Part I: Exercise of Monopoly Power

Chapter 1: Monopoly

Two assumptions:

A1. Quality of goods is known by consumers;
A2. No price discrimination.

• Best known monopoly distortion: \( p > MC \Rightarrow DWL \) (section 1).

• Other distortions:
  – Monopolist has no control over costs (section 2);
  – Rent dissipation behavior (section 3).
1 Pricing Behavior

• Distortion associated to monopolist pricing.

1.1 A Single-Product Monopolist

• \( q = D(p) \) demand function, \( D'(p) < 0 \), \( p = P(q) \) the inverse demand function.

• \( C(q) \) the cost of producing \( q \) units of good, \( C''(q) > 0 \).

• Elasticity of Demand:

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

• Program of the monopoly (in quantity)

\[
\max_q \{ qP(q) - C(q) \}
\]

FOC: \( qP'(q) + P(q) - C''(q) = 0 \) \( \Rightarrow q^m \)

SOC: \( qP''(q) + 2P'(q) - C'''(q) < 0 \)

Result 1: \( MR(q^m) = MC(q^m) \Rightarrow p^m > MC \)
• Program of the monopoly (in price)
\[
\max_p \{ pD(p) - C(D(p)) \}
\]

FOC : \( pD'(p) + D(p) - C''(D(p))D'(p) = 0 \Rightarrow p^m \)

SOC :
\[
pD''(p) + 2D'(p) - C'''(D(p))(D'(p))^2 - C''(D(p))D''(p) < 0
\]

• + assumptions on \( D''(p) \) and \( C'''(q) \) (concavity or quasi concavity).

**Result 2:**
\[
\mathcal{L} \equiv \frac{p^m - C'(.)}{p^m} = \frac{1}{\varepsilon}
\]

where \( \mathcal{L} \) is the Lerner index or relative markup.

**Example** Demand function \( q = kp^{-\varepsilon} \) where \( k > 0 \).

**Result 3:** Monopolist always operates where \( \varepsilon > 1 \).

• See graph

• Formally:
\[
\frac{p^m - C'(.)}{p^m} < 1 \text{ because } p^m - C'(.) < p^m
\]

so, \( \frac{1}{\varepsilon} < 1 \Rightarrow \varepsilon > 1 \)

**Result 4:** Monopoly price is a non decreasing function of marginal cost.
Proof:

- 2 alternative cost functions $C_1(.)$ and $C_2(.)$.
- $C_2'(q) > C_1'(q)$ for any $q$.
- $p_1^m, q_1^m$ if $C_1(.)$, and $p_2^m, q_2^m$ if $C_2(.)$.
- If cost is $C_1(.)$ (resp. $C_2(.)$), $p_1^m$ (resp. $p_2^m$) is charged by the monopolist
  \[ p_1^m q_1^m - C_1(q_1^m) \geq p_2^m q_2^m - C_1(q_2^m) \]
  \[ p_2^m q_2^m - C_2(q_2^m) \geq p_1^m q_1^m - C_2(q_1^m) \]
- Sum these 2 inequalities
  \[ C_2(q_1^m) - C_2(q_2^m) \geq C_1(q_1^m) - C_1(q_2^m) \]
  \[ C_2(q_1^m) - C_1(q_1^m) - [C_2(q_2^m) - C_1(q_2^m)] \geq 0 \]
  \[ \int_{q_2^m}^{q_1^m} [C_2'(x) - C_1'(x)] \, dx \geq 0 \]
- Because $C_2'(x) > C_1'(x)$ then $q_1^m \geq q_2^m$ and $p_1^m \leq p_2^m$.
- Appropriate measure of distortion is the loss of social welfare: the dead-weight loss.
- see graph
• Benchmark case: perfect competition

**Result 5:** The welfare loss does not necessarily decrease with the elasticity of demand, even though the relative markup does.

**Proof:** exercise 1.1. page 67 Tirole.

• DWL determines the loss from a monopoly to an idealistic situation.

• DWL is one distortion created by a monopoly power.

• What kind of public intervention?

• Example: commodity taxation. Policy to restore social optimum.

• Government imposes a tax on the output, \( t \).

• The program of the monopolist becomes:

\[
\max_p \{pD(p + t) - C(D(p + t))\} \\
FOC: pD'(p + t) + D(p + t) - C''(D(q + t))D'(p + t) = 0 \\
\Leftrightarrow \\
[D(p + t) - tD'(p + t)] \\
+D'(p + t) [p + t - C''(D(q + t))] = 0
\]

• From the second term: \( p + t = C''(.) \).
• First term:

\[ D(p + t) = tD'(p + t) \Rightarrow t = \frac{D(p^c)}{D'(p^c)} \]

• and thus \( t < 0 \) = subsidy!

• Why?
  – monopoly price induces consumers to consume too little.
  – If subsidy, consumption will increase.

• But the government needs to have information concerning cost and demand.
  – Demand can be found with statistic studies.
  – Difficult to get information on costs.

• Incentive theory.
1.2 Multi-Product Monopolist

- Multi-product firm has a monopoly power over all goods.
- \( q_i = D_i(p) \), demand for good \( i = 1, \ldots, n \).
- Prices, \( p = (p_1, p_2, \ldots, p_n) \).
- Quantities \( q = (q_1, q_2, \ldots, q_n) \).
- Cost \( C(q_1, q_2, \ldots, q_n) \).
- Single-product firm (\( n \) pricing problems) \(\Leftrightarrow\) multi-product firm with
  - independent demands: \( q_i = D_i(p_i) \)
  - separable costs: \( C(q_1, q_2, \ldots, q_n) = \sum_{i=1}^{n} C_i(q_i) \).
- For each good \( i \)
  \[ \mathcal{L}_i = \frac{p_i^m - C'_i}{p_i^m} = \frac{1}{\varepsilon_i} \]

**Result 6:** The markup is higher on goods with a lower elasticity of demand (Ramsey pricing).
• General multi-product monopolist program is

$$\begin{align*}
\max_{p_1, p_2, \ldots, p_n} \left\{ \sum_{i=1}^{n} p_i D_i(p) - C(D_1(p), D_2(p), \ldots, D_n(p)) \right\}
\end{align*}$$

$$\text{FOC}_i : p_i \frac{\partial D_i(p)}{\partial p_i} + D_i(p) + \sum_{j \neq i} p_j \frac{\partial D_j(p)}{\partial p_i} - \sum_{k=1}^{n} \frac{\partial C(\cdot)}{\partial q_k} \frac{\partial D_k(p)}{\partial p_k}$$

$$\forall i, \forall k \neq i$$

• SOC must be satisfied.

2 polar cases:
1. dependent demands, separable costs;
2. independent demands, dependent costs.

1.2.1 Dependent demands and separable costs

• Example: set of divisions
• $$q_i = D_i(p)$$
• $$C(q_1, q_2, \ldots, q_n) = \sum_{i=1}^{n} C_i(q_i)$$
• Program of the multi-product monopolist is
\[
\max_{p_1,p_2,\ldots,p_n} \left\{ \sum_{i=1}^{n} p_i D_i(p) - \sum_{i=1}^{n} C_i(D_i(p)) \right\}
\]

from (1)

\[
p_i - \frac{\partial C_i(.)}{\partial q_i} = \frac{-D_i(p) + \sum_{j \neq i} \frac{\partial D_j(p)}{\partial p_i} (p_j - \frac{\partial C_j(.)}{\partial q_j})}{p_i \frac{\partial D_i(p)}{\partial p_i}}
\]

- Own elasticity of demand

\[
\varepsilon_{ii} = -\frac{p_i}{D_i(p)} \frac{\partial D_i(p)}{\partial p_i}
\]

- Cross elasticity of demand for good \( j \)

\[
\varepsilon_{ij} = -\frac{p_i}{D_j(p)} \frac{\partial D_j(p)}{\partial p_i}
\]

- FOC becomes

\[
\frac{p_i - \frac{\partial C_i(.)}{\partial q_i}}{p_i} = \frac{1}{\varepsilon_{ii}} - \sum_{j \neq i} \left( p_j - \frac{\partial C_j(.)}{\partial q_j} \right) \frac{D_j(p)\varepsilon_{ij}}{\varepsilon_{ii} p_i D_i(p)}
\]

- Sign of the second term? (depends on the sign of \( \varepsilon_{ij} \)
– If (−), $\mathcal{L}_i > \frac{1}{\varepsilon_{ii}}$, and thus higher price than in the case of a single-product monopolist.
– if (+), $\mathcal{L}_i < \frac{1}{\varepsilon_{ii}}$, and thus lower price.

- If goods are **substitutes**, $\frac{\partial D_j(p)}{\partial p_i} > 0$ for $j \neq i$ so $\varepsilon_{ij} < 0$
  – thus $\mathcal{L}_i > \frac{1}{\varepsilon_{ii}} \Rightarrow p_i > p^m$.

- If goods are **complements**, $\frac{\partial D_j(p)}{\partial p_i} < 0$ for $j \neq i$ so $\varepsilon_{ij} > 0$
  – thus $\mathcal{L}_i < \frac{1}{\varepsilon_{ii}} \Rightarrow p_i < p^m$.

- **Example**: Intertemporal pricing.
- Single-product monopolist
- 2 periods: $t = 1$, $t = 2$.
- At $t = 1$,
  – demand function $q_1 = D_1(p_1)$
  – cost function $C(q_1)$
- At $t = 2$,
  – demand function $q_2 = D_2(p_2, p_1)$
  – cost function $C(q_2)$
- Goodwill effect: $\frac{\partial D_2(.)}{\partial p_1} < 0$
• Monopolist’s profit
\[ p_1 D_1(p_1) - C(q_1) + \delta[p_2 D_2(p_2, p_1) - C(D_2(p_2, p_1))] \]
where \( \delta \) is the discount factor.

• \( \Leftrightarrow \) multi-product firm with interdependent demands.

\[ FOC_1 : p_1 \frac{\partial D_1}{\partial p_1} + D_1(.) - \frac{\partial C(.)}{\partial q_1} \frac{\partial D_1}{\partial p_1} + \delta(p_2 - \frac{\partial C(.)}{\partial q_2} \frac{\partial D_2}{\partial p_1}) = 0 \]

\[ FOC_2 : p_2 \frac{\partial D_2}{\partial p_2} + D_2(p_2, p_1) - \frac{\partial C(.)}{\partial q_2} \frac{\partial D_2}{\partial p_2} = 0 \]

• In the second period, monopoly price as
\[ \mathcal{L}_2 = \frac{1}{\varepsilon_{22}} \Rightarrow p^m_2 \]

• In the first period, the monopolist sets a lower price as
\[ \mathcal{L}_1 < \frac{1}{\varepsilon_{11}} \Rightarrow p_1 < p^m_1 \]

• Thus, the monopolist reduces the price at date 1 (sacrifice some short run profit) to increase the demand (and thus the profit) at date 2.
1.2.2 Independent demands and dependent costs

- The demand functions are independent, \( q_i = D_i(p_i) \).
- \( C(q_1, q_2, \ldots, q_n) \)
- The program is
  \[
  \max_{p_1, p_2, \ldots, p_n} \left\{ \sum_{i=1}^{n} p_i D_i(p_i) - C(q_1, q_2, \ldots, q_n) \right\}
  \]
- Example: learning-by-doing
- Cost reduction can be achieved over time simply because of learning.
- Example: semi-conductor industry, computers industry
- Single-Product monopolist
- 2 periods: \( t = 1, t = 2 \).
- At \( t = 1 \),
  - demand function \( q_1 = D_1(p_1) \)
  - cost function \( C_1(q_1) \)
- At \( t = 2 \),
  - demand function \( q_2 = D_2(p_2) \)
  - cost function \( C_2(q_2, q_1) \) with \( \frac{\partial C_2(\cdot)}{\partial q_1} < 0 \)
Monopolist’s profit
\[ p_1 D_1(p_1) - C_1(D_1(p_1)) + \delta [p_2 D_2(p_2) - C_2(D_2(p_2), D_1(p_1))] \]
where \( \delta \) is the discount factor.

\[ FOC_1 : \quad p_1 \frac{\partial D_1}{\partial p_1} + D_1(p_1) - \frac{\partial C_1(.)}{\partial q_1} \frac{\partial D_1}{\partial p_1} - \delta \frac{\partial C_2(.)}{\partial q_1} \frac{\partial D_1}{\partial p_1} = 0 \]

\[ FOC_2 : \quad p_2 \frac{\partial D_2}{\partial p_2} + D_2(p_2) - \frac{\partial C_2(.)}{\partial q_2} \frac{\partial D_2}{\partial p_2} = 0 \]

In the second period, monopoly price as
\[ \ell_2 = \frac{1}{\varepsilon_{22}} \]

In the first period, the monopolist sets a lower price as
\[ \ell_1 < \frac{1}{\varepsilon_{11}} \]

Thus, the monopolist reduces the price at date 1 (and sells more in the 1st period) to reduce the cost (and thus increase the profit) in the 2d period.
However, in a more general setting (exercise 1.7) where the output grows over time with stationary demand and the cost decreases with experience, there are 2 effects:

a. myopic behavior: as MC decreases, quantity must increase.

b. non myopic behavior: higher quantity at the beginning.

⇒ First effect dominates the second effect: The monopolist does not reduce the price in the first period.
2 Cost Distortion

• Distortion on the supply side.

• For given quantities, a monopolist may produce at a higher cost than would a competitive firm.

• Delegation problem
  – shareholders and manager do not have the same objective.
  – Thus, problem of monitoring and controlling.
  – $\Rightarrow$ inefficiency.

• How this inefficiency is affected by market power?

• Shareholders can use yardstick competition (comparison with other firms)

• Example: Ford management can be compared to GM.

• But you need to have another firm to be able to compare!

• These extra costs add to the DWL.
3 Rent Seeking behavior

• Third kind of distortion: the wasteful expenses incurred by a firm to get and to maintain a monopoly position.

• The rent of the monopolist (profit) may lead to rent-seeking behavior.
  – Firms will tend to spend money and effort to acquire the monopoly position;
  – Once installed they will tend to keep on spending money and exerting effort to maintain it.

• Different kinds of expenses:
  – Strategic expenses
    * R&D cost of obtaining a patent (chapter 10),
    * accumulation of capital,
    * barriers to entry (chapter 8).
  – Administrative expenses
    * cost of lobbying,
    * advertising campaigns,
    * legal expenses against charges of antitrust violation.
• Axiom (Porter, 75) says that

1. rent dissipation (total expenses to obtain rent = amount of the rent). This is the zero-profit free entry condition.
2. socially wasteful dissipation: it is not socially valuable. Regulated monopoly is allocated on the basis of lobbying influence.

• So, rent-seeking behavior certainly wastes some of the monopoly profit.

• The monopoly profit may be part of the welfare loss, but what fraction, it is not clear...
4 Conclusion

Distortions created by monopoly power
1. high prices, DWL
2. inefficiency (because objectives of managers are different to those of the owner of the firm)
3. dissipation of the monopoly profit.

But a monopoly can have some advantages:
1. under increasing return to scale, production by a single firm is technologically more efficient (it is less costly to have only one firm, natural monopoly). It prevents a wasteful duplication of fixed costs.
2. Schumpeter said that monopoly may be a necessary condition to a decent amount of R&D (patents).