

How to protect firm's technological innovation ?

Patents

APPROPRIABILITY

The degree to which a firm can capture the rents from its innovation is termed **appropriability**.

The appropriability of an innovation is determined by how easily or quickly competitors can imitate the innovation.

The ease with which competitors can imitate the innovation is, in turn, a function of both the nature of the technology itself and the strength of the mechanisms used to protect the innovation.

Level of difficulty in Imitation

Some technological innovations are difficult for competitors to copy;
The knowledge underlying the technology may be rare and difficult to replicate.

A firm's unique prior experience or talent pool may give it a foundation of technical know-how that its competitors do not possess.

This knowledge base could be:

- **tacit:** it cannot be readily codified into documents or procedures;
- **socially complex:** it arises through complex interactions between people and competitors will typically find it very difficult to duplicate.
 - a firm that has a team of uniquely talented research scientists may have a **rare and difficult-to-imitate** knowledge base.

Level of difficulty in Imitation

- While some of the skill of the research scientists may be due to imitable training procedures,
 - ***talent*** typically implies that an individual (or group) has a natural endowment or ability that is very difficult, if not impossible, to replicate through training.
- Furthermore, if the unique capabilities of the research team arise in part from the nature of the interactions between the scientists, their performance will be socially complex.
- Interactions between individuals can significantly shape what each individual perceives, and thus what each individual—and the collective group—discovers or learns.

Level of difficulty in Imitation

Many innovations, however, are relatively easy for competitors to imitate.

Individuals and firms often employ legal mechanisms to attempt to protect their innovations.

Most countries offer legal protection for intellectual property in the form of:

- ❖ **Patent**
- ❖ **Trademark**
- ❖ **Copyright**
- ❖ **Trade secret laws**

PATENTS, TRADEMARKS, AND COPYRIGHTS

Patents, copyrights, and trademarks are all ways of protecting intellectual property, they are each designed to protect different things.

- A **patent** protects an invention;
- a **trademark** protects words or symbols intended to distinguish the source of a good;
- a **copyright** protects an original artistic or literary work.

Thus, a typical computer might have components whose designs are protected by patents, logos such as the Starbucks mermaid that are protected by trademark law, and software that is protected by copyright.

Patents

- In many countries, inventors can apply for patent protection for their inventions.
- An invention can be a product, such as a new type of battery, or a process, such as a new way to manufacture bagels.
- In the United States, patents are categorized into different types such as:
 - *utility* patent for a new and useful process, machine, manufactured item, or combination of materials;
 - *design* patent for an original and ornamental design for a manufactured item;
 - *plant* patent for the discovery and asexual reproduction of a distinct and new variety of plant.
- Each country has its own patent system with different requirements, and unless a patent is filed under a regional patent office or an international treaty, the rights it is granted are applicable only in the country in which the patent is filed.

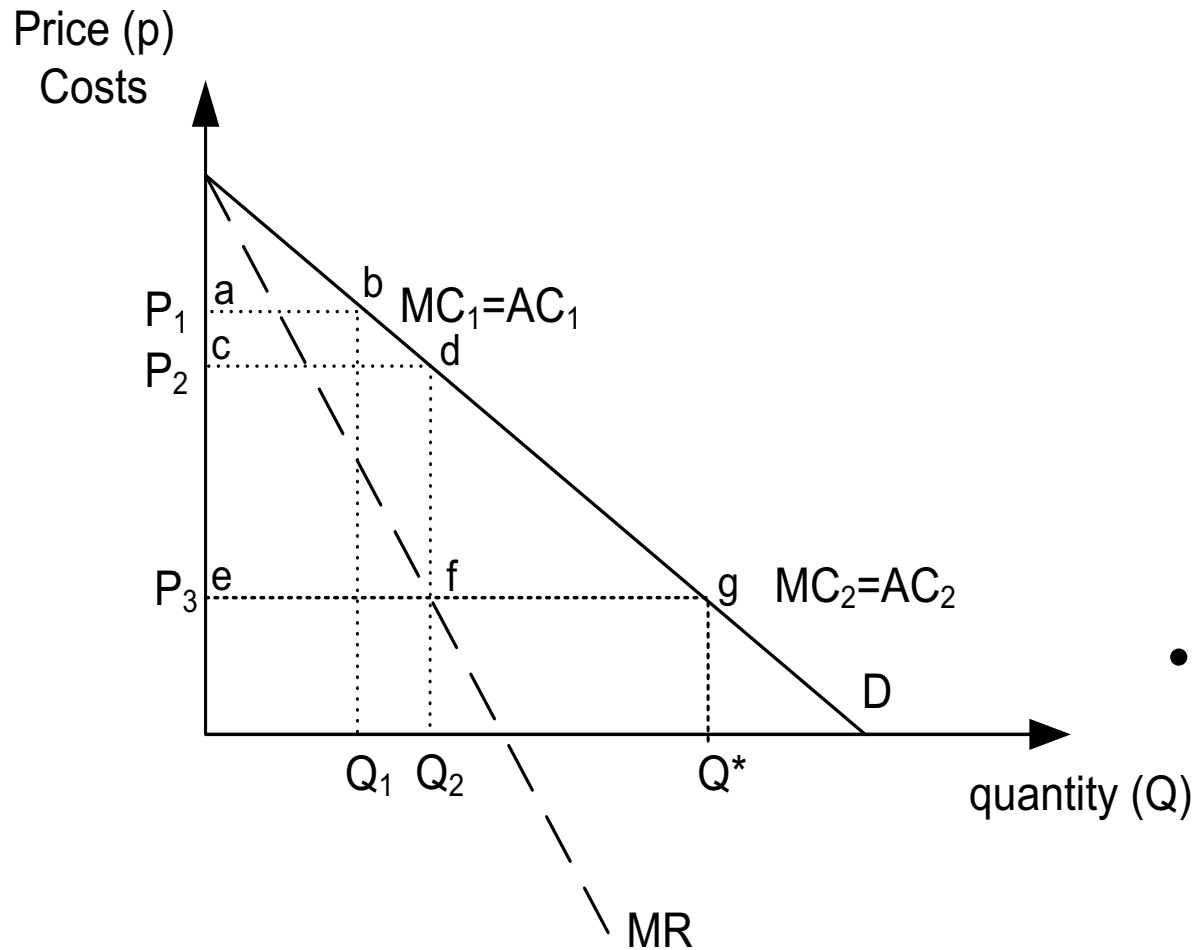
Why are patents awarded?

- Incentive to invest in innovation
 - Note: invention may occur without monetary incentives (due to human curiosity), but an innovation requires investment
- Without some guarantee of private ownership, innovators might not put resources into innovative activity, as their findings would rapidly be imitated, leaving them with little or no profit.
 - This happens as knowledge has the characteristics of a public good: it is nonrival, meaning it can be used by many without being used up; and it is nonexcludable, as it cannot be easily defended from imitators.
 - So IPRs assist the creators of a nonrival good (the innovative knowledge or design) to appropriate the returns of their innovation for themselves alone.

Illustrating the role of patents

- Since patents make a nonrival good excludable, they introduce inefficiency for the duration of the right.
- The patents gives the creator a monopoly right and this causes the price of the good to be above the marginal cost of its production.
- Consumers lose because a monopolist restricts output to raise prices: that is, they lose out because not enough of the innovative good is being sold.

Illustrating the role of patents



- Figure shows a drastic process innovation
 - Patent owner now has monopoly (sets high price compared to marginal cost, and restricts quantity)
 - BUT, price is lower than previous price (pre-innovation), hence society wants innovation.
 - Society would also like lower prices ($P=MC$), and this happens when patent protection expires (normally after 20 years)
- Note: the above logic applies for all product and process innovation, but easy to illustrate with drastic process innovation

Qualification for a Patent

To qualify for a patent, an invention must usually meet the following criteria:

1. It must be *useful* (i.e., it must produce a desirable result, solve a problem, improve on or propose a new use for an existing development or show potential of doing so).
2. It must be *novel* (i.e., it must not already be patented or described in public literature, or be in public use for more than a year).
3. It must *not be obvious* (i.e., a person with experience or skill in the particular art of the patent would not be expected to achieve the same invention with a normal amount of effort).

What cannot be patented

In most countries, the discovery of scientific principles that pertain to natural laws (e.g., gravity) cannot be patented because they are considered to have always existed. Additionally, the following are not typically patentable:

- Substituting one material for another (e.g., plastic for metal).
- Merely changing the size of an already existing device.
- Making something more portable.
- Substituting an element for an equivalent element.
- Altering an item's shape.

How to apply for a patent

To apply for a patent, the inventor must explain how to make and use the invention, and make claims about what it does that makes it a new invention.

Drawings of the new invention are also often required.

In the US, this application is reviewed by a patent examiner who may modify the scope of the claims made by the patent. The patent is then published for a time in which other inventors can challenge the patent grant (if, e.g., they believe that the patent infringes on previously granted patents). If the standards for patentability are met, the patent is then granted. The entire process from application to granting is lengthy.

Dimensions of patent

1. How long does a patent last if it is granted?

- The monopoly right to exploit a patented invention is assigned to the creator for up to twenty years, after which the property right expires and the right to exploitation is open to all without fee or further restriction. There are some exceptions.

2. How near to the original invention another party can get without being judged to have infringed the right of the patent holder?

- This is partly determined by what claims of originality are accepted by the patent examiner in their scrutiny of the application.

3. The patent property right is geographically limited to the area of the legal jurisdiction under which it is registered.

Major International Patent Treaties

- There is currently no “world patent”
- A patent granted in one country does not automatically provide protection in other countries.
- In some regions, however, there are regional patent offices that grant patents valid in all the member nations of that program.
 - the European Patent Office
 - the Africa Regional Intellectual Property Organization

Many inventors wish to patent their inventions in many countries simultaneously. To make that easier, several international treaties have been negotiated between countries that seek to harmonize the patent laws around the world.

Major International Patent Treaties

Two of the most significant treaties are:

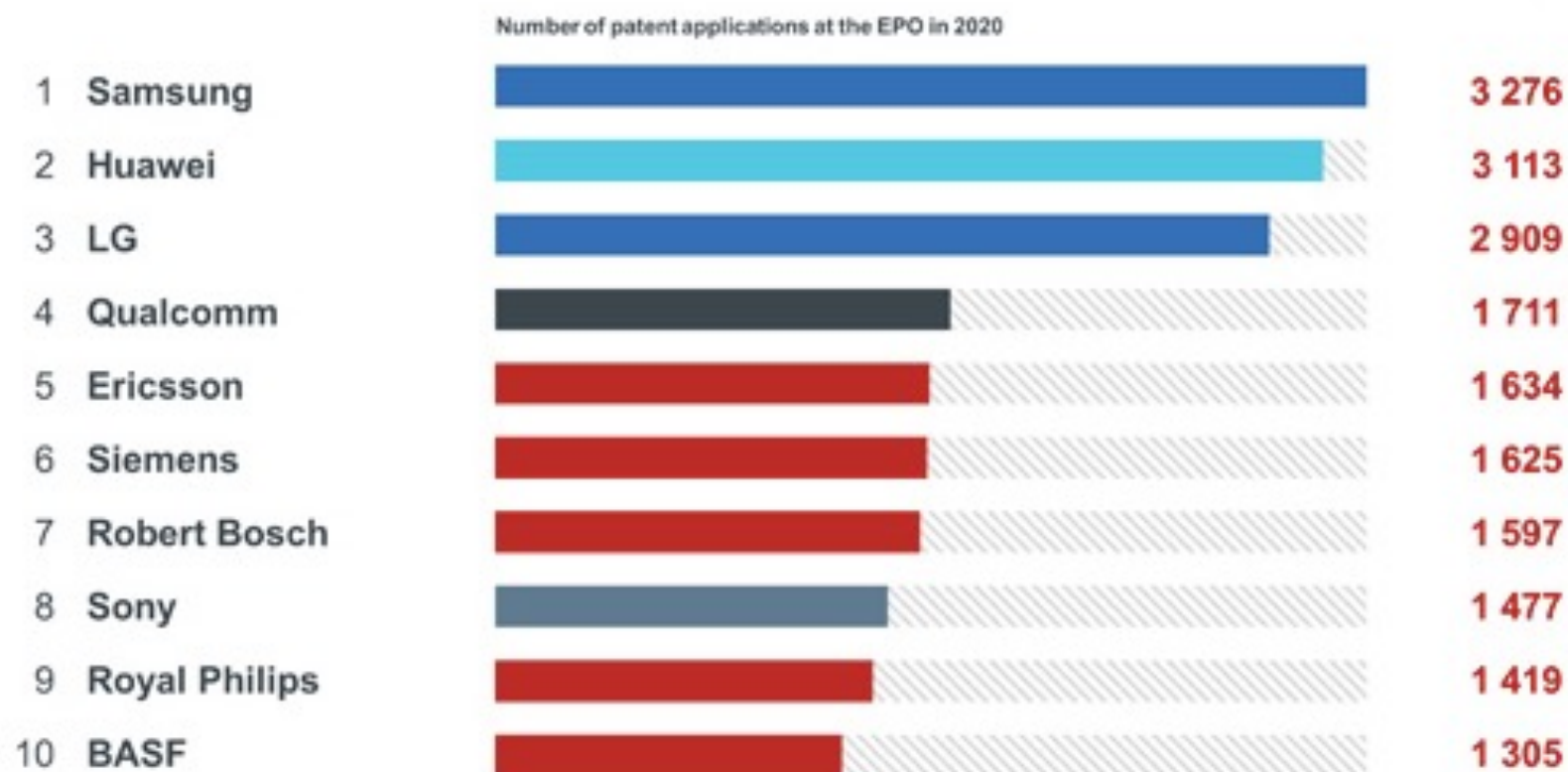
- The **Paris Convention for the Protection of Industrial Property**, signed in Paris, on 20 March 1883, adhered to by 177 countries was one of the first intellectual property treaties. It established a Union for the protection of industrial property. The Convention is currently still in force. The substantive provisions of the Convention fall into three main categories: national treatment, priority right and common rules. Under the Paris Convention, a citizen of any member country may patent an invention in any of the member countries and enjoy the same benefits of patent protection as if the inventor were a citizen of those countries.
- The **Patent Cooperation Treaty (PCT)** is an international patent law treaty, concluded in 1970. It provides a unified procedure for filing patent applications to protect inventions in 152 countries. A patent application filed under the PCT is called an **international application**, or **PCT application**.

A Market for Patent Rights?

- Once a patent is granted, the documentation about the ownership, content, and coverage of the IPR means that the right is saleable (if the owner wishes to take an immediate full private profit).
- Alternatively, the use of the technique, or other inventive step, can be licensed to others at the discretion of the patent holder, providing returns to an inventor who does not wish to pursue production.
- Firms can also engage in patent pooling with one or more other firms, offering their IPRs in exchange for access to other firms' IPRs; they can even make advance contracts for the interfirm exchanges of technology where they see large advantages in reducing uncertainty and time lags in contracting.
- All these features of patents mean that a market for property rights in knowledge can be established.

Top applicants for European patents 2020

TOP 10



● EPO states

● United States

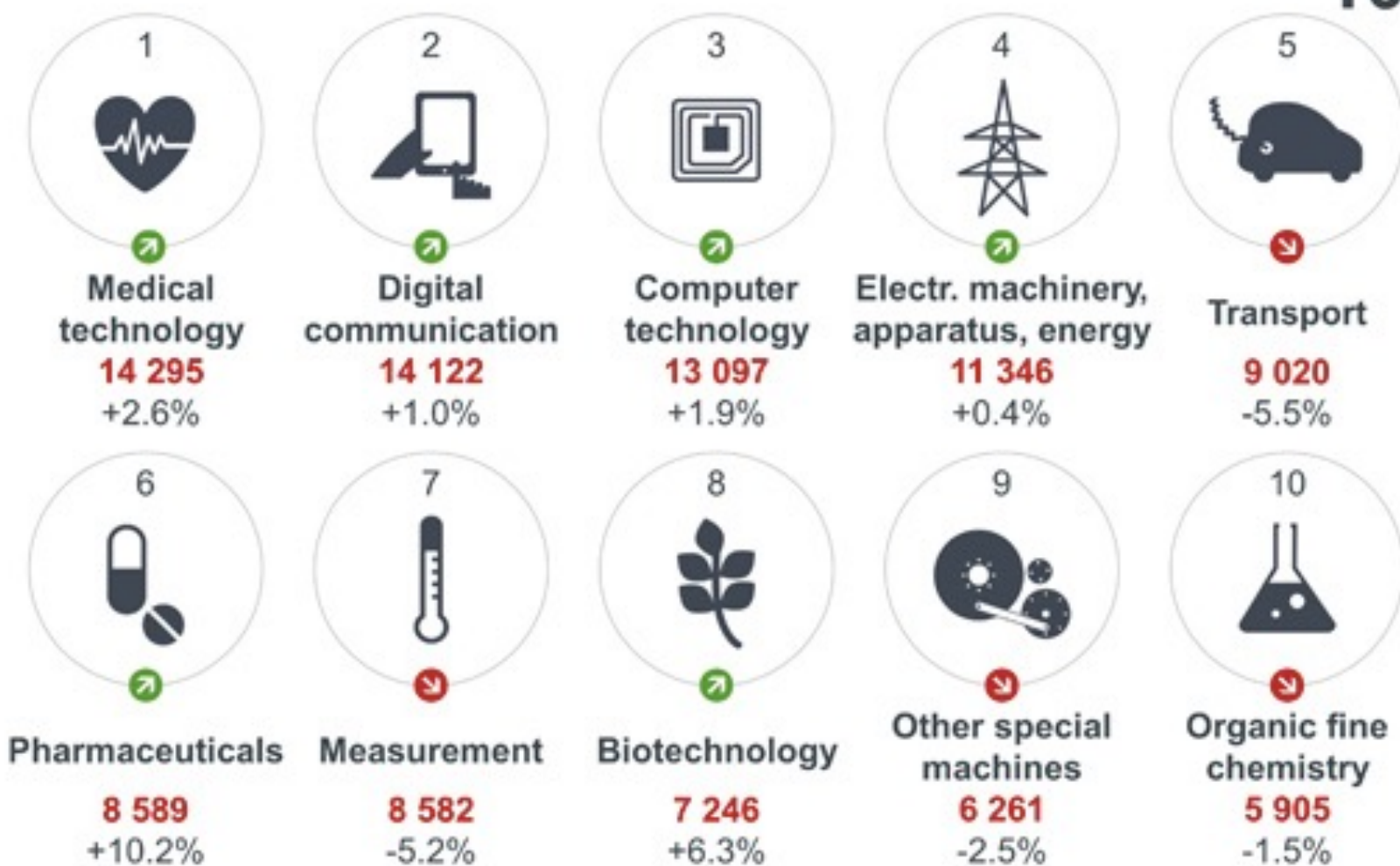
● R. Korea

● P.R. China

● Japan

Top technical fields for European patent applications 2020

TOP 10



Patent Strategies

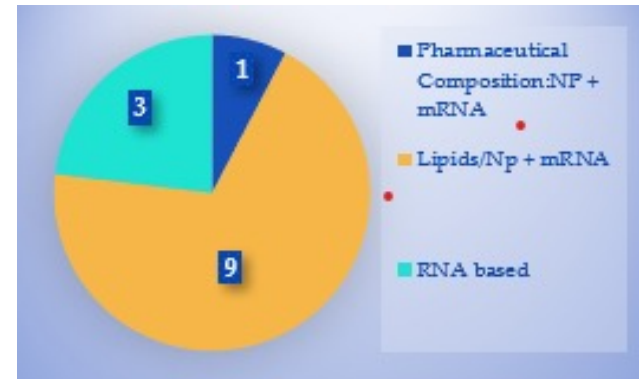
- In general inventors seek a patent because they desire to make and sell the invention themselves.
- However, inventors and firms may monetize patents in a range of different ways, including licensing the technology to others or selling the patent rights to another firm that can better utilize the technology.
- Furthermore, whereas the conventional wisdom is that most inventors prefer to keep the details of their invention secret before the patent is granted (to prevent rivals from having access to their proprietary knowledge), this turns out not to be the case.
- Firms may also seek patents just to limit the options of competitors or to earn revenues through aggressive patent lawsuits. These actions are sometimes referred to as “**patent trolling**.”
- In industries with complex technologies such as computers, software, and telecommunications, a dense web of overlapping patents known as “**patent thickets**” can make it very difficult for firms to compete without falling prey to patent suits by other firms in that technology domain.

An example of patent

Safe and effective vaccines are key to combating the Covid-19 pandemic; patents and other intellectual property claims directed at vaccine technologies create legal barriers for equitable access and fair allocation.

We identified several patents claimed by BioNTech relating to the pertinent vaccine technologies. We placed them in three groups based on their description and their primary independent claim:

- Patents directed at RNA non-exhaustive list.
- Patents directed at Lipids/NP + mRNA
- Patents specifically directed at pharmaceutical compositions involving lipid NP + mRNA



All patents and patent applications identified in this study were claimed by BioNTech indicating that they are the inventor of the relevant vaccine technology, while Pfizer is acting as the innovator and leading the large-scale manufacturing, development, and regulatory approval process.

Patent races

- A patent race is a competition between two or more inventors (usually firms) to discover an invention first in order to obtain patent protection for the invention and exclude competitors.
- In a typical patent race, each inventor or company makes an irrecoverable bid – notably, inventors make substantial research and development (R&D) investments - for the prize of obtaining the patent.
- In a race, the player that is prepared to pay the most to develop the invention first wins the prize (patent).
- One of the players in the race is usually an incumbent monopolist, currently supplying products with which the future invention would compete.
- If the incumbent's rivals do not obtain the patent first, then the monopoly persists, but if the challenger (new firm) wins the patent, the latter will enter the market and compete with the incumbent (Harris and Vickers, 1985).
- In research-intensive industries, such as pharmaceuticals and high-technology electronics, the constant introduction of new products and R&D investment to achieve product innovation are critical for the survival of a firm.

What is the relationship between patent races and innovation?

With regard to innovation, it is important to distinguish between two kinds of patent races:

- 1) standard races, in which the winning firm obtains the patent and the other firm loses its R&D expenditures;
- 2) asymmetrical races, where an incumbent firm tries to prevent a rival from filing a patent first and thereby avoid competition

What are the policy implications of patent races?

Since patent races lead to increased investment, they can also lead to quicker innovation. Therefore, it is important that the patent system be designed to encourage innovation, while carefully weighing the benefits of quick innovation against possible harmful costs generated by races.

Where this is the case, governments can promote research alliances in order to avoid over-investment and duplication of research efforts.

Wasteful patent races could also be eliminated by the early grant of the patent. Nonetheless, this approach has to be carefully designed in order to maintain the incentives that the patent system provides for innovators.

Further information on patents

- US: <http://www.uspto.gov>
 - http://www.uspto.gov/web/offices/ac/ahrpa/opa/kids/kidevents_press.html
- UK: <http://www.ipo.gov.uk>
 - <http://www.ipo.gov.uk/types/patent/p-about/p-funandgames/p-map.htm>
- European Patent Office: <http://www.epo.org/>
 - <http://www.epo.org/topics/ip-webguide.html>
- World IP Office: <http://www.wipo.int>
- Patent scoreboards (national offices and also)
http://bwnt.businessweek.com/interactive_reports/most_innovative/
- There are many on-line resources, including free patent searches (e.g.
<http://www.patents.com/>)

Exercises

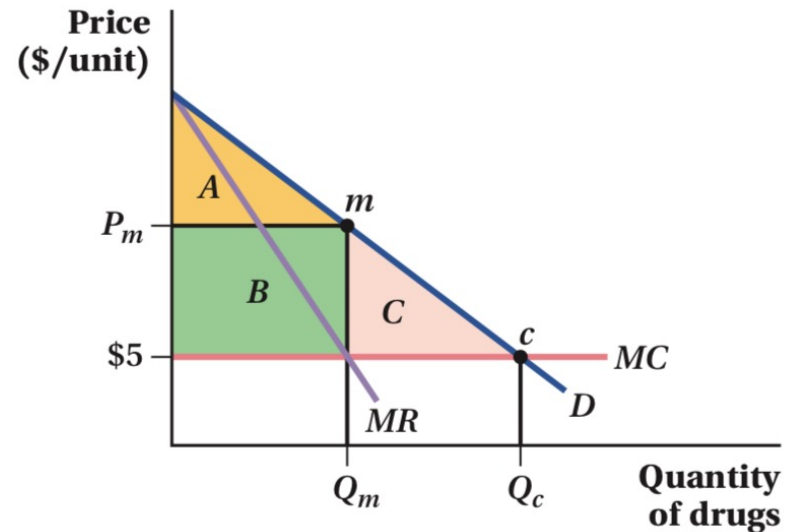
Exercise 1 - Patents

The government encourages innovation by giving companies monopolies on products. D represents the demand curve for the cure for the common cold. In a perfectly competitive market, the drug would be sold at a price equal to its marginal cost, \$5.

1. Draw a graph in which it is shown the consumer surplus
2. At this price, the firm would be able or unable to recover the fixed cost of developing the drug? and would choose to invest or not to invest in the cure for the common cold?
3. What happens if the government give the firm a patent? Determine the price the quantity and the new consumer surplus

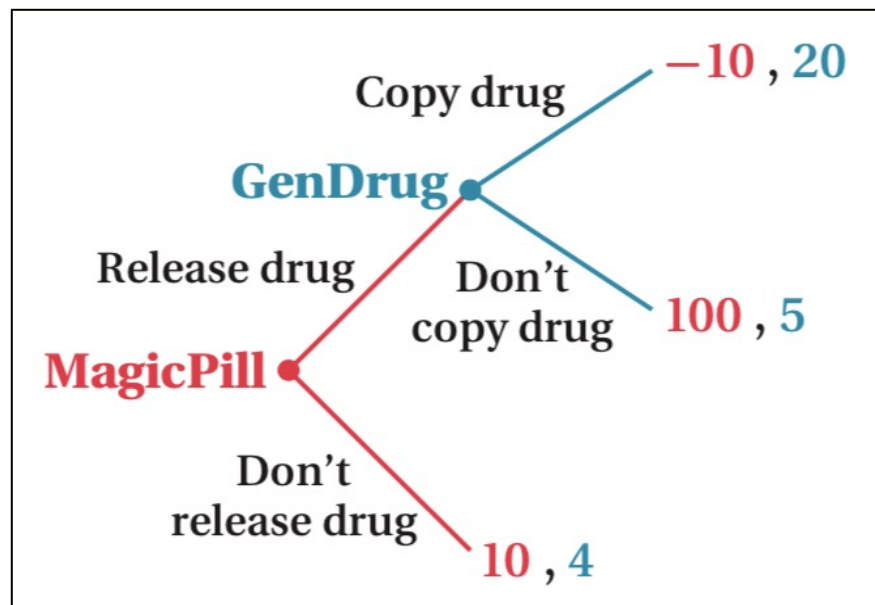
Solution exercise 1

- 1) The consumer surplus would be $A + B + C$
- 2) At this price, the firm would be unable to recover the fixed cost of developing the drug and would choose not to invest in the cure for the common cold.
- 3) By giving the firm a patent, the government allows it to recover the costs of innovation, and the firm produces at the monopoly price P_m and quantity Q_m . The consumer surplus is now the triangle A



Exercise 2 - Patents

MagicPill Inc. has developed a new wonder drug for curing obesity that has been approved by the Food and Drug Administration. If the drug is released for sale, a competitor, GenDrug, will attempt to copy the formula and steal all of MagicPill's customers by offering the wonder drug at a lower price. (Assume there are no patent laws at this time.) The extensive form of the game is shown below (payoffs represent profits in millions of dollars):



- Should MagicPill release this new wonder drug for sale? Explain.
- Would your answer to (a) change if GenDrug promised not to copy the new drug? Explain.
- Would your answer to (a) change if GenDrug signed a contract with MagicPill promising to pay \$10 million if it copies the drug? Explain.
- How would your answer to (a) change if patent laws protect MagicPill's exclusive right to produce its new wonder drug?

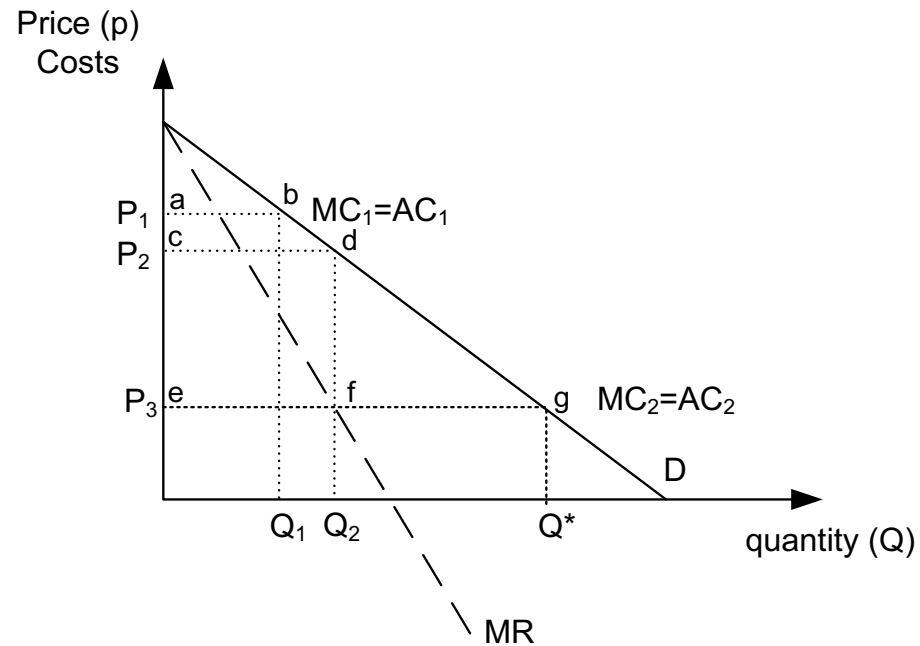
Solution exercise 2

- a. No, MagicPill will not release the drug. Using backward induction, we can see that if the drug is released, GenDrug will choose to copy it (because it can earn \$20 million profit rather than \$5 million). Knowing this, MagicPill is better off not releasing the drug (because it can earn \$10 million rather than losing \$10 million).
- b. No. GenDrug's promise would not be credible. The incentive (\$15 million additional profit) is large enough that MagicPill cannot believe the promise by GenDrug.
- c. No. The payment of \$10 million by GenDrug will not change GenDrug's incentive for copying the drug ($\$20 \text{ million} - \$10 \text{ million} > \$5 \text{ million}$). Furthermore, the payment of \$10 million would not be enough to induce MagicPill to release the drug ($-\$10 \text{ million} + \$10 \text{ million} < \$10 \text{ million}$).
- d. Yes. If the patent prohibited GenDrug from copying the wonder drug, we can ignore the "Copy Drug" option in the game. In this case, Magic Pill will want to release the drug because $\$100 \text{ million} > 10 \text{ millions}$

Exercise 3 - Patents

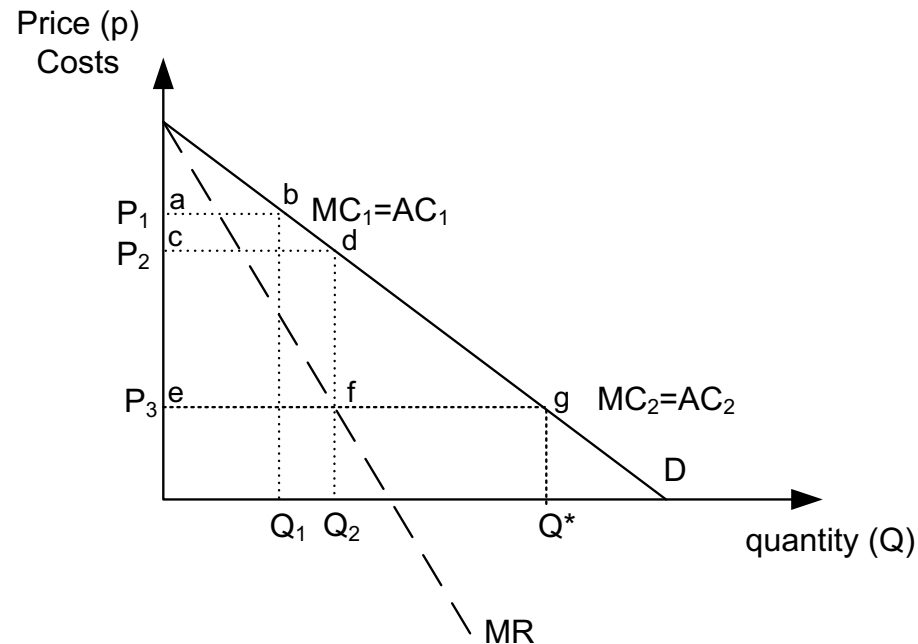
- Draw a graph of a perfectly competitive market, in which the process of production of fabrics with some protection characteristics is standard and the good would be sold at a price equal to its marginal cost, MC_1 .
- On the same graph now draw the situation of one firm that acquires a patent for the innovative technique that allows production of a line of high-tech fabrics with protection characteristics. The new marginal MC_2 cost will be higher or lower?

Solution exercise 3



Before the cost-reducing process innovation many firms produce and sell at price $P_1 = MC_1 = AC_1$ (i.e., the market is perfectly competitive). After the innovation, one firm acquires a patent for the innovative technique that allows production at cost MC_2 . With the new cost at MC_2 , the profit-maximizing price is P_2 (profit maximization occurs where $MR = MC_2$, hence quantity Q_2 is produced and sold at P_2). The patent holder can either supply all of the market at price P_2 or issue licenses to others for the use of the patented technology, charging them $P_2 - MC_2$. When the patent expires the product price falls to $P_3 = MC_2$.

Solution exercise 3 - Discussion



Economists are particularly interested in the *welfare* implications of such cases and we now look at these in detail. The total *social welfare* gain from the innovation in the long run is given by the area ABGE, all of which accrues to consumers by increasing their *consumer surplus* (which measures the difference between the amount they actually pay and the maximum amount they would be willing to pay for this quantity of the product). During the patent period the innovator produces less than Q^* and receives profits of CDFE. These profits provide the incentive for innovation and are generated by the fact that $P_2 > MC_2$. However, this incentive to innovate is lower than the long-run welfare gain by the welfare loss of monopoly, triangle DGF, plus the short-run gains from price reduction accruing to customers of area ABDC.