

Economics of Innovation

Lecture 3 – Incentives to innovate and market failure

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Agenda for today

- Sources of market failure in provision of innovation / new knowledge (Arrow 1962)
- What can be done to deal with this market failure
 - Appropriation mechanisms
 - Incentive mechanisms
 - Patents
 - What are they
 - History
 - Pros and Cons
- Market structure and innovation (Arrow 1962)

Tapping into ideas

- Creative ideas that could provide economic benefit (i.e. potential innovation)
 - often exist in abundance
 - or, alternatively, society might have an interest that someone makes the investment to come up with these ideas
- Challenge: How and to whom should incentives be provided to tap into or discover these ideas?
- Is the market going to provide sufficient incentives?

Arrow (1962): Innovation as an economic good

- Innovation is creation (and application) of new knowledge
- Knowledge has public good characteristics
 - Non-rival in use
 - Non-excludable (unless specific laws exist)
- Knowledge is intangible
 - Easy to copy, imitate and spread (wasn't always like that before printing, broadcasting, Internet...)
- Source of spillovers
 - Creation of knowledge is a positive externality to others
- Paradox with demand
 - To know the value of an idea, you need to know the idea. But once the idea has been revealed, you won't want to pay for it...

Characteristics of knowledge creation

- High fixed costs, low or zero costs of reproduction or transmission
- Indivisibility
- High uncertainty
 - Risk and uncertainty aversion may prevent undertaking R&D as much as socially desirable
- Moral hazard problem
 - Cannot contract out creative efforts (e.g. researcher at the beach)
 - Hard to shift risks (e.g. no insurance for failure to innovate)
- Appropriability problem
 - Hard to keep benefits of R&D to the one who paid the costs

Market failure in R&D and innovation

- Special characteristics of knowledge and innovation lead to market failure
 - Similar and potentially worse than for other public goods
- Basic tension between:
 - Incentives to innovate on the one hand, and reaping the full social benefits from innovation
 - Public interest in fast diffusion of knowledge (interest of consumers and competitors, economic growth)
 - Static efficiency – perfect competition, but no innovation?
 - Dynamic efficiency – innovation, but no competition?
- Market failure → room for governmental intervention

Mechanisms of appropriability

- Secrecy - firm
- First mover advantages - firm
 - Lead time
 - Moving down the learning curve
 - Reputation, prestige, brand name
- Intellectual property rights (IPR) - government
 - Patents
 - Copyrights
 - Trademarks
- Complementary resources - firm
- Other

Alternative innovation incentives to IPR

- Prizes (ex post)
- Contests
- Grants
- Funded research projects
- Other
- Very complex issue:
 - Which incentive mechanism and specific implementation is most efficient?
 - To whom and how should the incentives be offered?

Patents - 1

- Gives its owner the right to sue for infringement if anyone tries to make, sell, offer, or import an invention that is patented in a country
- Invention must be patentable subject matter, have utility, novelty, and non-obviousness
- Patents expire after some time, usually 20 years
- Must be disclosed

Patents - 2

- Patents provide legal monopolies for the use of an invention to the inventor
- The patent holder has full discretion about what to do with the invention, e.g.
 - Use it productively (entrepreneurship)
 - License or sell it to someone else (for a fee / profit)
 - Not use it at all
- Idea: Grant temporary monopoly rights to the inventor as a reward and incentive for his innovative work

History of patent law

- Patent systems (without written, enforceable laws) in Venice in the 15th century
- Emerged in England out of the system of royal privileges in 1623 (Statute of Monopolies)
- In other countries much later
 - France 1791
 - USA 1793
 - Prussia 1815
 - Netherlands 1817
 - Switzerland 1882 (259 years later than in England)

Historical patent debate

- *Machlup and Penrose* (1950)
 - Intense public political controversy about patents 1850-1875 in many countries
 - At the end of 1860's, the cause of patent protection seemed completely lost and many countries resisted introduction or carrying out of patent laws
 - But the advocates of the patent system organized a counteroffensive using modern means of propaganda
 - A general political tendency for protectionism turned the tide
 - Patent laws were introduced almost everywhere
 - Holland was the last bastion of "free trade in inventions": for forty years after 1869 no patents were granted

Arguments in favor of patents

1. **Natural law:** Everyone should have a natural property right for his / her own ideas
2. **Morale:** Inventors do something good for society and should therefore be rewarded
3. **Best incentive to innovate:** Patents create incentives to innovate, this is desirable for society because it creates economic progress
 - Promise of a future monopoly profit makes (risky) investments into R&D a potentially worthwhile activity
 - Without this incentive, there would be no economic progress
4. **Best incentive to disclose secrets:** Sharing of knowledge is essential for scientific and technological progress. Without patent protection, inventors have no incentive to reveal their findings to the public because they would be immediately copied by rivals.

Arguments against patents

- Monopolies are bad from a welfare point of view (at least in a static perspective)
- Limit use of technologies that can foster economic development and the wealth of nations
- Limit free trade
- Innovations are not intellectual property because they build on all publicly available knowledge
 - They are also different from art because they are not expressions of individuality
- If the inventor is truly ahead of others having similar ideas, this head-start should allow him to profit from the innovation

Are patents efficient?

- Pro:
 - "...an exclusive privilege, of temporary duration is preferable; because it leaves nothing to anyone's discretion; because the reward conferred by it depends upon the invention's being found useful, and the greater the usefulness, the greater the reward and because it is paid by the very persons to whom the service is rendered, the consumers of the commodity" (*John Stuart Mill 1848*)
 - "an exclusive privilege of inventors produces an infinite effect and costs nothing" (*Bentham 1843*)

Are patents efficient?

- Contra:
 - To the extent that the stimulus of the patent system is effective, in the sense of causing people to do what they would not do otherwise, its effectiveness may consist chiefly in diverting existing activity into different, perhaps less productive, channels.
 - The diversion might be from ordinary productive pursuits into "inventing"
 - Or diversion from one field of research into another field in which the results enjoy patent protection
 - Costs of bureaucracy
 - Costs of monopoly power
 - Costs of delaying and restricting the use of new technology
 - Costs of multiple inventions and strategic patenting

Are patents necessary?

- Pro:
 - UK and US had rapid industrialization and a patent system
 - "The granting of patent privileges offers a prize to inventive minds. The hope of obtaining that prize arouses the mental powers and gives them a direction towards industrial improvement" (*Friedrich von List* 1841)
 - Wealthier nations have more frequently patent systems (Lerner 2002) – however, this does not imply causality
- Contra:
 - Germany and Switzerland had no patent system and still made progress
 - "Man does not need a property or privilege as a stimulus to invent" (*Rodriguez* 1862)

Other problems with patents

- Patents can be "invented around"
- Patents work only for certain types of industries / products (e.g. pharmaceuticals, chemicals) and not for others (e.g. service industries, software)
- Most patents do not have any money value
- Provide only uncertain ex-post financing for R&D

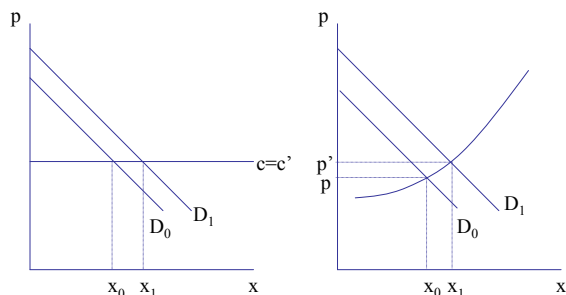
Modern debate about patents

- Academic controversy did not end with a “decision”
- But the political controversy ended with a victory for the patent advocates
- Patent law established in most industrialized countries and the patent debate was almost forgotten
- Patents are now largely viewed as an important incentive mechanism that spurs innovation and economic growth
- But how far reaching should patent privileges be? What should be patentable and what not? (software, human genome)
- Are there better alternatives? In which situations?

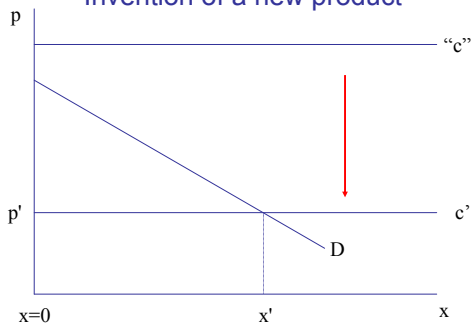
Arrow's model of innovation incentives

- c : constant unit production costs (marginal costs)
- x : demand in units
- D : demand curve
- $R(x)$: marginal revenue curve
- p : prices
- π : additional profits after an innovation (innovation incentive)
- r : interest rate
- Superscript $'$: after innovation
- Subscripts c, m, s, t : competition, monopoly, society, time

Product innovation

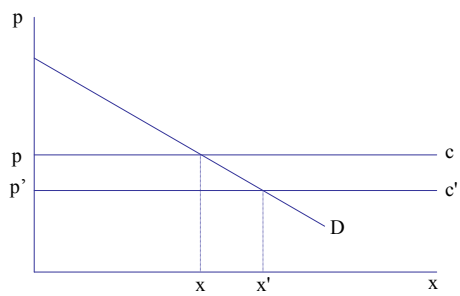


Invention of a new product



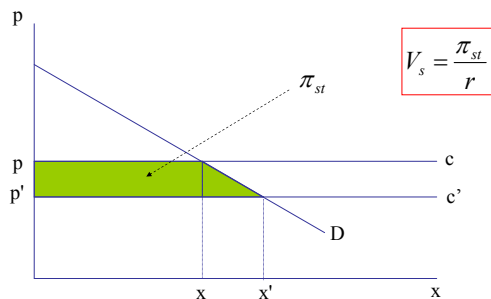
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Process innovation



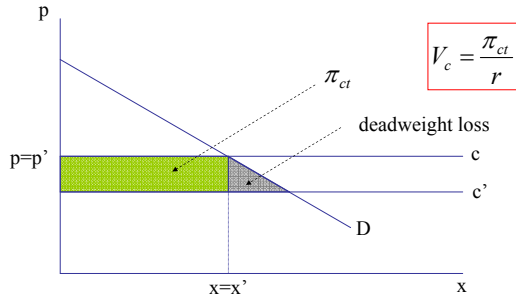
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Social benefits from process innovation



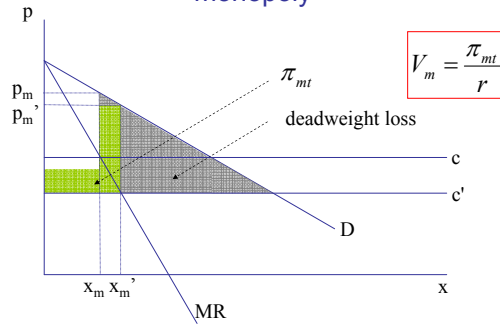
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Non-drastic innovation incentive for competitive firm that gets a *patent*



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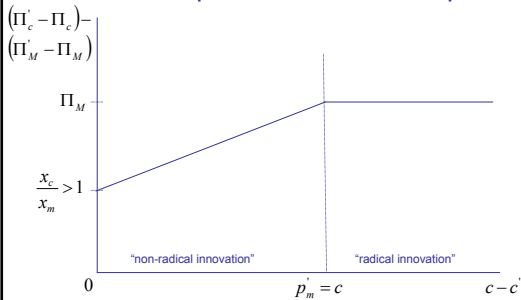
Non-drastic innovation incentive for monopoly



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Incentive difference between competitive and monopolistic markets with patents



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Welfare ranking

- Arrow: $V_s > V_c > V_m$ - Undersupply of innovation even with patents
- Policy issue:
 - If $R\&D > V_s \rightarrow$ should *not* innovate
 - If $V_s > R\&D > V_c \rightarrow$ should innovate but market will not
 - If $V_c > R\&D > V_m \rightarrow$ only competitive markets will innovate
 - If $V_m > R\&D \rightarrow$ both competitive market and monopoly will innovate

Welfare ranking could change if...

- Ranking $V_s > V_c > V_m$ could change *if*
 - IPRs do not exist or are not effective
 - Monopolies can better appropriate returns from innovation
 - Monopolies are contestable (i.e. market entry is possible)
 - Market power might be related to R&D cost advantages
 - Capital markets are not efficient (i.e. internal financing needed for innovation, monopolies might be in a better position to do so)
 - Indivisibilities and spill-overs among researchers (i.e. large research departments with many experts needed for some innovations)
- To be continued...
