Industrial Organization 01
Monopoly, Monopoly Regulation, Price discrimination

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Structure

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3. Mono-product monopoly
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Monopoly Definition

Let’s assume that a "market" has been defined (relevant market definition stage).

Monopoly definition:

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

Examples?

- Firms in some network industries
- For a long time, EDF (electricity) and France Telecom (telecom), transportation firms (RATP), water supply...

A "dominant" firm:

- Between 50% and 100% of its market,
- Without any important competitor
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.

- **Entry barriers**: due to some market characteristics (high costs or existence of an essential facility) or threats coming from firms already present in the market (strategic barriers).

- **Legal restrictions to entry**: exclusive licensing, patents, public service concessions...

**Symmetric situation to monopoly**: a unique buyer is a *monopsony*. 
We suppose that a market has been defined, where there is only one firm. This firm produces only one product or service.

- The demand function is \( q = D(p) \), with \( q \) a quantity and \( p \) a price, and is decreasing with the price,
  \[
  \frac{dD(p)}{dp} < 0.
  \]

- The inverse demand is denoted by \( P(q) \).

- The production cost for \( q \) unity of product is denoted by \( C(q) \), and we suppose that \( C'(q) \geq 0 \).
Mono-Product Monopoly

- The profit maximisation problem is written as follows,

$$\max_p \quad pD(p) - C(D(p))$$.

- The first order condition (FOC) is written as follows ($Rm - Cm = 0$):

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

or also

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

- We introduce the price elasticity of demand:

$$\varepsilon = -\frac{\partial D}{\partial p} \frac{p}{D}.$$
The Inverse Elasticity Rule

We obtain the inverse elasticity rule:

\[
\frac{p - C'(D(p))}{p} = \frac{1}{\epsilon}.
\]

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

- Why?
- What happens if \( \epsilon < 1 \) ?

Attention: except some particular cases (iso-elastic demand curve), the elasticity depends on the price.
The Inverse Elasticity Rule and Market Power

- **Definition of "market power":** \textit{the ability of a firm to raise its price above its marginal cost.}

- Has a monopoly a high market power?
- Recall the inverse elasticity rule:

\[
\frac{p - C'(D(p))}{p} = \frac{1}{\varepsilon}.
\]

- Left-hand side of the rule = \textit{Lerner index} = 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 is 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 the monopoly power).

To define a monopoly by the "monopoly power" is more robust than to define it by the "market share":

- Market definition problems: Apple operates as a monopoly on the Mac market.
- A firm with 80% of market shares could have more power than a firm with 100% of market shares.
Example: Microsoft Defence

In the legal battle against the American Department of Justice (Netscape case) between 1998 and 2001, Microsoft (MS) could not claim it had not a quasi-monopoly position on the operating systems. How MS defended itself?

Microsoft claimed it was unable to set a monopoly price due to the competition from

- rival products,
- potential entrants,
- its own installed base,
- pirated softwares.

To conclude, MS had a monopoly *position*, but no monopoly *power*.

An american industrial economist (Schmalensee) calculated that the monopoly price (without these constraints) should have been set between 900$ et 2000$.
Comparative Statistics

**Comparative statistics**: variation of an economic variable at the equilibrium depending on an exogeneous factor.

What is the relation between the monopoly price and the marginal cost level?

**General result (e.g., see Tirole, 1988)**

If the cost function increases with the quantity produced, the monopoly price function increases with the marginal cost.

**Example:**
- If the demand is given by $D(p) = 1 - p$ and the cost of production is $C(q) = cq$
- What is the monopoly price $p^m(c)$?
- We maximize the profit $(p - c)(1 - p)$ in relation 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", which produces 2 goods.
- Demand for good $i$, with $i = 1, 2$, is $q_i = D_i(p)$.
- The production costs, $C(q_1, q_2)$, is separable:

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

- The monopoly proposes a vector of prices $p = (p_1, p_2)$ and quantity $q = (q_1, q_2)$.

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

$$\max_p \{ (p_1 D_1(p) - C_1(q_1)) + (p_2 D_2(p) - C_2(q_2)) \}.$$
The first order condition for good \( i \) (1 or 2) 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

\[
C'_i = \frac{\partial C}{\partial q_i}
\]

\[
\varepsilon_{ii} = -\frac{\partial D_i}{\partial p_i} \frac{p_i}{D_i} \quad \text{et} \quad \varepsilon_{ij} = -\frac{\partial D_j}{\partial p_i} \frac{p_i}{D_j}.
\]

– If \( \varepsilon_{ij} = 0 \), demands are independent. It is as if we had two independent mono-product monopoly problems.

– Otherwise, we have to adapt 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 then we have

$$\frac{(p_i - C'_i)}{p_i} = \frac{1}{\varepsilon_{ii}} + \text{a positive term.}$$

The monopoly sets higher prices, that two independent monopolies wouldn’t do. Why?

→ The monopoly "internalizes" the negative externality (competition effet) stemming from the substitution between the two goods.
Complementary Goods

We have $\frac{\partial D_j}{\partial p_i} < 0$, which implies that

$$\varepsilon_{ij} > 0,$$

and then

$$\frac{(p_i - C'_i)}{p_i} = \frac{1}{\varepsilon_{ii}} - \text{a positive term.}$$

The monopoly sets lower prices than two independent monopolies.

The monopoly internalizes the positive externality stemming from the complementarity between the two goods.
The Monopoly Inefficiency

Two main reasons for the monopoly inefficiency:
- The deadweight loss
- Rent-seeking

But there are other arguments to say that a monopoly situation is efficient:
- In a situation with a natural monopoly, it is less costly that only one firm produces than several
- Schumpeterian argument: "Big firms" are more innovative than "small firms"
The Deadweight Loss

The graph illustrates the concept of deadweight loss in the context of monopoly regulation. The area marked as "surplus des consommateurs" (consumer surplus) and the area marked as "profit" are not affected by the monopoly. However, the area marked as "perte de poids mort (deadweight loss)" represents the loss in economic efficiency due to the monopoly's pricing and output decisions. The figure shows the marginal cost (C) and price (p^m) on the vertical and horizontal axes, respectively. The deadweight loss is indicated by the shaded triangle above the marginal cost line and below the demand (p) line, highlighting the inefficiency caused by the monopoly's market power.
Deadweight Loss: Estimations

Some economic studies have sought to calculate the deadweight loss at the national level:

- Worcester (1973) for the US: between 0.4 and 0.7% of GDP
- Cowling and Mueller (1978): between 4 and 13%
- For France: Jenny and Weber (1983): 7.4%
The Real Cost of Monopoly

Posner (1975) argues that the deadweight loss, as we have defined it, **under-estimates** the real cost of monopoly.

→ The prospect of monopoly profits could act as an incentive for firms (or stakeholders) to spend real resources to obtain a monopoly situation.

We talk about ("rent seeking").

In the extreme scenario, a firm could be ready to spend all of its future monopoly profit to become a monopoly.
The Optimal Monopoly Regulation

Principe:
We obtain allocative efficiency when all units of production which generate a non-zero "total surplus" are produced.

- In other words: the willingness to pay for this additional unit is at least as high as its cost of production.
- Efficient ressource allocation = marginal cost pricing.
The Optimal Monopoly Regulation

A simple example
Let’s assume that \( C(q) = F + cq \). What is the efficient price? What is the firm’s profit?

- Efficient price: \( p^* = c \)
- Leads to a loss for the monopoly: \( \pi^* = -F \)
In the previous example, we obtained $\pi^* = -F$

There is a **budget balance** problem, the first best equilibrium is therefore not feasible.

A solution: give a subsidy of $F$ to the firm.

**Problem?**

- Subsidies could be forbidden by the law.
- To get $F$, the regulator or the government should rise a tax, which will lead to a loss of efficiency... higher or lower than the efficiency loss that the regulator is supposed to eliminate.
- A budget transfer from the State to the regulated firm introduces a risk of "rent seeking": we talk about "regulator capture".
Regulation with a Budget Balance Constraint

Principe:
Social welfare maximization, under the constraint that the regulated firm has a balanced budget ($\pi \geq 0$).

Mono-product monopoly case?
- Simple: average cost pricing.

Multi-product monopoly case?
- More complex: there are numerous prices (and quantities) combinations so that the monopoly makes a non-zero profit.
- The optimal price combination: "Ramsey-Boiteux" pricing
- An idea?
- Ramsey-Boiteux prices are proportional (but inferior) to the inverse elasticity: the idea is to compensate the fixed costs on the least elastic services
Alternatives to Regulation

Costs of regulation:
- Information asymmetries (costs, demand)
- Direct costs of regulation (regulatory body)
- Risks of capture

Could we imagine other solutions than regulation?
- Competition "à la Demsetz"
- Contestable markets
- Intermodal competition
Competition "à la Demsetz"

- If the competition in the market is not possible, we can imagine to organize an auction to grant the market to the one offering the "highest bid" (the lowest price).
- Auction for the market = competition "for the market" rather than "within the market".
- In a mono-product industry, if there is no collusion between the bidders, and if the production inputs are available at a competitive price for all,
- Competition "a la Demsetz" should lead to average cost pricing.
Contestable Markets

- Baumol, Panzar et Willig Theory (1982).
- The competition for the market should lead to the optimum with budget balance, without public intervention (such as bid for the market), if there are no sunk costs.
- Sunk costs = fixed costs that cannot be recouped in case of a production breakdown.
- If the monopoly sets a higher price than the marginal cost, competitors enter and take all 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 transport: rail instead of roads for freight.
- Competition between electronic communication networks: telecoms instead of cable or satellite.
Definition of price discrimination

Practices which consists in setting different prices for the same good (or similar goods), the selling price depending on: the quantity bought, the buyer’s characteristics or other contract terms.

Examples:
- Student price
- Flight ticket price ("yield management")
- Sliding scale ("2nd product offered")
- Discount, vouchers, ...
There is price discrimination if the price difference between two versions of a good cannot be explained by a cost difference.

Stigler test (1987):

\[ \frac{p_1}{p_2} \neq \frac{c_1}{c_2}. \]

Philips test (1983):

\[ (p_1 - c_1) \neq (p_2 - c_2). \]
Conditions of Price Discrimination

Conditions for price discrimination:

1. Firms should have market power.
2. Consumers should have different willingness to pay and firms should be able to identify them directly or indirectly (self-selection).
3. Resale opportunities should be limited.

Resale (or arbitrage) is difficult:

- If the good is a service,
- If the warranty applies only to the buyer,
- If transaction costs are high (storage costs, research costs...),
- If there is legal restriction to resale.
Pigou Classification

Pigou (1920) identifies three types of price discrimination:

- First degree discrimination (or personalized pricing).
- Third degree discrimination (or multi-market discrimination or group discrimination).
- Second degree discrimination (or versioning, or menus pricing). Include volume discounts (and all forms of non-linear pricing).

These three types of discrimination require some level of information, which decreases (1st degree > 3rd degree > 2nd 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 experience (2000)...

**What is the deadweight loss? →** No deadweight loss...

**Property**
If a monopoly implements first-degree price discrimination, allocative efficiency is reached.
First-degree price discrimination is feasible if the customers consume more than one unit of the good or service.

Let's take a telecommunication operator in monopoly.

- With $u(q)$ the utility to make $q$ phone calls
- All consumers are identical
- The monopoly sets a non-linear price $T(q) = f + pq$
- $f =$ subscription, $p =$ price per call (or minute)

What is the optimal price for the monopoly? How can it implement first-degree price discrimination?
An Example of First-Degree Price Discrimination

First step: Once a consumer has subscribed to the service, he chooses the number of calls, with:

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

Second step: the monopoly anticipates the consumer’s optimal number of calls. It sets the subscription price such as the utility to make calls is higher to the subscription price: \( v(p) \geq f \).

Third step: let’s write \( q(p) \) the demand for calls. The monopoly problem writes:

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

under the constraint that

\[ f \leq v(p). \]
An Example of First-Degree Price Discrimination

Let’s replace $f$ by $v(p)$ and differentiate wrt $p$ (CPO):

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

we have therefore

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

such that

$$p^* = c$$
An Example of First-Degree Price Discrimination

Results

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

Intuition:

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

Remark: all consumers pay the same price.
The European Car Market in the 1990s

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

<table>
<thead>
<tr>
<th>Modèle</th>
<th>Belgique</th>
<th>France</th>
<th>Allemagne</th>
<th>Italie</th>
<th>Royaume-Uni</th>
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<td>23,1</td>
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<td>Ford Escort</td>
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<td>9,5</td>
<td>8,9</td>
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<td>10,2</td>
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<td>14,4</td>
<td>17,2</td>
<td>15,6</td>
<td>12,3</td>
</tr>
</tbody>
</table>

→ Example of third degree discrimination (**multi-market**).
Third-Degree Price Discrimination

Definition

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

Example: Movie tickets.
Let’s suppose, for example, that a monopoly is active on different geographical markets.

The monopoly sets its price on each market such as the marginal revenue is equal on all markets and equal to the marginal cost:

\[ Rm_1 = Rm_2 = Cm, \]

This can be written with the Lerner index:

\[ \frac{p_i - C'_i(q)}{p_i} = \frac{1}{\epsilon_i}. \]

The price of the good is lower in the market where the demand is the most elastic.
Second-Degree Price Discrimination

Definition
We talk about second-degree price discrimination when the monopoly sets a different price for each of its customer segments and *is not able to* identify to which segment belongs each of its customers.

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

Principle:
- The monopoly is not able to identify the customers.
- But it knows the distribution of the customers types in the population.
- The monopoly can define an offer so as to discriminate between the different type 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 differences reflect the cost differences
- Lower price to respond to a lower price of a competitor
In Europe, price discrimination on the retail markets is not forbidden.

Could be abusive on an intermediate market if the firm is dominant and the input offered important for the buying firms.

Case of United Brand (1978):

- United Brands sold bananas in different European countries
- Costs roughly similar, but wholesale price very different: for example, price in Denmark > 2 x price in Ireland
- United Brands indicated that it priced in function of what "each market could bear".
- Considered as an abuse of dominant position by the European Commission
Take-Aways (1)

- Some companies are active on a market in a "monopoly". Usually there are natural monopolies or markets on which there are important entry barriers (strategic or non-strategic).
- The monopoly which sells only one product prices as such as the relative margin rate 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 between the goods.
- A monopoly can use its market power even more if it is possible to discriminate between consumers.
Monopoly social costs and benefits

**Social Benefits**
- Efficiency gains if increasing returns
- Investments in R&D (Schumpeter against Stiglitz)
- Market power is not necessarily exercised

**Social Costs**
- Exercise of market power on consumers: deadweight loss
- Dissipation of the monopoly rent
- Cost of monopoly regulation (information asymmetry)