EE481: Industrial Economics

Patents and R&D (Chapter 16)

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We ask the following questions

Please read Chapter 16 of "Modern Industrial Organization" by Carlton and Perloff.

- If there is no patent or government incentives, would there be too little research and development (R&D)?
- If there is too little R&D, what method(s) should be used to encourage it?
- What is the optimal patent duration?
- How does the market structure affect the incentives to innovate?

Distinctions Between Patents, Copyrights and Trademarks

- Patents = exclusive rights to produce.
  - Encourages firms to innovate.
- Copyrights = exclusive rights to produce, publish (usually for art works).
  - Encourages the creation of new works.
- Trademarks = symbols or other marks used to distinguish a good or service.
  - Encourages firms to maintain their reputation.

Trademark Case: Starbung

In 2013, "Starbucks Coffee Company" sued Starbung for using its logo.

Trademark Case: Starbung

Do you think it is reasonable for Starbucks to sue Starbung?

Patent Case: Compulsory License

Compulsory License = Government grant of license to 3rd party to use patent without consent of patent holder

- Brazil (Antiretroviral (ARV)) - domestic price ⇓by 50-70%
- Thailand (Antiretroviral (ARV) and Cencer drugs)
- India (Cancer drugs)
- etc.

Sometimes the US government responded by removing special treatments on bilateral trade agreements.

- Do think governments should give compulsory license?

Are Cheap Drugs a Good Thing?

"Allowing prescription drug firms to earn profits with prices above the competitive level increases the investment in pharmaceutical research. Government pricing restrictions over the last ten years in Europe have held down the prices of prescription drugs relative to the prices received in the US. Prior to the price restrictions, Europe and the US both spent approximately $10 billion a year on drug research. Currently, Europe spends just over $20 billion compared to the $30 billion expenditures by the US. Between 1993–1997, Europe produced 81 new molecular entities while the US produced only 48. Europe produced only 44 new molecular entities from 1998–2002. During the same period, the US developed 85. The European price controls have limited the earnings capabilities of the drug companies there and innovation has declined."
Source: "The Trouble with Cheap Drugs," The Economist, January 31, 2004.

Incentives for inventions are needed

- Many new inventions give huge benefits to people.
- Innovation has a "positive externality"$\Rightarrow$ market failure
- To increase social gain, the government gives more incentives to inventors.
  - Through patents, copy rights, research grants.
  - Patents also encourages disclosure for future research.
  - .. but in some cases, firms do not register for patents because they don't want to disclose their secrets.

Patents, Prizes, Research Contracts and Joint Ventures

- Patents = right to be a monopoly on the product for a certain period of time.
- Prizes = big money rewarded only if the project is successful
- Research contracts =

- Joint ventures = allowing firms to cooperate on their R&D.

When to use which method?

- Patents - There exists a market for the product. Government has incomplete information about the cost and probability of success.
- Prizes -

- Research contracts - No market exist but the innovation would benefit the society (has large positive externalities)
- Joint ventures - If relaxing competition can increase more research efforts.

Research Contracts

Suppose the government wants to find a cure for cancer.
So, it gives research grants to researchers at the universities/research centers.

- How many research grants should it give?
- If it can calculate the social benefits, cost of research, probability of success, then it can find the optimal number of grants to give.

The optimal number of firms or projects

Suppose

1. The cure for cancer has a social value of B =25 million THB.
2. The probability of success $\rho(n)$ increases as the number of projects increases.
   where $(\rho(n) = 1 - e^{-0.205n})$
3. It costs 1 million THB to fund 1 project.

We want to find the number of projects (n) that maximizes the net social benefit.

The optimal number of firms or projects

When n = 8, net social benefit is maximized.

Table 1: Costs and Benefits of Research Programs

n	$\rho(n)$	E(Social Benefit) $B \times \rho(n)$	$C(n)$	Net Social Benefit $B \times \rho(n) - C(n)$
6	0.70	17.61	6	11.61
7	0.76	18.97	7	11.97
8	**0.80**	**20.08**	**8**	**12.08**
9	0.84	20.98	9	11.98
10	0.87	21.72	10	11.72
11	0.89	22.32	11	11.32

Source: Carlton and Perloff (2005), page 540.

The optimal number of firms or projects

When n = 8, net social benefit is maximized.
$\Rightarrow$ and marginal E(social benefit) = marginal cost

Table 2: Costs and Benefits of Research Programs

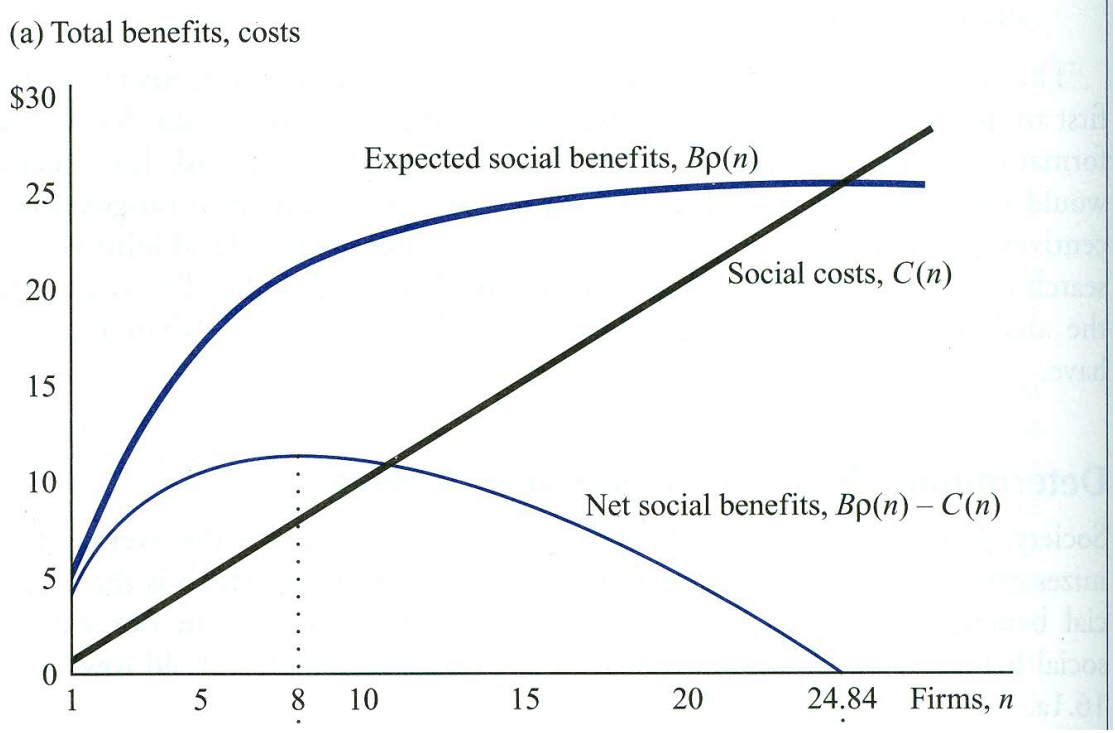
n	$\rho(n)$	E(Soc. Benefit) $B \times \rho(n)$	Marginal E(Soc. Ben.)	$C(n)$	Marginal cost	Net Soc. Benefit $B \times \rho(n) - C(n)$
6	0.70	17.61	-	6	1.00	11.61
7	0.76	18.97	1.23	7	1.00	11.97
8	**0.80**	**20.08**	**1.00**	**8**	**1.00**	**12.08**
9	0.84	20.98	0.82	9	1.00	11.98
10	0.87	21.72	0.67	10	1.00	11.72
11	0.89	22.32	0.54	11	1.00	11.32

Source: Carlton and Perloff (2005), page 540.

The optimal number of firms

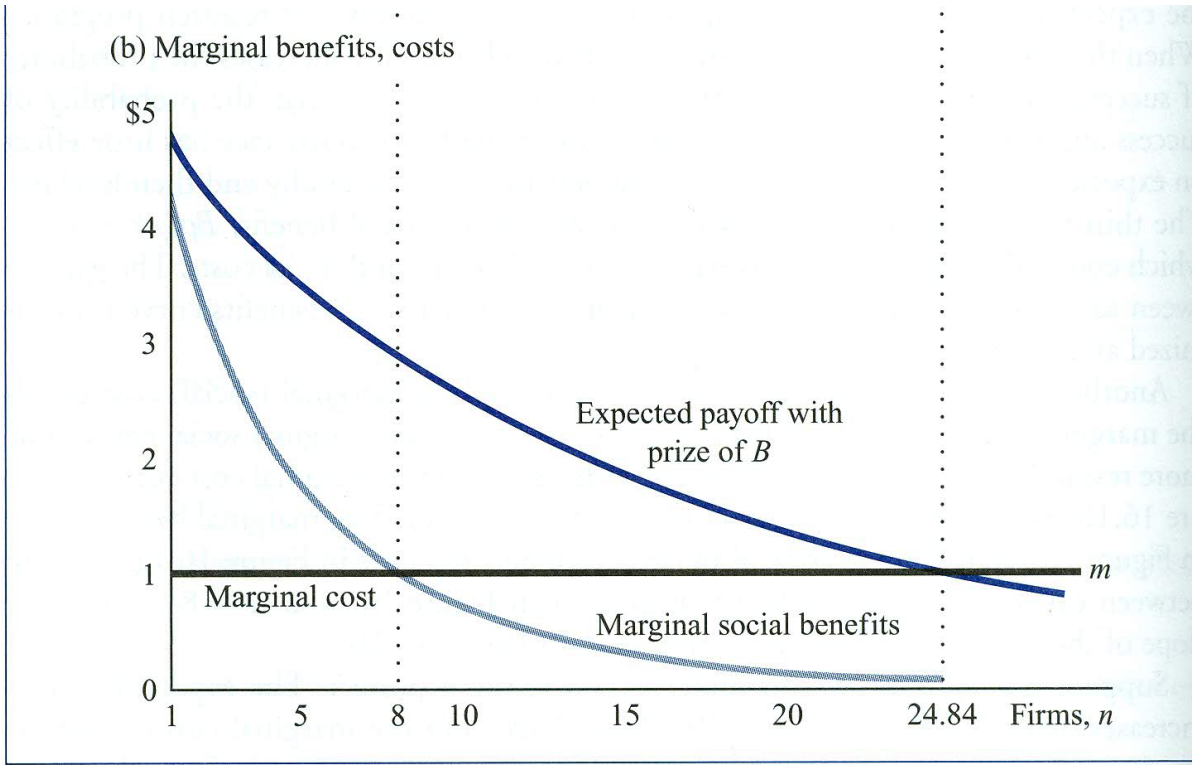
This is very similar to profit-maximization. But instead of revenue and cost, you have social benefit and social costs.

FIGURE 16.1 Costs, Expected Benefits, and Net Social Benefits from R&D



The optimal number of firms

Net benefit is maximized when marginal social benefit = marginal cost.



Prizes

What should be the optimal value of prize?

- If prize is too low -> not enough R&D
- If prize is too high -> excessive research
- We know that firm invests if $E(prize) \geqq cost\ of\ research$.
- So, the optimal price is where $E(prize) = cost$.

Optimal Value of Prize

The optimal value of prize

where n =number of firms, $\rho(n) = 1 - e^{-0.205n}$ = probably of at least 1 firms succeed, m = cost of research

- Suppose $n = 8$ results in the socially optimal outcome, we have $\rho(n) = 0.80$.
- If $m = 1$, substituting all the numbers gives prize = 10.

Prizes (extra note)

- As a result, government sets the prize = 10
- ASSUME that firms know the total number of firms that compete for the prize
- There would be exactly 8 firms in the equilibrium
  - if more than 8, some firms will drop out
  - if less than 8, more firms will participate

Patents

- Patents give rights for firms to be the ONLY owner/producer of their invention(s).
- This creates a good incentive to innovate BUT
  - Firm would exploit their monopoly power (price would be distorted)
  - So, a patent should not last forever.
  - The optimal length of patent depends on the cost of invention, probability of success, social benefits etc.

Value of a Patent (Permanent Patent)

If the patent (monopoly right) lasts forever. What would be the value of it? Suppose:

1. Demand in each period: $p = 6 - 5Q$
2. Average cost = Marginal cost of production = 1
3. Only 1 firm made the discovery.
4. The interest rate, r, is 10 percent

This would give $\pi^m = 1.25$ per period. If the monopoly right is forever, then

$$Patent\ Value = \frac{\pi^m}{(1+r)} + \frac{\pi^m}{(1+r)^2} + ... + \frac{\pi^m}{(1+r)^\infty} = \frac{\pi^m}{r} = \frac{1.25}{0.1} = 12.5$$

Value of a Patent (Finite Patent Length)

The value of a patent that lasts for t periods of time is:

For example, if $t = 10$, we have

$$Patent\ Value = \frac{1.25}{(1.1)} + \frac{1.25}{(1.1)^2} + ... + \frac{1.25}{(1.1)^{10}} = 7.68$$

Optimal Patent Length (1)

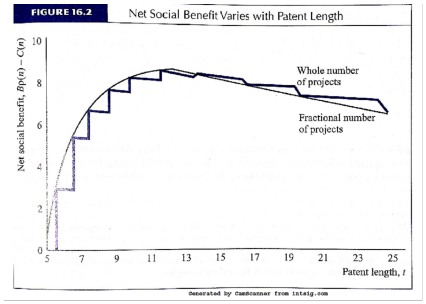
Now, if we know the value of a patent, probability of success $\rho(n)$ and cost of a project m, we can calculate the number of projects undertaken in equilibrium.

- A firm undertakes a project if $E(gain) \geq cost$, where $E(gain) = Patent\ Value \times Prob(success)$.
- Suppose $t = 10$ (thus patent value $= 7.68$) and $m = 1$, we have

$$Patent\ Value \times Prob(success) \geq cost$$

- If $\alpha = 0.2031$, we get $n \leq 5.09$. (I used a numerical method to solve for this number. It's complicated. You won't need to solve this in the exam.)

Optimal Patent Length (2)



It is complicated to solve for the optimal patent length, e.g. how many years should the right be granted. So, you won't need to calculate this in the exam. You just have to understand the graphs.

Government Uncertainty

- Accurate information on the cost of research, social benefit and probability of success are needed for the government to find the optimal value if prize or lenght of patent.
- Under full information
  - patents are less desirable because they distort pricing.
  - giving prize or research contract would be better because after the discovery, government can let anyone use the innovation.
- Under imperfect information
  - patents maybe more desirable
  - if the government use prize or research contract, they may calculate the value incorrectly.

Market Structure and Incentive to Innovate

- How does the market structure affect the incentives to innovate?

If firms **don't have** to worry about others inventing the product first

- A monopoly would .. not bother to invent.
- In this case, competitive firms invent.. more (or faster) than a monopoly.

If firms **have** to worry about others inventing the product first

- A monopoly has an incentive to innovate to maintain its monopoly position.
- Compared with firm in a competitive market, a monopoly would have a greater incentive to innovate because.. the reward from successful innovation is greater.

Reference and Further Reading


Carlton, D.W. and J.M., Perloff.
Modern Industrial Organization. 4th Edition.
Pearson Addison Wesley Press, 2005.