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 a function of :

- the nature of the technology itself
- 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 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 Starbuck's 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.

- 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.

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.

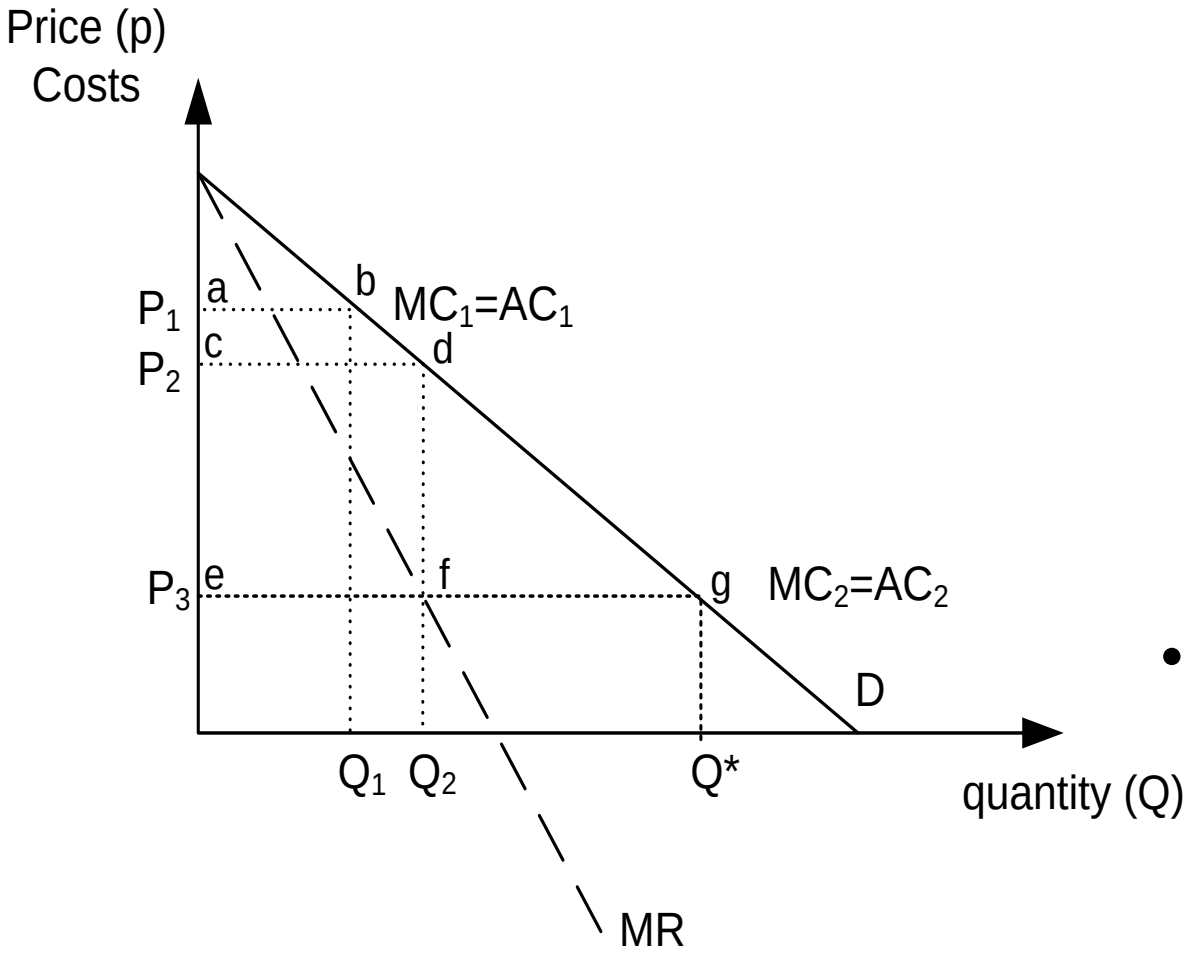
Why are patents awarded?

- An incentive to invest in innovation --> 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, which is a non-rival good, can be used by many without being used up, and it is non-excludable, as it cannot be easily defended by 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,
- make claims about what it does that makes it a new invention.

To obtain a patent, your invention must meet certain criteria, like being new and involving an inventive step. The process starts by filing one or more patent application(s) with the relevant patent office(s).

The office will review your application, and based on their examination, they will decide whether to grant the patent or reject the application.

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.

Dimensions of patent

- 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.

Dimensions of patent

- For **protection across multiple European countries,** you have these options:
- **European patent:** This is the traditional option. You can **file a European patent application**with the **European Patent Office (EPO)**. Should a European patent be granted, you must then **"validate" it with the national patent office** in each country where you seek protection. Each country may have its own requirements, like translations or fees. Today, a European patent may cover up to 44 countries.
- **Unitary patent:** For any European patent granted on or after 1 June 2023 you can also choose the new **Unitary Patent System**, by requesting 'unitary effect' to be attributed to that patent. Today this **gives you coverage in 18 EU countries** (and more in the future), without any national validation requirements.
- If you wish to have **protection at international level**, you can file an 'international application' under the **Patent Cooperation Treaty** to seek **protection in up to 158 countries**. After the 30-month 'international phase', where you will receive feedback on your invention's patentability, you can choose to move forward and apply for patents in the national or regional patent offices that best suit your goals

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. 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.

Top 25 applicants in patents

RANK	ORGANIZATION	2024 US PATENTS	COUNTRY
1	SAMSUNG ELECTRONICS CO., LTD.	9304	KR
2	LG CORPORATION	5156	KR
3	TAIWAN SEMICONDUCTOR MFG. CO. LTD.	4010	TWN
4	QUALCOMM	3489	USA
5	HUAWEI TECHNOLOGIES CO., LTD.	3285	CHN
6	APPLE INC.	3115	USA
7	INTERNATIONAL BUSINESS MACHINES CORPORATION	2774	USA
8	ALPHABET INC.	2698	USA
9	CANON K.K.	2654	JAP
10	TOYOTA JIDOSHA K.K.	2428	JAP
11	SONY CORPORATION	2424	JAP
12	RTX CORPORATION	2047	USA
13	INTEL CORPORATION	2018	USA
14	BOE TECHNOLOGY GROUP CO., LTD.	1993	CHN
15	DELL TECHNOLOGIES	1888	USA
16	MICRON TECHNOLOGY INC.	1869	USA
17	HYUNDAI MOTOR COMPANY	1836	KR
18	MICROSOFT CORPORATION	1781	USA
19	PANASONIC CORPORATION	1769	JAP
20	AMAZON.COM, INC.	1688	USA
21	JOHNSON & JOHNSON	1590	USA
22	TELEFONAKTIEBOLAGET LM ERICSSON	1530	SE
23	HITACHI, LTD.	1425	JAP
24	NIPPON TELEGRAPH & TELEPHONE CORP.	1347	JAP
25	FUJIFILM HOLDINGS CORP	1281	JAP

Top 10 technical fields

1
Digital communication
17 749
+8,6%

2
Medical technology
15 985
+1,3%

3
Computer technology
15 746
+1,2%

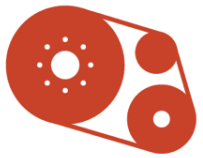
4
Electrical machinery
15 304
+12,2%

5
Measurement
9 565
+3,5%

6
Transport
9 445
+0,0%

7
Pharmaceuticals
9 273
-3,4%

8
Biotechnology
8 367
+5,9%



9
Other special machines
6 538
+1,4%

10
Organic fine chemistry
6 108
+4,1%

Patent Strategies

Inventors seek a patent because:

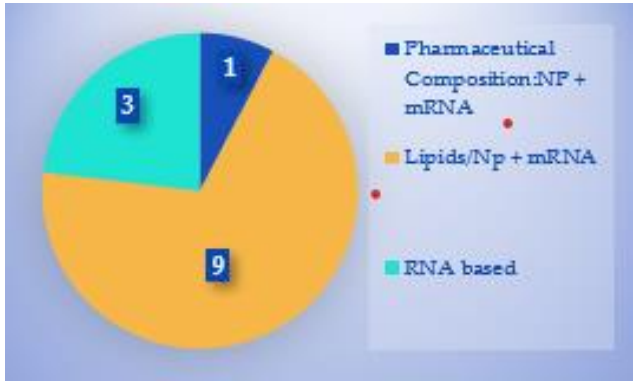
- most often they desire to **make and sell the invention** themselves;
- may desire to monetize patents in a range of different ways, including **licensing the technology to others or selling the patent rights** to another firm that can better utilize the technology;
- just to limit the options of competitors or to earn revenues through aggressive patent lawsuits with actions called “**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

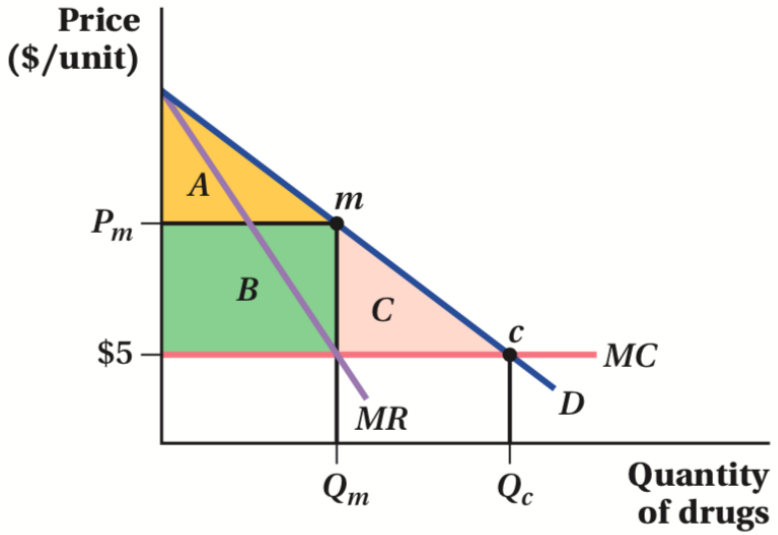
Exercise 1 - Patents

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 appens if the government give the firm a patent? Determine the price the quantity and the new consumer surplus

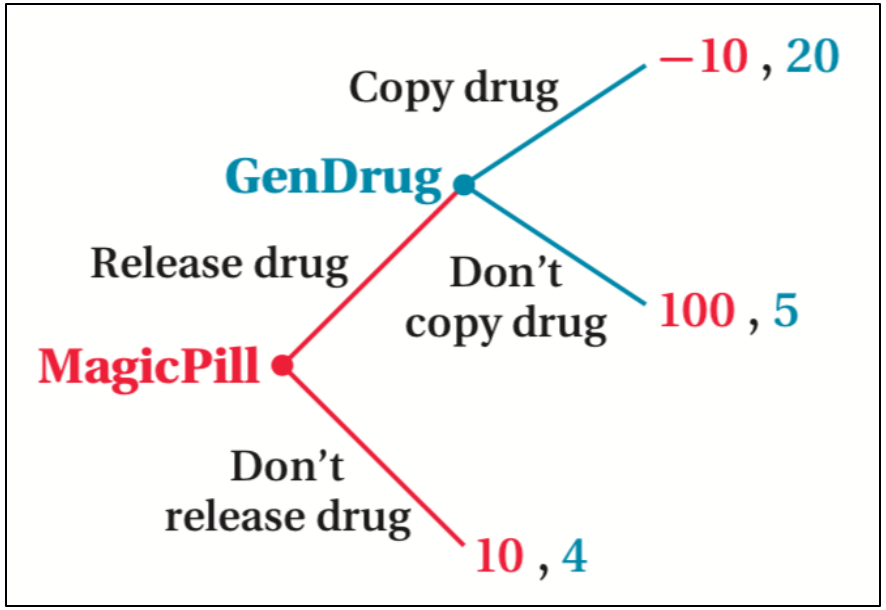
Solution exercise 1

1) The consumer surplus would be *A* + *B* + *C*
2) At this price, the firm would 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 *Pm* and quantity *Qm*. 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):



a. Should MagicPill release this new wonder drug for sale? Explain.
b. Would your answer to (a) change if GenDrug promised not to copy the new drug? Explain.
c. Would your answer to (a) change if GenDrug signed a contract with MagicPill promising to pay $10 million if it copies the drug? Explain.
d. 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.

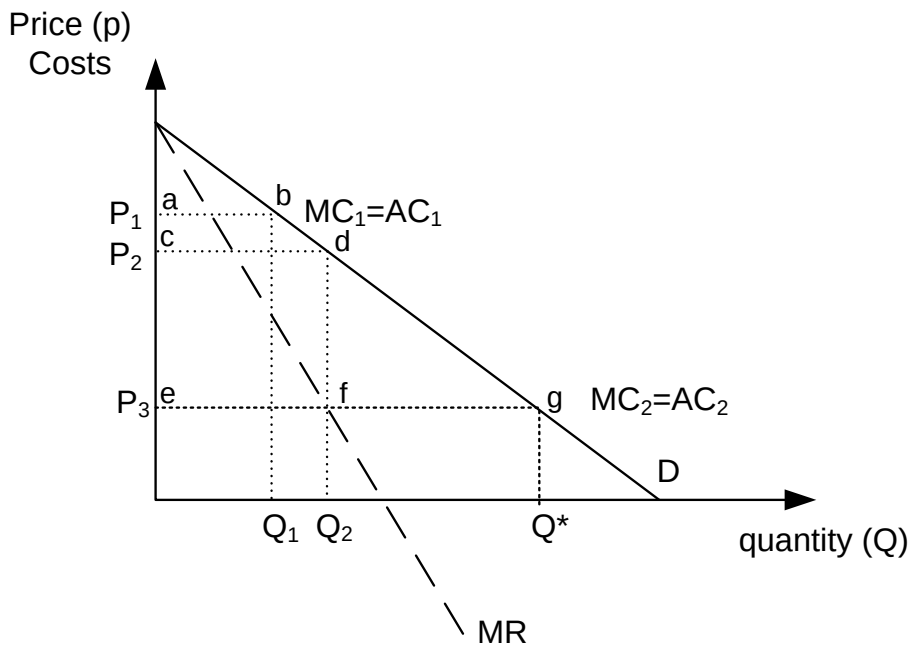
c. No. The payment of $10 million by GenDrug will not change GenDrug's incentive for copying the drug ($20 million – $10 million > $5 million). Furthermore, the payment of $10 million would not be enough to induce MagicPill to release the drug (– $10 million + $10 million < $10 million).

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 million > 10 millions

Exercise 3 - Patents

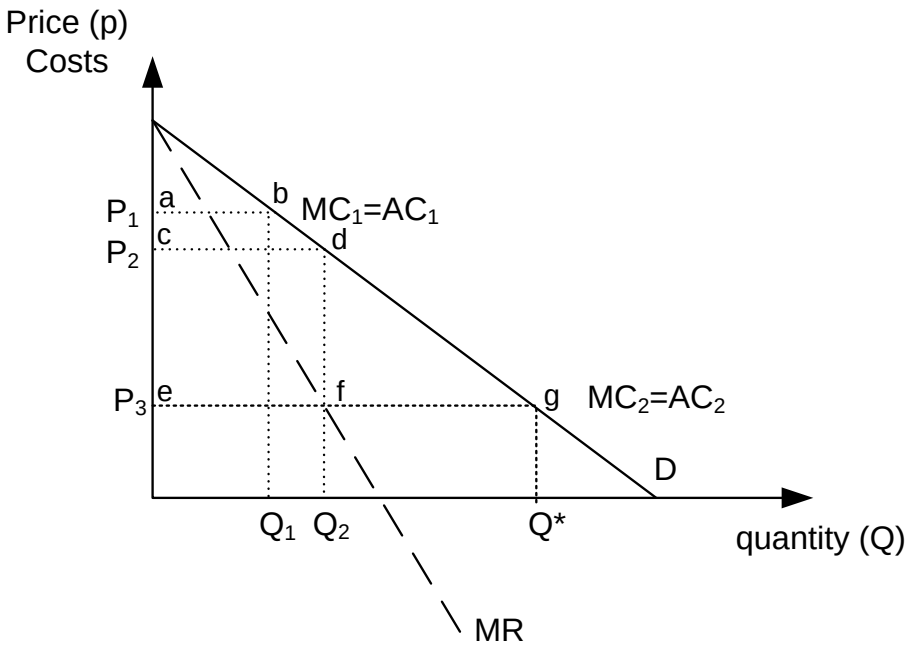
- Draw a graph of a perfectly competitive market, in which the process of production of fabrics with some protection characteristics is standard and the good would be sold at a price equal to its marginal cost, MC_1.
- On the same graph now draw the situation of one firm that acquires a patent for the 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 = MC1 = AC1 (i.e., the market is perfectly competitive). After the innovation, one firm acquires a patent for the innovative technique that allows production at cost MC2. With the new cost at MC2, the profit- maximizing price is *P*2 (profit maximization occurs where MR = MC2, 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 −MC2. When the patent expires the product price falls to *P*3 = MC2.

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 > MC2. 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.