Monopoly, Regulation of Monopoly, Price Discrimination
Industrial Organization

Frieder Neunhoeffer

ISEG, 2025/26

Outline

What is a monopoly?

Let's assume that a "market" has been defined (definition of the *relevant market*).

Definition of monopoly
A firm that dominates the whole (or almost the whole) market.

Examples of monopolistic firms?
- firms in some network industries
- for a long time, EDP (electricity), REN (electricity & gas transmission networks), CTT (postal service provider), Infraestruturas de Portugal (railway), water supply, ...

"Dominant" firms:
- Between 50% and 100% of their market
- No significant competitor

Why do monopolies exist?

Sources of monopoly:

- *Natural monopoly:* due to high entry costs in the industry, economies of scale or scope, it is less costly for one firm to produce than for several
- *Resource-based monopoly:* exclusive control of a scarce input
- *Legal monopoly:* exclusive licensing, patents, public service concessions...
- *Strategic monopoly:* threats coming from firms already present in the market

Symmetric situation to a monopoly? a single buyer is a *monopsony*

Single-product monopoly

Suppose a market has been defined in which there is only **one firm** *(monopoly)*. This firm produces only **one product or service** *(single-product)*.

- The demand function is $q = D(p)$, where q is a quantity and p is a price; demand decreases with price:

$$\frac{dD(p)}{dp} < 0$$

- The inverse demand is denoted by $P(q)$
- The production cost for q units of a product is denoted by C

Single-product monopoly

- The monopoly sets the price that maximizes its profit:

$$\max_{p} \; pD(p) - C\big(D(p)\big)$$

- The *first order condition* (FOC) is given by $MR - MC = 0$ or:

$$D(p) + pD'(p) - C'\big(D(p)\big)D'(p) = 0$$

or also

$$p - C'\big(D(p)\big) = -\frac{D(p)}{D'(p)} = -\frac{\partial p \, D}{\partial D}$$

- We introduce the *price elasticity of demand*:

$$\varepsilon = -\frac{\partial D}{\partial p} \, \frac{p}{D}$$

Price elasticity of demand

Definition

The *price elasticity of demand* measures the sensitivity of demand for a product to its price. Formally, it is defined by the equation:

$$\varepsilon = -\frac{\partial D/D}{\partial p/p}$$

Idea: a 1% decrease in price leads to an ε % increase in demand

Some examples:

- Water: 0.16 (California), 0.17 (South Africa), 0.21 (Australia)
- Electricity: 0.20 (residential), 0.10 (industrial)
- Mobile telephony: 1.5 to 4 in Portugal

The inverse elasticity rule

We use the *price-elasticity of demand* to express the profit-maximizing price

We obtain the inverse elasticity rule:

$$\frac{p - C'\big(D(p)\big)}{p} = \frac{1}{\varepsilon}$$

The monopoly produces on the elastic part of the demand curve (where $\varepsilon > 1$)

- Why?
- What happens when $\varepsilon > 1$?

Attention: except in some special cases (iso-elastic demand curve), the elasticity depends on the price

The inverse elasticity rule and market power

- Definition of "market power": the ability of a firm to raise its price above its marginal cost
- Does a monopoly have strong market power?
- Recall the inverse elasticity rule:

$$\frac{p - C'(D(p))}{p} = \frac{1}{\varepsilon}$$

- Left-hand side of the rule (*Lerner index*) $\rightarrow$ measure of market power

Corollary of the inverse elasticity rule

The **monopoly's market power** is inversely proportional to the price elasticity of demand

Monopoly and market power

Article 102 of the Treaty on the Functioning of the European Union:

- A dominant position (we assume it equivalent to a high market share) is not illegal *per se*
- What constitutes a breach of the Treaty is *an abuse of dominant position* (which is a reference to monopoly power)

Defining a monopoly by "monopoly power" is more robust than defining it by "market share"

- Market definition problems: Apple operates as a monopoly on the Mac market
- A firm with 60% market share could have more market power than a firm with 100% market share

Example: Netscape case

In the legal battle against the U.S. Department of Justice between 1998 and 2001, Microsoft (MS) couldn't claim not to have a quasi-monopoly position in the operating system market.

How did MS defend itself?

MS claimed it could not charge a monopoly price because of

- competing products
- potential entrants
- demand elasticity
- pirated software

$\rightarrow$ MS argued to have a monopoly *position*, but not a monopoly *power*

An American industrial economist (Schmalensee) calculated that the monopoly price (without these constraints) should have been set between \$900 and \$2000.

Comparative statics

Definition:

Comparison of two different economic outcomes by varying an exogenous factor

What is the relationship between the **monopoly price** and the **marginal cost**?

General result:

if the cost function increases with the quantity produced, the monopoly price increases with the marginal cost

Example:

- if demand is given by $D(p) = 1 - p$ and cost of production is $C(q) = cq$
- What is the monopoly price $p^m(c)$?
- We maximize the profit $(p - c)(1 - p)$ with respect to p, and we have $p^m(c) = (1 + c)/2$, which is increasing in c

Multi-product monopoly

- Let's consider a *multi-product monopoly* that produces 2 goods
- The monopoly sets a vector of prices $p = (p_1, p_2)$ and quantity $q = (q_1, q_2)$
- The demand for good i, with $i = 1, 2$, is $q_i = D_i(p)$
- The cost of production, $C(q_1, q_2)$, is separable:

$$C(q_1, q_2) = C_1(q_1) + C_2(q_2)$$

- The profit maximization problem for the monopoly is then as follows:

$$\max_p \left\{ \left(p_1 D_1(p) - C_1(q_1) \right) + \left(p_2 D_2(p) - C_2(q_2) \right) \right\}$$

Multi-product monopoly

The FOC for good i is:

$$\frac{p_i - C_i'}{p_i} = \frac{1}{\varepsilon_{ii}} - \varepsilon_{ij}\frac{(p_j - C_j')\,D_j}{p_i\,D_i\,\varepsilon_{ii}}$$

with

$$C_i' = \frac{\partial C}{\partial q_i}$$

$$\varepsilon_{ii} = -\frac{\partial D_i}{\partial p_i}\frac{p_i}{D_i} \qquad \text{and} \qquad \varepsilon_{ij} = -\frac{\partial D_j}{\partial p_i}\frac{p_i}{D_j}$$

- if $\varepsilon_{ij} = 0$, the demands are independent: it is as if we had two independent single-product monopoly problems
- otherwise, we have to adjust the inverse elasticity rule

Substitute goods

If goods 1 and 2 are substitutes, we have $\partial D_j / \partial p_i > 0$, which implies that

$$\varepsilon_{ij} < 0$$

and thus we have

$$\frac{p_i - C_i'}{p_i} = \frac{1}{\varepsilon_{ii}} + \text{a positive term}$$

The monopoly sets higher prices than two independent monopolies would.

Why?

$\rightarrow$ The monopoly *internalizes* the negative externality (competition effect) resulting from the substitution between the two goods.

Complementary goods

If goods 1 and 2 are complements, we have $\partial D_j / \partial p_i < 0$, which implies that

$$\varepsilon_{ij} > 0$$

and thus we have

$$\frac{p_i - C_i'}{p_i} = \frac{1}{\varepsilon_{ii}} - \text{a positive term}$$

The monopoly sets lower prices than two independent monopolies would.

Why?

$\rightarrow$ The monopoly *internalizes* the positive externality resulting from the complementarity between the two goods.

Inefficiency of monopoly

Two main reasons for the inefficiency of a monopoly:

- The deadweight loss
- Rent-seeking

But there are also arguments that a monopoly situation is efficient:

- In a natural monopoly situation, it is less costly for only one firm to produce than for several firms to produce
- Schumpeterian argument: "Big firms" are more innovative than "small firms"

Measuring social welfare

When trade occurs, economic agents derive some 'surplus':

Consumer surplus
Difference between consumers' willingness to pay and the price actually paid
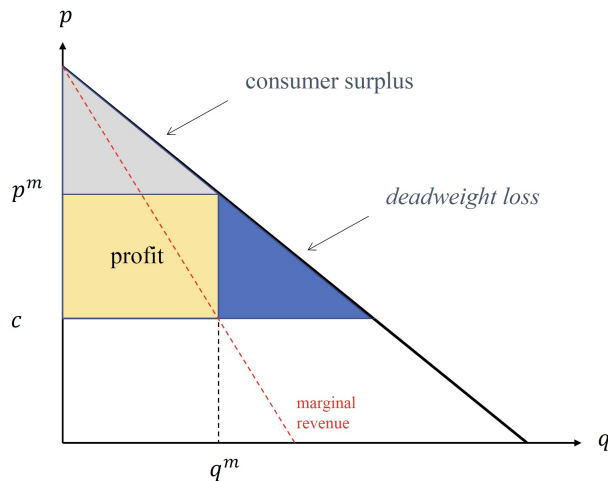
Producer surplus
Difference between producers' revenues and their production costs

Total surplus
Sum of consumer surplus and producer surplus = **measure of social welfare**

The deadweight loss

Some economic studies attempted to calculate the **deadweight loss** at the national level:

- Worcester (1973) for the US: 0.4-0.7% of GDP

The real social cost of a monopoly

Posner (1975) argues that the deadweight loss, as we have defined it, underestimates the real social cost of a monopoly.

$\rightarrow$ The prospect of monopoly profits could act as an incentive for firms (or any economic agent) to expend real resources to obtain a monopoly situation

$\rightarrow$ Idea of "rent seeking"

At the extreme, a firm might be willing **to spend all of its future monopoly profits** to become a monopoly

Optimal regulation of a monopoly

Principle:

In a market, we achieve *allocative efficiency* when all units of production that generate a positive surplus are produced.

- *In other words:* the consumer's willingness to pay for an additional unit should be at least as high as the marginal cost of production
- Efficient allocation of resources = marginal cost pricing

Optimal regulation and balanced budget: a simple example

- Suppose that $C(q) = F + cq$
- What is the efficient price?
- $\rightarrow p^* = c$
- What is the firm's profit at this efficient price?
- Leads to a loss for the monopoly: $\pi^* = -F < 0$
- There is a budget balance problem $\rightarrow$ the optimal regulation is not feasible
- **Solution:** give the firm a subsidy of F
- Problem?
    - subsidies may be prohibited by law
    - to get F, the regulator or the government should raise a tax, which will lead to some efficiency loss, too
    - budget transfers from the state to the regulated firm introduce a risk of *rent seeking*: we talk about **regulator capture**

Regulation with a budget balance constraint

Principle:

Maximize social welfare given that the regulated firm has a balanced budget ($\pi \geq 0$)

Single-product monopoly case?

- Simple: average cost pricing

Multi-product monopoly case?

- More complex: there are many combinations of prices and quantities such that the monopoly firm makes a non-zero profit
- Optimal price combination: "Ramsey-Boiteux" pricing
- Ramsey-Boiteux prices are proportional to the inverse elasticity: the idea is to cover fixed costs by charging more for the least elastic products

Alternatives to regulation

Costs of regulation:

- Information asymmetries (costs, demand)
- Direct costs of regulation (staff of regulatory agency, etc.)
- Risks of capture

Other solutions than regulation? $\rightarrow$ discipline monopoly behavior through market forces

- Competition "à la Demsetz"
- Contestable markets
- Intermodal competition

Competition "à la Demsetz"

- If competition in the market is not possible, we can organize an auction to grant the market to the firm offering the "highest bid" (i.e., proposing the lowest price for the good)
- Auction for the market = competition "for the market" instead of competition "in the market"
- In a single-product industry, if there is no collusion between bidders, and if production inputs are available to all at a competitive price $\rightarrow$ competition "à la Demsetz" should lead to average cost pricing

Contestable markets

- Theory of Baumol, Panzar, and Willig (1982)
- Competition for the market should lead to the optimum with budget balance without public intervention (such as bidding for the market) if there are no sunk costs
- **Sunk costs** = fixed costs that cannot be recouped when production stops
- If the monopoly sets a price higher than marginal cost, competitors will enter and take over the market by setting a slightly lower price ("*hit and run*" strategy)

Intermodal competition

Competition between different "modes" of production

Examples:

- Competition between different modes of transportation: rail versus road for freight
- Competition between different electronic communication networks: telecom networks versus cable TV or satellite networks

Price discrimination

Definition

The practice of charging different prices for the same good (or similar goods), with selling price depending on: the quantity purchased, the characteristics of the buyer, or other contract terms

Examples:

- Student price
- Airline fares ("yield management")
- Volume discounts ("2nd product offers")
- Vouchers ...

It is not price discrimination if prices differ because costs differ (shipping, production, quality)!

Stigler test (1987):

$$(p_1 - c_1) \neq (p_2 - c_2)$$

Conditions for price discrimination

- Firms have market power
- Consumers have different willingness to pay and firms are able to identify them directly or indirectly (self-selection)
- Resale (arbitrage) opportunities are **limited** $\rightarrow$ applies
    - if the good is a service
    - if warranty applies only to the (first) buyer
    - if transaction costs are high (storage costs, search costs, ...)
    - if there are legal restrictions on resale

Pigou classification

Pigou (1920) identifies three forms of price discrimination:

- First degree discrimination (or personalized pricing)
- Third degree discrimination (or group pricing)
- Second degree discrimination (or versioning, or menu pricing). Includes volume discounts (and all forms of non-linear pricing)

These three forms of price discrimination require some level of information about consumers, in decreasing order (1st degree $> 3^{rd}$ degree $> 2^{nd}$ degree).

First-degree price discrimination

Definition (Tirole, 1988)

The producer captures the entire consumer surplus

Examples of first-degree price discrimination? → Bazaar, fortune teller, Amazon (2000), ...

What is the deadweight loss? → No deadweight loss

Remark

If a monopoly implements first-degree price discrimination, allocative efficiency is reached

An example of first-degree price discrimination

Let's consider a monopoly telecommunication operator

- All consumers are identical
- The utility of making q phone calls is $u(q)$
- The monopoly sets a two-part tariff $T = f + pq$
  with f = subscription, p = price per call (or minute)

What is the optimal price for the monopolist?

How can it implement first-degree price discrimination?

An example of first-degree price discrimination

<u>First step</u>: after subscribing to the service, the consumer chooses the number of calls q they want to make to maximize their net utility, $u(q) - pq$, and obtain the following utility from making their optimal number of calls:

$$v(p) = \max_q \{u(q) - pq\}$$

<u>Second step</u>: the monopolist anticipates the consumer's optimal number of calls. It sets the subscription price such that their utility is just higher than the subscription price:

$$v(p) \geq f$$

<u>Third step</u>: let's denote $q(p)$ the demand for calls. The monopoly problem under constraint is:

$$\max_{p,f} \pi = (p - c)q(p) + f$$

An example of first-degree price discrimination

Let us replace f by $v(p)$ and differentiate with respect to p:

$$q(p) + (p - c)\frac{\partial q(p)}{\partial p} + \underbrace{\frac{\partial v(p)}{\partial p}}_{= -q(p)} = 0$$

We have therefore

$$(p - c)\frac{\partial q(p)}{\partial p} = 0$$

such that

$$p^* = c$$

An example of first-degree price discrimination

Result

The optimal price is such that $p^* = c$ and $f^* = v(p^*)$

Intuition:

- The monopoly sets a price for calls that maximizes consumer surplus
- And extracts all the surplus with the subscription price

Remark: all consumers pay the same per-unit price

The European car market in the 1990s

Relative margin ($\frac{p-c}{p}$) for a list of car models in Europe in % (*Verboven, 1996*).

Car model	Belgium	France	Germany	Italy	UK
Fiat Uno	7.6	8.7	9.8	21.7	8.7
Nissan Micra	8.1	23.1	8.9	36.1	12.5
Ford Escort	8.5	9.5	8.9	8.9	11.5
Peugeot 405	9.9	13.4	10.2	9.9	11.6
Mercedes 105	14.3	14.4	17.2	15.6	12.3

$\rightarrow$ Example of third-degree discrimination (multi-market)

Third-degree price discrimination

Definition

third-degree price discrimination occurs when the monopoly sets a different price for each of its customer segments and is able to identify which segment each of its customers belongs to

Example: movie tickets

Third-degree price discrimination

For example, suppose a monopoly operates in different geographical markets.

The monopoly sets its price in each market so that the marginal revenue is the same in all markets and equal to marginal cost:

$$MR_1 = MR_2 = ... = mc$$

This can be written using the **Lerner index**:

$$\frac{p_i - mc}{p_i} = \frac{1}{\varepsilon_i}$$

Prices are lower in markets where demand is more elastic.

Second-degree price discrimination

Definition

Second-degree price discrimination occurs when the monopoly sets different prices for customer segments but is **unable** to identify which segment each of its customers belongs to

We also talk about *discrimination by self-selection, versioning*, or *menu pricing*

Idea:

- The monopoly cannot identify the customers
- But it knows the distribution of customer types in the population
- The monopoly can define an offer to discriminate between the different types of customers
- How? What constraints should be taken into consideration?

Discrimination and competition policy

In the US, the Robinson-Patman Act states that:

"... it shall be unlawful ... to discriminate in price between different purchasers of commodities of like grade and quality ... where the effect of such discrimination may be substantially to lessen competition ... in any line of commerce, ... or to injure ... competition with any person who either grants or knowingly receives the benefit of such discrimination, or with customers of either of them."

Exceptions:

- The price difference reflects the cost difference
- Lower price in response to lower price of a competitor

Real-world example

Discrimination and competition policy

In Europe, price discrimination in retail markets is not prohibited.

United Brand case (1978):

- United Brands sold bananas in different European countries
- Costs roughly similar, but wholesale price very different: e.g., Denmark $> 2\times$ as in Ireland
- United Brands stated that it priced according to what "each market could bear"
- Considered as an abuse of dominant position by the European Commission

Take-aways (1)

- Some companies operate in a "monopoly" market; typically, there are natural monopolies or markets where there are significant barriers to entry (strategic or non-strategic).
- A monopoly that sells only one product sets its price such that the relative margin rate (Lerner index) is inversely proportional to the elasticity of demand.
- A monopoly does not necessarily use its market power.
- A *multi-product monopoly* sets its prices by taking into account the substitutability or complementarity of the goods.
- A monopoly can use its market power even more if it can price discriminate.

Take-aways (2): Monopoly social costs and benefits

Social Benefits

- Efficiency gains from increasing returns
- Investment in R&D (Schumpeter vs. Stiglitz)
- Market power is not necessarily exercised

Social costs

- Exercise market power on consumers: deadweight loss
- Dissipation of monopoly rents
- Cost of monopoly regulation (information asymmetry)

Course materials are based on the Industrial Organization course by Michele Fabi and Marc Bourreau, whom I gratefully acknowledge for generously sharing their materials.