The Economics of Patents

Stefano Breschi
(Università L. Bocconi)

April-May 2003

- Fundamental problem: **APPROPRIABILITY**
- 3 types of solutions:

1. Strategic means of appropriation: secrecy, *lead time*, complementary *assets* (complementary services, productive capacity…) / "private" solution, ≠ degrees of effectivenss across industries
2. Public intervention in the production of public goods: R&D subsidies, public research, public procurement…
3. Intellectual property rights: patents, trademarks / direct solution to the appropriability problem

Patents as legal documents

- *A patent is a legal document*, i.e. the exclusive right (for a limited period of time) over the commercial exploitation of an invention granted by the state to an inventor in return for the publication of her or his invention.
- *Patent documents* point to those areas of activity in which a company has invested R&D resources.
- *Patent documents* are a typical output of application-oriented types of R&D, both formal and informal, i.e. applied research and experimental development.

A METHOD AND AN APPARATUS FOR COOLING A COMPUTER

Patent Number: WO0203770

Publication date: 2002-01-10

Inventor(s): MORESCO LARRY;; SENYK BORYS

Applicant(s): INTEL CORP (US)

Requested Patent: EP1297730

Application Number: WO2001US20049 20010621

Priority Number(s): US20000607871 20000630

IPC Classification: H05K7/20

EC Classification: H05K7/20D, G06F1/20P

Equivalents: AU7009901

Cited Documents: US5757615; US5588483; US5121291

Abstract

A heat exchanging system comprising circulating fluid through a tube coupled to an electronic component in a first part of a computing device an to a heat transfer plate in a second part of the computing device.

Claims

What is claimed is: 1. A method comprising: coupling a first heat transfer plate to an electronic component in a first part of a portable computing device and a second heat transfer plate in a second part of the computing device; and circulating a fluid between one of the first heat transfer plate and a second heat transfer plate.
2. The method of claim 1, further comprising: coupling the first heat transfer plate to a closed loop tube.
3. The method of claim 1, wherein the fluid is one of water, oil, and liquid refrigerant.
4. The method of claim 2, wherein the tube is coupled to a pump.
5. The method of claim 2, further comprising: coupling a disconnect to the tube.
6. The method of claim 1, further comprising: sensing the temperature of the electronic component ; and causing the fluid to move when a threshold temperature is detected.
7. The method of claim 1, further comprising: sensing the level of fluid in a fluid container.
8. The method of claim 1, further comprising: removing heat at a rate in the range of about 10 to 50 watts.

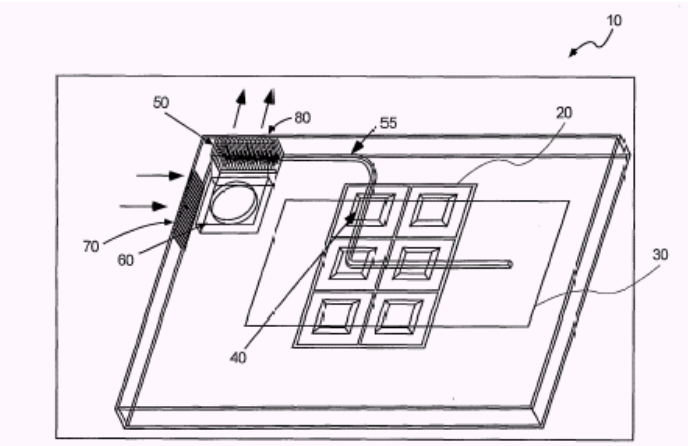


FIG. 1
(PRIOR ART)

Systems of patent law - 1

Patent procedures

a) Protection in a single country:

- The patent application
- Examining the application

b) Protection in more than one country (Paris Convention 1883):

- direct filing to the national patent office
- regional application (e.g. European application through EPO: Munich Convention 1973)
- international application (e.g. PCT application through WIPO: Patent Cooperation Treaty 1970).

Figure 4. **Patent application channels**

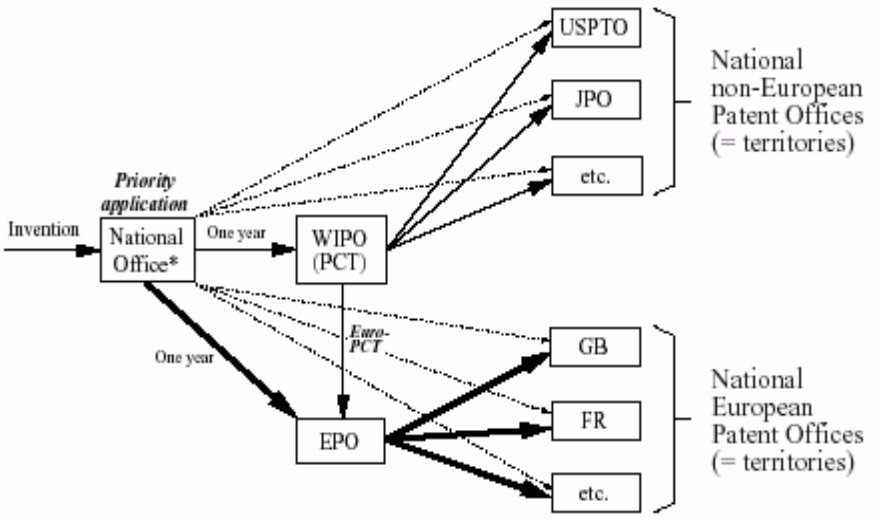
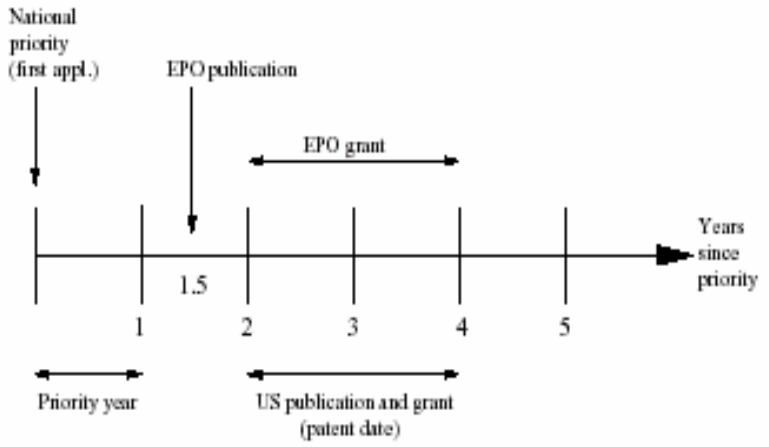


Figure 5. **The different lead times for patent application procedures**



Systems of patent law - 2

I) European Patent Office (EPO):

- ♦Central application, examination and grant for 18 European countries
- ♦Cost of procedure about 5 times higher than a national application

II) Patent Cooperation Treaty (PCT)

- ♦Central application, but national or regional examination and grant

III) United States Patent Office (USPO)

- ♦Patent documents published only if granted

IV) Japanese Patent Office (JPO)

- ♦High propensity to patent in the domestic market (40% of all world applications)

Technological info provided by patents - 1

A glossary of patent-derived data

Application, filing → **year of filing, country of filing**

Inventors, applicants → **country of invention (address)**

Priority application → **year of priority, country of priority**

Publication → **year of publication, country of publication**

Search report → **cited documents**

Designated countries

Grant of patent → **year of grant, country of grant**

Technological info provided by patents - 2

Patent classification systems

International Patent Classification (IPC):

- Hierarchical structure (about 64,000 entries)
- Combined function/application classification system
- Revised every five years

United States Patent Office Classification

- Hierarchical structure (different from IPC)
- Function oriented
- Revised every month
- Correspondence between IPC and USPOC

Table 2. **Main characteristics of IPC**

Heading name	Heading number	Code Letter	Code Label
Section	8	G	Physics
Sub-section	20	G0	Instruments
Class	118	G06	Computing Calculating, Counting
Subclass	616	G06F	Digital Computers
Main Group	6 871	G06F-009/000	Program control devices
Subgroup	57 324	606F-009/046	Multi-Programming

Advantages of patents as innovation indicators

- Data are regularly collected and available for very long time series (some series date back to the 19th century)
- Very detailed breakdown for technological fields
- Data are internationally comparable
- Data available at the firm (inventor) level
- Reveal inventive activities of very small firms and involving design, production and other non-structured inventive activities

Methodological problems of patent indicators

- Requisites and procedures for granting patents greatly vary across countries (better using international patenting or patenting in one country, EPO, US, Germany and Japan)
- Propensity to patent varies according to the industrial sector, size of firm and type of inventor
- Some inventions are not patented (e.g. secrecy), a certain number of activities (e.g. software) cannot be patented and many patents are of very low importance
- A significant proportion of patents are of a strategic type, i.e. applied for in order to pre-empt potential competitors

Possible uses of patent indicators - 1

Empirical issues	**Indicators**
Competitiveness and performance of countries and firms	♦ *patent counts* ♦ *revealed technological advantage* ♦ *shares*
Science-technology linkage	♦ *scientific papers cited in patent documents*
Technology linkage	♦ *patent citations* ♦ *co-classification analysis* ♦ *allocation of patents to industries of origin and industries of use*

Possible uses of patent indicators - 2

Geography of innovations	♦ *regional distribution of patents* ♦ *patent citations*
Sectoral patterns of innovation	♦ *patenting by type of firm* ♦ *patterns of internationalisation* ♦ *patents and multi-technology firms*
Research networks	♦ *co-patenting*
Quality or impact of inventions	♦ *patent citations counts* ♦ *patent renewals*
Technological forecasting	♦ *co-word analysis* ♦ *fast-growing technologies*

Economic theory of patents

- Objective: avoid market failures due to public good nature of technological knowledge (positive externalities)
- Fundamental logic:

  a. guarantee a return on investments in R&D through granting a property right on their results (→ incentives: dynamic efficiency)

  b. guarantee the diffusion of innovative ideas (→ avoid permanent monopoly: static efficiency)

  → solution: temporary monopoly on the economic exploitation of ideas in exchange for public disclosure of underlying knowledge

Main characteristics of patent systems

- *Length*: lifetime of patents (around 20 years) / renewal fees
- *Scope*:

  a. Breadth: nr. of varieties of basic invention protected by patent

  b. Width: nr. of markets (industries) in which an invention is protected (e.g. patents on genetic sequences)

  c. Heighth: minimum degree of novelty for a patent to be granted
- *Disclosure*: information about invention required for granting a patent

Fundamental trade-offs

• Length: if ↑ incentives to innovation increase, but static efficiency gains reduce (retarded). If ↓ incentives to innovation reduce.

• Breadth: if ↑ too much (patents too generic) others' innovative activities are inhibited (problem associated to uncertainty)

• Width: if ↑ too monopoly position extended to other markets + creates barriers to entry

• Heigth: if ↑ incremental innovations are more difficult

Wide range of appropriability means

Key means of appropriation: patents, secrecy, continuous innovation, control of complementary assets, lead time

• effectiveness of patents differs across industries: highest in drugs, chemicals and plastics, lowest in aerospace
• patents more effective for product than process innovation
• in most sectors, most effective means are secrecy, lead time, complementary assets, learning curve
• patents can be 'invented around' through reverse engineering, independent R&D

Patent length (Nordhaus model)

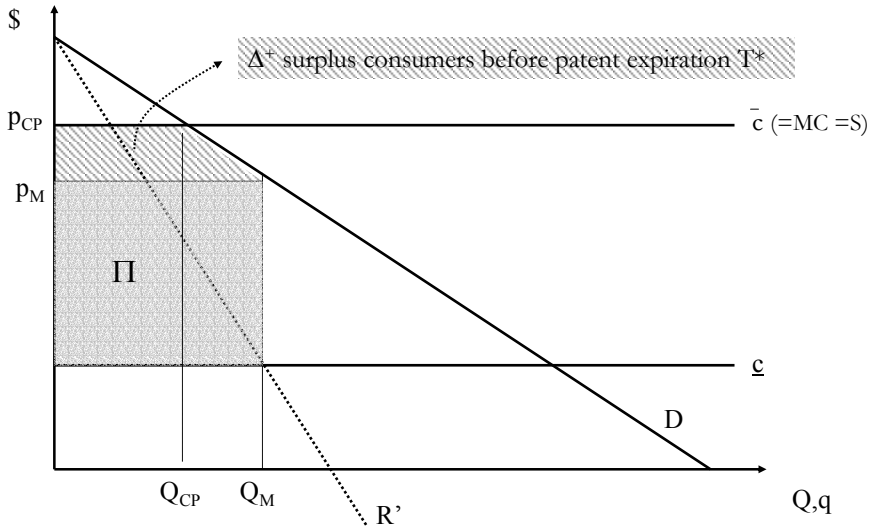
Hypotheses:

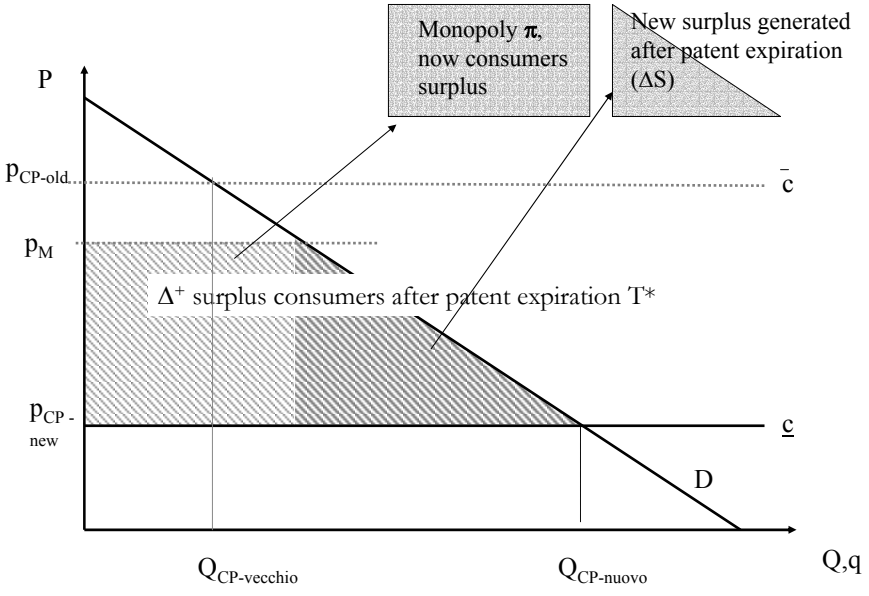
- 1 innovation = 1 patent
- Process innovation (Δ^- average cost: from $\bar{c}$ to $\underline{c}$)
- Patent only appropriability means
- Weak uncertainty (risk) → maximising agents
- Market structure: perfect competition, monopoly after patent

Important distinction: "radical" vs. "incremental" innovation

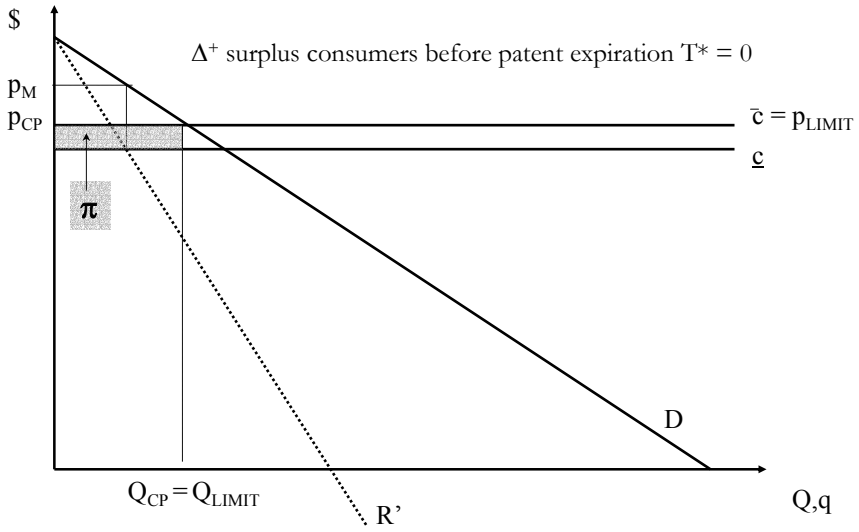
Conclusion: patent length should differ across industries, as a function of: radicalness of innovation, technological opportunities (research productivity), elasticity of demand (e_p)

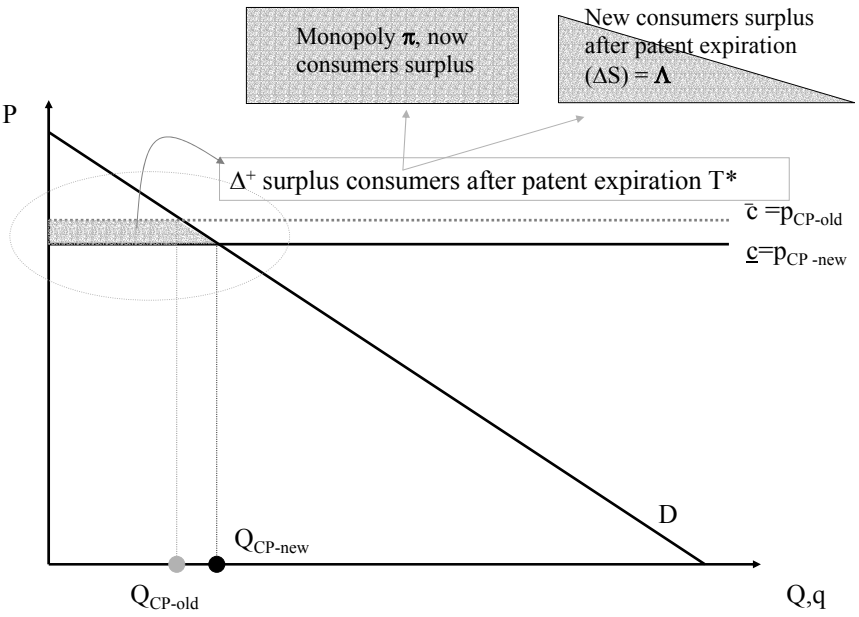
RADICAL INNOVATION: monopoly price lower than marginal cost of non-innovators

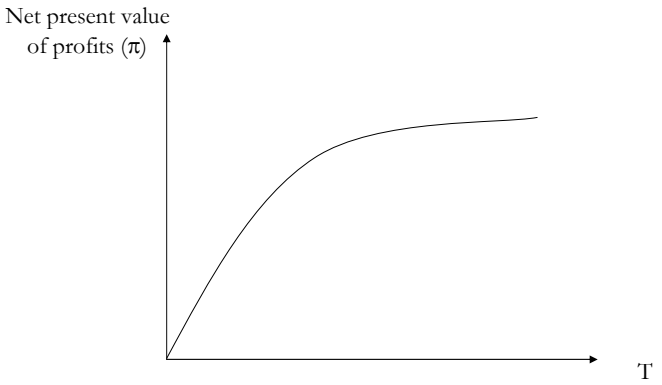




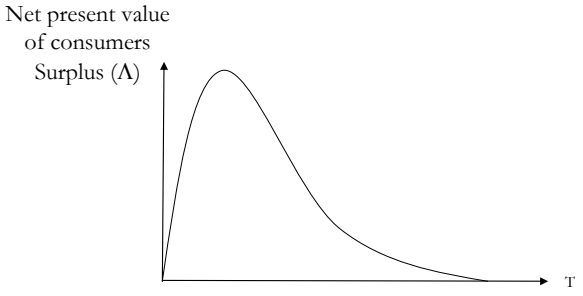
INCREMENTAL INNOVATION: monopoly price higher than marginal cost of non-innovators



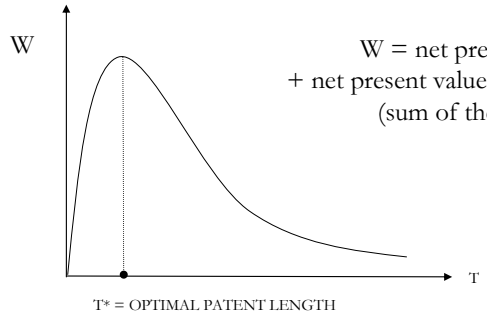




- Net present value of monopoly profits increases with the length (T) of patent → **longer patents induce higher R&D outlays and hence larger innovations**
- Obviously a firm would prefer an infinite patent length

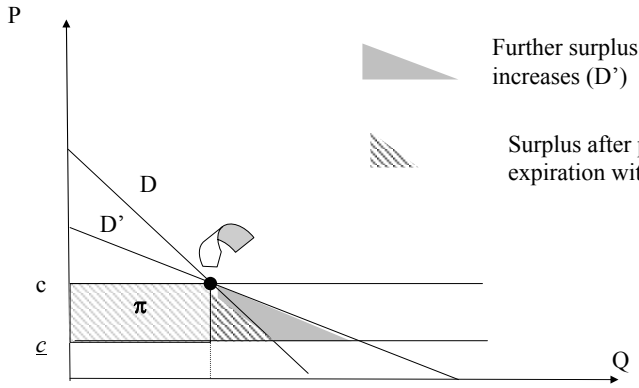


- Starting from a zero patent life consumers benefit from an increase in T → higher R&D investments → innovation
- However, as T increases too much, consumers surplus gets shifted into the future → after patent expiration



W = net present value of π
+ net present value of consumers surplus
(sum of the two curves)

- Picking a too long patent life would produce "too much" incentives for innovators, without any benefit for the consumers
- Picking a too short patent life would not provide enough incentives for innovators and hence no benefits for consumers



Further surplus, if elasticity increases (D')

Surplus after patent expiration with D

- If elasticity increases, ceteris paribus, the "cost" of a patent for the society (lost additional surplus from 0 to T) increases
- … better reducing T (and hence having a less radical inovation), but enjoy the benefits sooner