

# **The Economics of Ideas and Intellectual Property**

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## ***Introduction***

- ◆ we challenge the notion that government awards of monopoly through patents and copyright are “the way” to provide appropriate incentives for innovation
- ◆ economically relevant unit is a copy of an idea

## ***Only Copies Matter***

- ◆ many copies of an idea exist
- ◆ in physical form, such as a book, a computer file or a piece of equipment
- ◆ in the form of human capital embodied in people who know and understand the idea
- ◆ only copies matter: if they were all to be erased, the idea would have no longer any economic value
- ◆ copies are relatively good substitutes for each other
- ◆ for functioning of markets property rights in copies of ideas is assured by ordinary laws against theft
- ◆ what is ordinarily referred to as “intellectual property” involves not the ownership of copies of ideas, but a monopoly over how other people make use of their copies of an idea.

## ***Ideas versus Other Goods***

- The first copy of an idea produced is indivisible

All goods are subject to some degree of indivisibility

- The first copy of an idea is produced using a different technology than subsequent copies.

There is nothing special about a capital good that is used to produce itself. All capital/quality ladders have this flavor.

- Imitators have an advantage over innovators because they get the idea for “free”

The original copy of an idea is the capital good (the tree) from which all other copies (the fruits) must originate. Innovators must compete with one another, enabling innovators to appropriate the net present value of all copies through competitive pricing.

➤ Ideas are subject to “spillover externalities”

how do ideas “spill out” if they are embodied in physical objects such as books?

how do ideas “spill out” if they are embodied in particular individuals

some notion of “public view” example of the wheelbarrow

most ideas are quite costly to communicate – we make our living that way after all and overwhelming historical and current evidence shows that diffusion and adoption of innovations is costly and time consuming.

## ***The “Public Domain”***

- ideas for which copyright has expired; think book
- legal scholars have tend to view public domain as a commons
- market for a public domain is very similar to the market for wheat or any other competitively provided good or service
- many copies of a book, each a good substitute for the other
- each copy is owned by someone
- to read the book, make copies, or turn it into a movie, must first buy the book from one of the current owners
- many owners compete with each other to sell you the book cheaply – this is a good thing
- evidence suggests market for goods in the public domain functions well; copies widely available and reasonably priced: finding a copy of a book by Dickens is no great problem.

## ***Problem of Promotion***

- copyright lobbyists and their lackeys: inadequate incentive to “promote” books, music and movies
- the benefit of the promotional effort would be shared by competitors
- applies to **all** competitive markets, wheat for example
- under monopoly, goods are priced high, and consumer receives little benefit: monopolist has an incentive to subsidize information
- under competition consumers must pay the cost of obtaining information: information about wheat widely available - doctors, diet advisors, books, magazines, and many other sources
- not available from wheat producers – so the information is less biased
- plentiful information available about works in the public domain - but not from book publishers.

## ***Economic Question***

indivisibility creates potential problem for competitive market, so there is a legitimate question of whether there is adequate incentive to produce the first copy of an idea

ideas always generate some income for creator

is it enough? not: can we make creators fabulously rich?



## ***Indivisibility and Competitive Production***

Quah [2002] and Boldrin and Levine [1999]: the fruit of the idea tree

$x_0$  initial copies of an idea produced at per-copy cost of  $\mu$

time  $t$  there are  $x_t$  copies

extreme assumption: copies of ideas simultaneously consumed and reproduced

utility of  $u(x_t)$  from consuming  $x_t$  simultaneously copies available grows at a constant rate,  $x_t = \beta x_t$

quadratic utility  $u(x_t) = 2\rho[2(x/x^C) - (x/x^C)^2]$  for  $x \leq x^C$  and

$u(x_t) = 4\rho$  for  $x > x^C$

$\rho$  is a measure of the “quality”

utility maximum  $x_t = x^c$  reached at  $\tau = (1/\beta) \ln(x^c/x_0)$

overall the present value of utility  $\int_0^\tau e^{-t} u(x_0 e^{\beta t}) dt$

(time normalized so subjective interest rate is one)

- technology for reproducing copies available to everyone
- anyone who has a copy can make and sell further copies
- reproduction technology has constant returns to scale so all proceeds accrue to the owner(s) of original copies

Napster like distribution system for MP3's in which owners of MP3's can legally sell copies

if I can profit by buying MP3's and selling copies so can you, so we'd compete up the price at which we'd buy and compete down the price at which we would sell

competition between resellers mean that they all earn zero profits

competition implies price of copies at time  $t$  is the marginal social value of an additional copy,  $u'(x_t)$

$\lambda$  number of consumers

suppose (it won't matter in a moment) original producer(s) of the idea face competition for creating first copies of the idea so they view prices holding fixed prices  $u'(x_0 e^{\beta t})$  as fixed

profit from producing  $x$  initial copies

$$\lambda \int_0^{\tau} e^{-t} u'(x_0 e^{\beta t}) x e^{\beta t} dt - \mu x$$

condition for competitive equilibrium/efficiency

$$\begin{aligned}\mu &= \lambda \int_0^\tau e^{(\beta-1)t} u'(x_0 e^{\beta t}) dt \\ &\equiv P \\ &= \frac{4\lambda\rho}{x^c(\beta-1)} \left[ \frac{\beta(x_0/x^c)^{(1-\beta)/\beta} + (\beta-1)(x_0/x^c)}{2\beta-1} - 1 \right].\end{aligned}$$

goes to zero as beta increases, but may rise initially

indivisibility:  $x_0 < 1$  implies no innovation at all

it may be that optimal initial choice of capital  $x_0 < 1$ : the indivisibility binds; only realistic option choose  $x_0 = 1$

some socially desirable ideas may not be produced under competition

## ***The Napster Effect***

for books, music and movies it may be imagined that changes in computer technology increase  $\beta$  so much that price is driven to zero almost immediately; note that as  $\beta \rightarrow \infty$  revenue  $P \rightarrow 0$ .

same technological change reducing cost of creation, so also  $\mu \rightarrow 0$

plus the first mover advantage

## ***First Mover Advantages***

simultaneous innovation implies that the indivisibility wasn't binding

the sole innovator generally has a monopoly for a while no matter what the law says

innovations: secrecy

books and movies: encryption

note that most sales take place within three months of initial release

pharmaceutical industry: first mover retains about 25% of the market at the original monopoly price

also

- complementary sales
- clever complementary investment

## Monopoly

monopolist does not allow quantity  $x_t$  to expand to  $x^c$ , but will restrict output to  $x^c/2$

as  $\beta \rightarrow \infty$  output jumps essentially immediately to  $x^c/2$

results in revenue to monopolist of  $\lambda\rho$

if only captured for a fraction of time  $\phi$ , corresponding revenue  $\phi\lambda\rho$

for remainder focus on this  $\beta$  large case, although it understates the benefits of competition

first mover advantage represented by fraction  $\phi^F$  before competitors are able to successfully enter

patent and copyright monopolies represented by fraction  $\phi$  representing duration

## ***Sequential Innovation***

monopolist scarcely likely to earn less than a competitor

seems that whatever the problems, government grants of monopoly at least increase the incentive to innovate

ideas are built from other ideas: innovations build on past innovations

profit from innovation by patent/copyright raised, but so is cost of production



competitive innovator with first mover advantage gets revenue  $\phi^F \lambda \rho$

production of new idea requires use of  $N$  existing ideas

each of these many ideas is small, so cost of producing a copy of each existing idea is  $\varepsilon/N$

no government granted monopoly, many copies of each existing idea competing with each other, so can get all  $N$  of them for a total cost of  $\varepsilon$

without government intervention, socially desirable invention takes place if  $\phi^F \lambda \rho > \varepsilon$ .

government awarded monopoly applies to all innovations

owners of the  $N$  existing ideas know only that  $\rho$  is drawn from a uniform distribution over  $[0, \bar{\rho}]$

each monopolist sets a price  $p_i$  at which they will license their invention

owners of all the other existing ideas setting  $p$  owner  $i$  gets an expected revenue of

$$\frac{\lambda \bar{\rho} - (N - 1)p - p_i}{\lambda \bar{\rho}} p_i$$

for  $\varepsilon < \lambda \bar{\rho}/2$  Nash equilibrium

$$p = \lambda \bar{\rho}/(N + 1)$$

inventor pays  $\frac{N}{N+1} \lambda \bar{\rho}$  to clear the needed rights, so innovation if

$$\frac{N}{N+1} \lambda \bar{\rho} < \lambda \rho$$

monopoly, innovation probability  $1 / N$

competition, innovation probability  $1 - \varepsilon / (\phi^F \lambda \bar{\rho})$ .

- number of existing rights that must be cleared increases probability of innovation under monopoly is smaller than that under competition, and drops towards zero
- additional incentive for innovation under an intellectual property regime is more than completely offset by the additional cost it imposes on innovation
- as technologies grow more and more complex requiring more and more specialized inputs, monopoly power induced by patents and copyright becomes more and more socially damaging

## ***Rent-seeking***

- key problems with government grants of monopoly is induced rent-seeking
- incentive for would-be monopolists to waste resources competing for monopoly
- patent race
- “work alike” innovations to get portion of the monopoly
- textbooks: every textbook just different enough from best-seller to avoid violating copyright
- pharmaceuticals: more time and effort is spent developing copycat drugs to get the share of a lucrative market, than spent developing genuinely new drugs

- regulatory capture or “monopoly creep”
- over time regulatory agencies becomes “captured” by the regulated industry
- serve to enable collusion and monopolistic practices within the industry
- patents and copyrights both Congress and the courts have gradually been taken over (the worst case is the special patent court)
- term of copyright in USA risen from 28 years to 95 years
- areas not previously allowed patents: business practices and software are now allowed to be patented
- in a theoretical sense, it might be desirable to have copyrights and patents lasting a few months or a few years, as a practical matter, once copyrights and patents are allowed at all, their term and scope is likely to begin to creep upwards

## ***Private Rent-seeking***

in absence of patents innovators likely to increase reliance on trade secrecy

one argument for patents is that it replaces trade-secrecy and forces innovators to reveal the secrets of their inventions

anyone who has read a patent will realize, the “secret” if there is one, is rarely revealed in a useful way in the patent

since patents last 20 years, only reason to get a patent is if the inventor thinks he cannot keep the secret for that long

so public rent-seeking is not a good substitute for private rent-seeking

## ***Optimal Duration of Intellectual Monopoly***

assuming away all the problems of IM, what is the optimal level of protection  $\phi$ ?

assume first copy of any idea has a unit cost of creation

(with linear demand) social value of the idea under monopoly is  $(3/2)\rho$   
and under competition  $2\rho$

ideas will be produced for which private revenue exceeds cost  $\phi\lambda\rho \geq 1$

without government intervention, so  $\phi = \phi^F$ , as size of economy  $\lambda$   
grows, quality of marginal idea that is produced,  $\rho = 1/\phi^F\lambda$ , declines  
and more ideas are produced

ideas are uniformly distributed on  $[0, \bar{\rho}]$ .

must set  $\phi > 1/(\lambda\bar{\rho})$  if any ideas are to be produced at all  
social welfare

$$\int_{1/\phi\lambda}^{\bar{\rho}} (\lambda[(3/2)\phi + 2(1 - \phi)] - 1)(\rho/\bar{\rho})d\rho$$
$$= \frac{1}{2}(\bar{\rho}\lambda[(3/2)\phi + 2(1 - \phi)] - \bar{\rho})(1 - (1/\phi\bar{\rho}\lambda)^2)$$

derivative with respect to  $\phi$

$$\frac{\bar{\rho}\lambda}{4} \left[ \left( \frac{6\phi + 8(1 - \phi)}{\lambda} - \frac{4}{\lambda^2} + 1 \right) (1/\phi\bar{\rho}\lambda)^2 - 1 \right]$$

for fixed  $\phi$  as  $\lambda$  grows approaches  $-\bar{\rho}\lambda/4$

implies choice of  $\phi$  which maximizes social welfare must eventually shrink to  $\phi^F$ .



## ***Implications***

- if the government is to grant monopolies, they should be limited, as they are by time limits in the case of both patents and copyright
- as the market expands through economic growth and trade, limits should be tightened, until they are eliminated altogether
- unfortunately this appears to be the opposite of what has happened

## *Policy Issues and IP Reform*

- based on empirical as well as theoretical considerations on balance it would be best to eliminate patents and copyrights altogether
- at one time government grants of monopoly were widely used, for example, as a revenue extraction mechanism
  - still true in the developing world today
- there is justifiable broad skepticism about government monopolies
- government monopolies in Eastern Europe produced fewer lower quality goods at greater cost and devastated the environment in the process
- developed economies have gradually replaced inefficient government grants of monopoly with more efficient mechanisms

- many economists do not recommend eliminating patents and copyrights altogether, but all recognize a strong need for reform
- insofar as it is desirable for the government to provide extra incentives for invention and creation it is not best done through grants of monopoly, but rather through proven mechanisms such as subsidies, prizes or monopoly regulated through mandatory licensing
- as the world has used the WTO process to gradually harmonize a lower international level of tariffs, increasing greatly the benefits of the free market, so too it should be possible through international collaboration such as TRIPS to harmonize substantial reductions in patent and copyright protection, greatly increasing the benefits of free trade in ideas