DEPARTMENT OF ECONOMICS & MANAGEMENT

UNIVERSITÀ DEGLI STUDI DI FERRARA
- EX LABORE FRUCTUS -

Market failure & the economics of patents

Economics of Innovation

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What is a market failure?

- Situations in which the market alone does not reach Pareto Efficiency
- The ‘market alone’ produce an outcome where an individual may be made better-off without making someone else worse-off
- In these cases, is a public intervention justified?
  - Which type of intervention? Depending on the situation and its characteristics various types of action are possible

Various categories of mkt failure

- Due to:
  - Asymmetries of information
  - Lack of competition
  - Externalities
  - Public good
  - …

What is a public good?

- Two characteristics identify the public good:
  - Non excludability: once produced it is not possible (or not convenient) to impede the fruition of the good
    - Such as in presence of free-riding
  - Non rivalry: a good cannot be consumed at the same time by two individuals
- In economics terms: the marginal cost of one additional individual consuming the good is zero (or very close to zero)
- The market does not create appropriate incentives to produce these goods

Pure public good

- A pure public good is both non-excludable and non-rival
  - Can you think of an example of pure public good?
- Can you think of a good which is excludable and non-rival?
- And a good that is rival but non-excludable?

Private & public good

	Excludable	**Non-excludable**
Rivalrous	Private goods	Common goods
	food, clothing, cars, parking spaces	fish stocks, timber, coal
Non-rivalrous	Club goods	Public goods
	cinemas, private parks, satellite television	free-to-air television, air, national defense

Data, Information, Knowledge

- Data: basic elements of information
- Information: sets of data
- Knowledge: comprehension of information and their applicability

- Economic theory did not distinguish information from knowledge for quite a long time
  - We consider information to be the same as knowledge

Information market failure

- Which is the contribution of information in relation to the innovation process and also to economic growth?
- Conflict interest between social and individual interest
  - Why?
    - Which is the social interest?
    - Which is the individual (firm) interest?

Arrow (1962) and Nelson (1959)

- Knowledge, given its characteristics of public good, once created, generate benefits also to those that did not contributed to produce it (it's a sort of spillover, knowledge spillover)
- The private marginal benefit of who made the investment to produce the new knowledge is inferior to the social benefit
  - Why is it so?

Example

- Let's think about the output of a research
  - What is the output of the research that made Google to come into life? Or Facebook?

- Have you seen "The Social Network" movie?
  - https://www.youtube.com/watch?v=BzZRr4KV59I

  - https://www.youtube.com/watch?v=xdiFzcpmmJc

As a consequence

- On the one hand the higher is the amount of knowledge in the economic system, the higher will be the benefit for the entire system
- On the other hand the private sector will invest in the production of knowledge only if they can return of the investment made to produce such knowledge

Which available solutions?

- Two possible solutions:
  - Public funding to the creation of knowledge
  - Incentives for privates to invest in new knowledge production
    - Patent system
- How does the patent system works? How does it respond to the two objectives of favouring knowledge diffusion and providing the incentives to firms to invest in knowledge creation?

What is a patent

- It is a right on a ‘public’ good
- Temporary monopoly on the property of a piece of information/knowledge or set of information/knowledge
- It probably represent the most important dimension of intellectual property rights (IPRs)

The economics of patents

- The patent system has two main functions:

1. Incentivise private sector investment in research (or in production of new knowledge): private incentive

2. Facilitate the diffusion of innovation: social benefit
    - Inventions that would be kept secret without patents are more likely to be revealed when under patent protection, making them freely available after the patent expires

According to David (2003)

- By increasing the expected private returns from innovation, it acts as an incentive mechanism to private investment in knowledge production.
- Patents facilitate the market test of new invention because they allow disclosure of the related information while (in principle) protecting against imitation
- Patents create transferable rights (by granting a license, the owner of the knowledge allows it to be exploited by other agents).
- Patents are a means to signal and evaluate the future value of the technological effort of the companies that own them (which is particularly useful in the cases of new or young companies for which other classes of "intangibles" cannot be used for proper evaluation).
- This way of providing market incentives for certain kinds of creative effort leaves the evaluation of the intellectual production to be determined *ex post, by the willingness of users to* pay; it thereby avoids having society try to place a value on the creative work *ex ante – as would* be required under alternative incentive schemes, such as offering prospective authors and inventors prizes, or awarding individual procurement contracts for specified works

According to Hall & Harnoff (2012)

The Patent System Tradeoffs

Effects on:	Benefit	Cost
Innovation	creates an incentive for R&D; promotes the diffusion of ideas	impedes the combination of new ideas & inventions; raises transaction costs
Competition	facilitates entry of new small firms with limited assets; allows trading of inventive knowledge, markets for technology	creates short-term monopolies, which may become long-term in network industries

Summing up, patents are useful for:

- Create the incentives for firms to invest in R&D (providing an economic return from the investment)
  - Know-how generated via R&D is very costly to produce and relatively cheap to reproduce
- In some sectors is the only way to advance research in the private sector:
  - Pharmaceutical and Biotech
    - Impede rapid imitation from competitors (and impede free riding)
    - Function also as signalling for start-up to raise venture capitalists (VC) funds
- Allow an efficient market for knowledge and facilitate technology transfer

Conversely the drawbacks are

- Given the indivisibility of knowledge:
  - Knowledge is cumulative (dispersion and fragmentation across agents)
  - Obstacle for new innovation based on knowledge owned by others
- Hostile behaviours: ‘patents war’
- Knowledge exchange and diffusion limited

Licenses

- Two main types of licenses:
  - Exclusive: patent licensing to only one buyer
    - Problems of diffusion and fragmentation of knowledge and inventions
  - Non exclusive: patent licensing to more operators at a lower price compared to exclusive license
    - Usually adopted when the invention is of lower value

Public finance of research

- In ancient times scientists were supported by riches and kings
- Today they are publicly supported by the State
- The greater the amount of knowledge in the society, the larger the welfare of the society
  - Think about Education, Health, and so on (examples of public good market failure in which the State support the expenditures)

Why do researchers quite like patents?

- Because they are a very nice source of information
  - IPC: international patent classes
    - Technological variety, technological distant, patterns of specialisation, …
  - Citations
    - Backword and forward: flows of knowledge, geography of knowledge, netowrks, …
- Very much used to study innovation
  - Sometimes caution is needed in drawing implications

Questions?

Innovation and IPRs
Granstrand (2005): Chapter 10 in OxfHand

- Intellectual property rights (IPRs) are of many form:
  - Patents, trade secrets, copyrights, trademarks, design rights, database rights, and so on
- Despite their long history, until rather recent times they did not occupy a central place in debates over economic policy, national competitiveness, or social welfare

Let’s stick to patents

- When and where was promulgated the first formal patent code? Make your bets
  - 1474
  - Venice
- The 1474 patent code constituted a policy for Venice to attract engineers from the outside and stimulate orderly technical progress. These laws signified the emergence of a new era, as patent-like privileges spread within Europe

Eras in the history of patents and IP

Table 10.1 Eras in the history of patents and IP[1]

Era	Characteristics
1. Non-patent era (Ancient cultures: Egypt, Greece, etc.)	Emergence of science separated from technology Emergence of cultural and industrial arts Secrecy and symbols emerging as recognized IP No patent-like rights or institutions for technical inventions
2. Pre-patent era (Middle Ages to Renaissance)	Emergence of universities Secrecy, copyright and symbols (artisan/trade marks/names) as dominant IP, also collectively organized Emerging schemes to grant privileges and remunerate disclosure Extensions of mining laws to inventions
3. National patent era (Late 15th–late 18th cent.)	Breakthrough of natural sciences Local codifications of laws for patents (Venice 1474, England 1623, etc.), copyrights (Venice 1544, England 1709, etc.), etc. Regulation of privileges Conscious stimulation of technical progress at national level, linked to economic policies (e.g. mercantilistic)

Eras in the history of patents and IP

4. Multinational patent era (Late 18th–late 19th cent.)	Emergence of modern nation states Industrialization Continued international diffusion of the patent system Local anti-patent movements Emerging international patent relations (e.g. disputes)
5. International patent era (Late 19th–late 20th cent.)	Emerging industrial and military R&D International coordination of the patent system (Paris Convention 1883, WIPO, PCT, EPO, etc.) Separate IP regimes in socialist countries and LDCs
6. The pro-patent/pro-IP era (Late 20th cent.–?)	Intellectual capital surpasses physical capital for many entities Intensified international competition Global activism for IP from industrialized countries, especially from the US (leading to TRIPS and the WTO) Almost worldwide adoption of the patent system Increased international patenting

Table 10.2 Chronological overview of major events in US post-war IPR development (through 2000)

Year	Event
1949	Patents so frequently declared invalid when litigated that Supreme Court Justice Jackson remarks, "the only patent that is valid is one which this Court has not been able to get its hands on". (*Jungerson v. Ostby & Barton Co.*)
1952	The present (as of 2003) US Patent Law is passed. Revisions have occurred continually.
1976	US Copyright Act enacted.
1979	US Senate and President Carter desire to strengthen domestic patent enforcement.
1980	US Supreme Court declares man-made microorganisms to be patentable and states in a dictum that "anything under the sun that is made by man" can be patented. Bayh-Dole Act enacted, facilitating for universities to patent inventions from federally funded research.
1981	The US Justice Department revises its antitrust enforcement activity to make it easier for patents not to violate antitrust statutes. US Supreme Court decision in the Diehr case leads through its USPTO interpretation to patentability of certain computer software.

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1982	CAFC is established. In quick order, the court changes the validity of litigated patents from 30% to 89%, thus initiating an era in which patents are of much greater interest to industry.
1983	Patent Commissioners' trilateral conference started.
1985	WIPO Harmonization conference. USITC litigations increased. The Young Report delivered to President Reagan by the Commission on Industrial Competitiveness (headed by Hewlett-Packard's John Young).
1986	TI semiconductor patent litigation initiated at USITC. GATT TRIPS negotiations started.
1988	US Trade Act (Special 301). US Tariff Act 337 amended.
1989	The Structural Impediments Initiative (SII) talks initiated between the USA and Japan remove structural impediments to trade between the two nations, and include intellectual property protection. Japan on Watch List of Special 301.
1992	US Patent Law reform report. Honeywell won patent litigation against Minolta.

...continued

1993	GATT TRIPS negotiations completed.
1994	World's industrialized nations agree to harmonize aspects of their intellectual property protection under the auspices of GATT, known as the TRIPS agreement. US–Japan Patent Commissioners' Understanding signed. After years of favorable court decisions, all software is now clearly patentable.
1995	GATT-related TRIPS agreement causes USA (and other nations) to amend its patent laws to expand the patent term to 20 years from filing date (from previous 17 years from issuing date, thus giving mixed effects depending upon the application processing time at the USPTO), allow inventive activity abroad to be considered by the patent office, and permit the filing of provisional patent applications.
1998	The CAFC declares inventions of so-called business methods to be patentable (which include e.g. financial inventions, teaching methods, and e-commercial methods) in *State Street Bank and Trust v. Signature Financial Group* by stating that "since the 1952 Patent Act, business methods have been, and should have been, subject to the same legal requirements for patentability as applied to any other process or method". The Digital Millennium Copyright Act enacted.

Grandstrand (2005)

“The IP system has over the years spawned a series of legal and economic controversies. Among the legal controversies is the nature of IPRs: are they rights in the first place? Couldn't a liability approach do better? Do they have to be exclusive and/or temporary rights? And if a right, what kind of right? Is it an individual natural (or moral) right or a right conferred to the individual by society, justified on the grounds that its consequences are beneficial to the society?”

Granstrand (2005)

"There has been a **continuing discussion** (with varying intensity) over the centuries **about the pros and cons of the patent system**. One key question is whether the system can correct for (or lead to) over-or underinvestment in R&D and innovation (from a societal point of view). Another issue is whether the system distorts, redirects, or blocks technological progress. Still another (but related) topic concerns how the patent system affects static and dynamic efficiency through its impact on competition and trade. For a classic review of these issues, see Machlup (1958); for a more recent contribution, see Mazzoleni and Nelson (1998)."

reading

Boldrin et al., 2009
“Do patents encourage or hinder innovation? The case of steam engine”

Granstrand (2005)

"Nordhaus (1969) argued that increasing the length of patent protection increases the incentives for investment in process innovation (and hence "dynamic efficiency") but at the expense of "static efficiency" (since increased protection means less competition, higher prices, and slower diffusion). An "optimal patent length", Nordhaus pointed out, involves a trade-off between these two effects, and will depend on the nature of competition, the price elasticity of demand and the R&D elasticity of process cost reduction."

Granstrand (2005)

“More recent research focuses on the optimal breadth or scope of a patent (see Jaffe 2000 for an overview) as well as optimal combinations of length and breadth (Klemperer 1990). The scope of a patent defines the range of its industrial applications by delineating the set of technological designs that the claims in the issued patent give protection to (i.e., exclusion of imitators). […] The scope of a patent is far more difficult to parametrize than its duration. Thus, the “optimal” scope for patents is a very complex issue, as shown by Merges and Nelson (1990). The scope of a patent affects the private as well as the social rates of return from patented industrial innovations (just as the time duration of a patent does), and these returns will vary among industries and technologies.”

In the words of Fritz Machlup

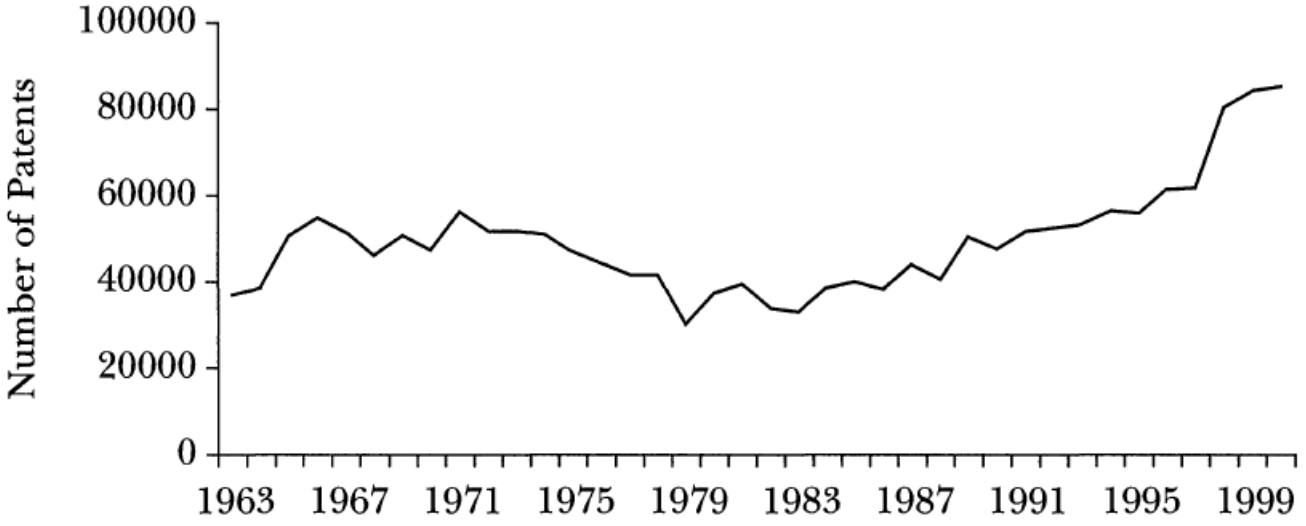
“If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.”

Some figures on patents

Gallini (2012): “New patent applications in the US by domestic inventors climbed to nearly 150,000 per year by the late 1990s, after hovering around 60,000 per year through most of the 1980s. The increase in patent applications gave rise to a doubling of new patents granted per year to domestic inventors between 1985 and 1999.”

Figure 1

U.S. Domestic Patent Grants, 1963–2000



Source: U.S. Patent and Trademark Office (2000).

...continued

Gallini, 2012: “Every major industrial sector has been represented in this surge in activity. The high-tech sector has been most prominent, with a doubling of biotechnology patent grants and of computer software patents between 1990 and 2000 (U.S. Patent and Trademark Office, 2000). The largest 100 universities tripled their annual patent output from 1984 to 1994 (Cohen et al., 1998b), and real expenditures on research and development by small and medium-sized firms (fewer than 5,000 employees) more than doubled between 1987 and 1997 (National Science Foundation, 1997)”

Patents differ across sectors

- Most studies of the role of IPRs, especially patents, reveal strikingly large differences across industries or sectors and countries or regions.

Table 10.4 Sensitivity of the R&D investments of large Japanese corporations to length of term (1992)

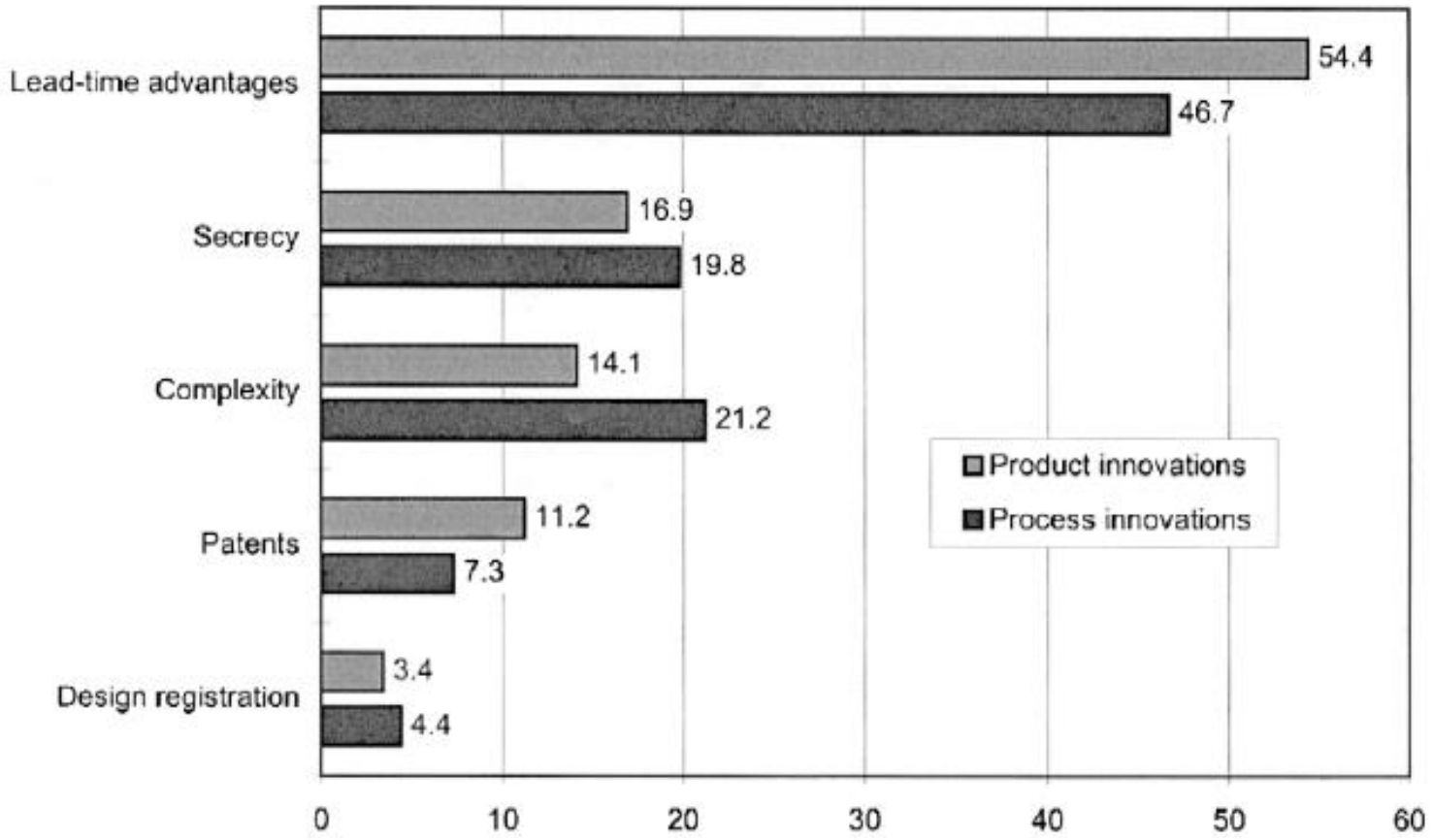
What would the effect be on your company's total R&D budget (as a rough percentage), if the maximum length of patent protection was:	**Chemical (n=9)**	**Electrical (n=10)**	**Mechanical (n=5)**	**Total (n=24)**
(a) Increased by 3 years	+8.5	+2.8	+0.3	+4.8
(b) Decreased to 10 years	−21.2	−3.7	−0.3	−10.7
(c) Decreased to 0 years (i.e. patent protection ceases)	−59.2	−40.0	−5.5	−38.2

Source: Granstrand (1999).

What about if a company is a start-up rather than an incumbent?

- In the later stages of industry evolution, the R&D scale is often high, and barriers to entry tend to be built up by incumbents, especially against small firms (see e.g. Granstrand and Sjölander 1990, and Arora et al. 2001). The use of various patent portfolio strategies such as blanketing or “evergreening” together with litigation threats by large firms (both incumbents and diversifying entrants) may serve this purpose (see Granstrand 1999, 2004). This may result in a division of R&D labor, in which small firms specialize in early-stage R&D, and license their new technologies to established firms specializing in later stages of the innovation process, and/or seek to be acquired by established firms (rather than investing in production and marketing).

How do firms protect their innovations?



Questions?