demand faced by the patent holder

### Breadth and demand elasticity (intuition)

- ▶ If close substitutes are allowed:
  - ▶ residual demand becomes **more elastic**
  - ▶ equilibrium price is lower (all else equal)
- ▶ If substitutes are excluded (broader patent):
  - ▶ residual demand is **less elastic**
  - ▶ equilibrium price is higher (all else equal)

### Breadth-length trade-off (given a target value)

Assume the “correct” expected private value of protection is fixed

# Optimal patent length with endogenous R&D (Shy)

Shy (1995) model: setup

- ▶ Demand:  $P(Q) = a - Q$
- ▶ Process innovation reduces marginal cost from  $c$  to  $c - x$
- ▶ R&D effort  $x$  costs  $R(x)$
- ▶ Two-stage game:
  1. Regulator chooses patent duration  $\tau$
  2. Firm chooses  $x$  to maximise discounted profit
- ▶ Objects
  - ▶ Choice variables:  $x$  (firm),  $\tau$  (regulator)
  - ▶ Parameters:  $a, c, r$

Shy model: firm's choice of  $x$  given  $\tau$

Firm solves:

$$\max_x \Pi(x; \tau) = \sum_{t=1}^{\tau} \rho^{t-1} \pi(x) - R(x), \quad \rho = \frac{1}{1+r}$$

Assume:

- ▶ per-period profit:  $\pi(x) = (a - c)x$
- ▶ cost:  $R(x) = \frac{x^2}{2}$

# Patent races

## Symmetric patent race: setup

- ▶ Two symmetric firms may incur a fixed cost  $f$  to establish a research division
- ▶ Success probability:  $p$  (per firm)
- ▶ Payoffs:
  - ▶ monopoly profit if sole innovator:  $\pi^m$
  - ▶ duopoly profit if both succeed:  $\pi^d$
- ▶ Welfare benchmarks (post-innovation welfare):
  - ▶ one research division:  $W^m = \pi^m + CS^m$
  - ▶ two research divisions:  $W^d = 2\pi^d + CS^d$
- ▶ Assumption (for the comparison):
  - ▶  $CS^d > CS^m$  (more competition in the product market raises consumer surplus)

## Patent race: Nash equilibrium condition



### Duplication incentive

"Winner-takes-all" payoffs can create privately excessive entry into R&D when firms ignore duplication costs

## Summary and next week

### Summary

- ▶ Patents trade off dynamic incentives against static distortions (deadweight loss during protection)
- ▶ In the ideas model, investment requires  $\pi\nu T \geq F$ , while welfare accounts for  $\frac{\nu}{r}$  and the DWL term  $\ell\nu T$
- ▶ Breadth and length can be substitutes in delivering a given private incentive level (broad–short vs narrow–long)
- ▶ Patent races can generate socially excessive duplication when private entry incentives exceed social benefits

### Next week: multi-stage games

- ▶ Commitment and first-mover advantage (Stackelberg)
- ▶ Subgame perfect equilibrium and backward induction
- ▶ Strategic delegation (Vickers)

### References

Scotchmer, Suzanne. 2006. *Innovation and Incentives*. MIT Press.