Applied Microeconomics: Firm and Household

Lecture 15: Monopoly

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Outline

- Monopoly
  - Market Power
  - Entry and Exit
  - Analysis of Monopolies
    - Price-Cost Margin and the Lerner Index
  - Price Discrimination
    - First-, Second-, and Third-Degree Price Discrimination

Assumptions of perfect competition

The underlying assumptions of a perfectly competitive industry are:

- There is a large number of firms.
- Each firm is producing the same homogeneous product.
- There is perfect information.
- There are no transaction costs.
- There are no barriers to entry.
- Firms are price-takers, i.e. the actions of a single firm have no effect on the market price.

If any of these assumptions does not hold, the market is characterized by imperfect competition. The field of economics that studies imperfectly competitive markets is called industrial organization.

What is industrial organization?

Industrial organization (IO) is the study of the structure of firms and markets and of their interactions.

To clarify, the word “industry” here refers to the market or sector of activity, as in the wheat market or the fluid milk market. It doesn’t refer to the industrial sector, as opposed to the agricultural sector or the services sector.

Alternative names for IO could be

- the economics of firms and markets

or

- the economics of imperfect competition

Market power

Market power is an important subject addressed in IO.

Definition: Market power is the ability of a firm to profitably influence prices away from the competitive level.

Some of the important questions related to market power are:

1. Do firms exercise market power?
2. How do firms maintain market power?
3. What are the (empirical and welfare) implications of market power?
4. What can policy makers do about market power?

These questions reflect economics' double perspective of positive and normative analysis.

Some real-world observations

Examples of recent developments in food and agricultural markets:

- Increasing market domination by large processing and retailing firms (via consolidation)
  - Food Retailing: Walmart, Kroger
  - Food Manufacturing: Dean's, ConAgra, Cargill, General Mills
  - Input Markets: Monsanto, Agrium
- Growing emphasis on product differentiation and quality.
  - Product's taste, appearance, healthfulness
  - Characteristics of production process, (use of chemicals, confinement conditions of animals)
  - Food labeling

Barriers to entry

The ease of entry and exit plays a critical role in determining market structure and the subsequent performance of firms.

In markets where entry is restricted, the incumbent firms may be able to exercise market power by setting price above marginal cost.

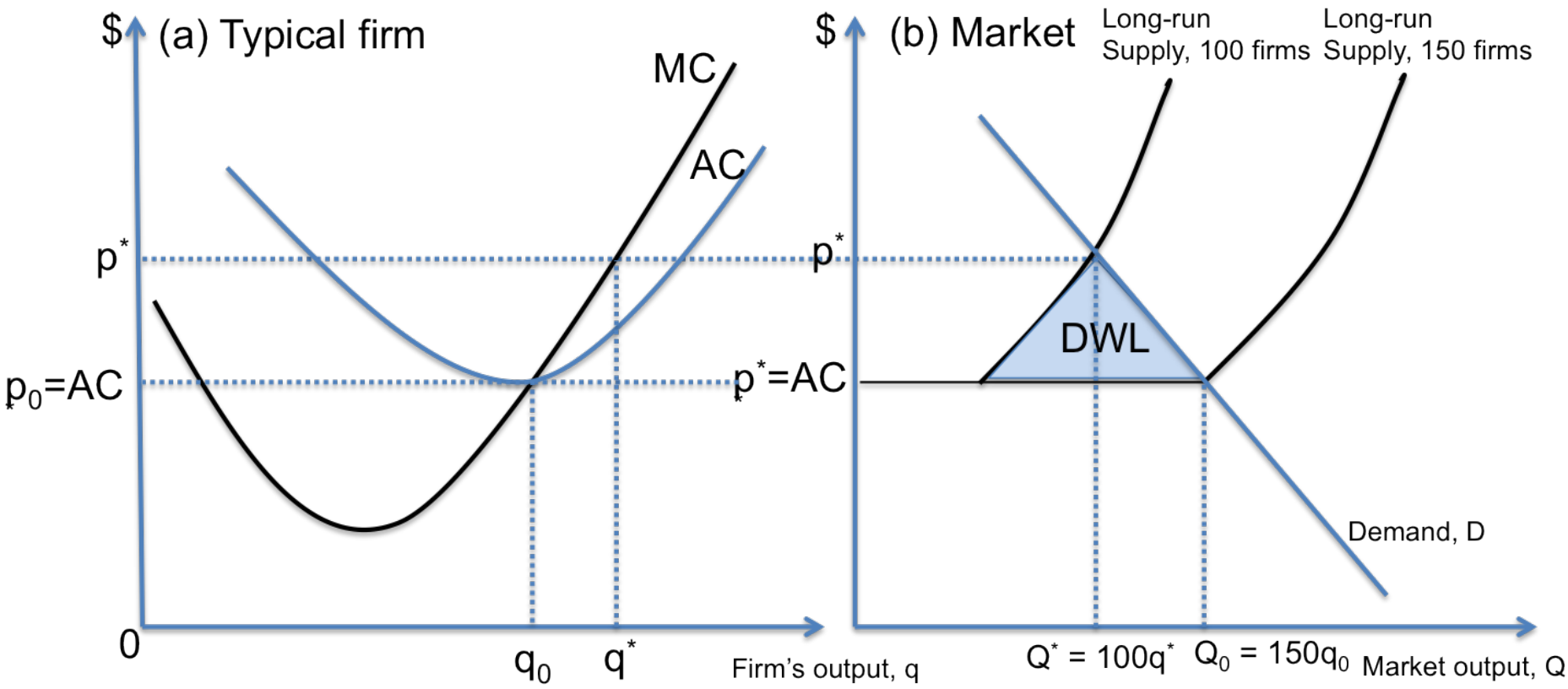
Some examples of restrictions on entry are:

- Licensing requirements
- Production quotas

Empirical findings on entry restrictions indicate that developed countries have the lowest restrictions on entry. A survey of 85 countries reveals that (Djankov et al., 2002)

- On average it takes 47 days to enter a typical business.
- In Canada and Australia it takes only two days.
- On average cost of entry in each country is 47% of per-capita GDP.
- In the U.S. cost of entry is 0.5% of GDP per capita.

LR equilibrium with an entry restriction



- In the absence of restrictions on entry, the competitive equilibrium is (Q_0, p_0), and there are 150 firms in the market.
- If the government restricts number of firms to 100, the equilibrium is (Q^*, p^*).

LR equilibrium with an entry restriction

Economic implications of restrictions on entry:

- In the absence of an entry restriction the market is competitive. CS is at its maximum, PS is zero, and there are no welfare losses: $DWL = 0$.
- If the government restricts number of firms to 100, the LR supply curve lies to the left of the original one.
  - The kink point of the supply curve is determined by the maximum quantity that can be produced at the shutdown price.
- With the restriction the equilibrium is (Q^*, p^*). 1) Consumers pay more. 2) Producers capture some of the CS and make positive profits.
- There is a DWL due to the restriction on entry. The sources of inefficiency are:
  - Total output falls from Q_0 to Q^*.
  - The AC of production is higher due to the restriction.

Varieties of barriers to entry

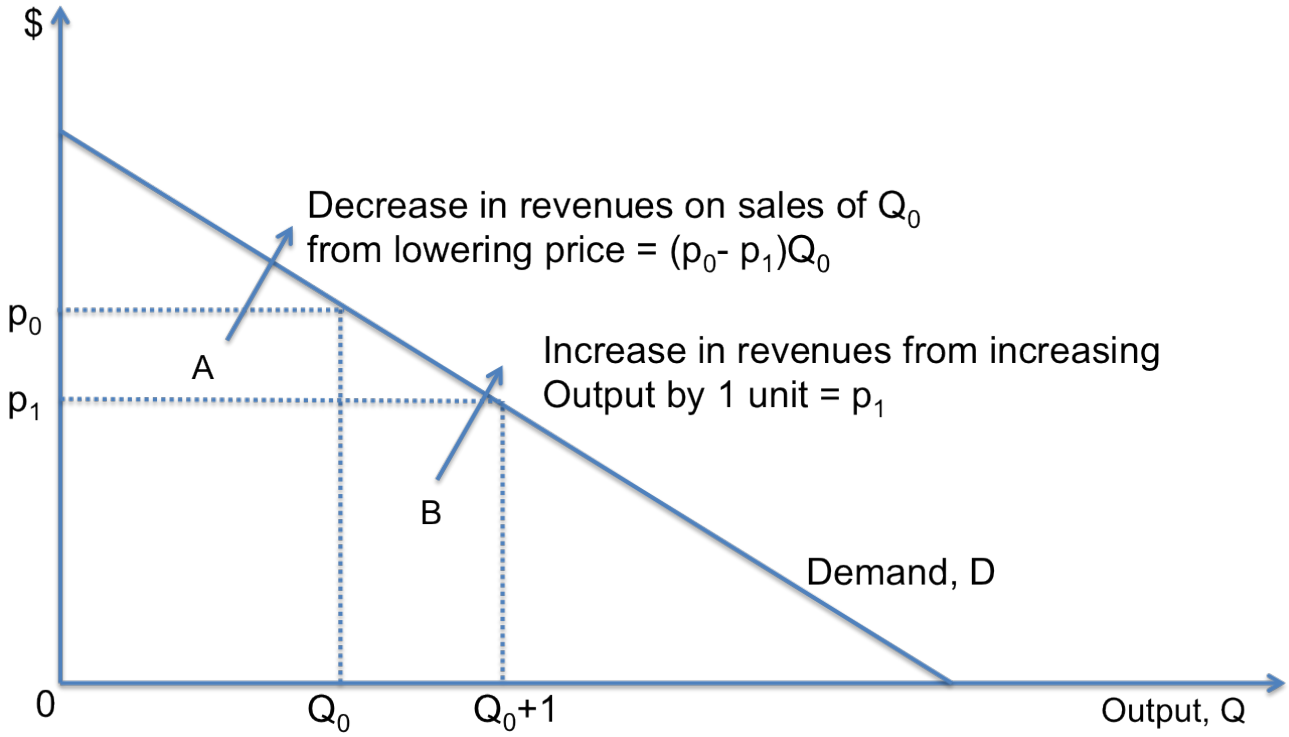
- Patents: Grants inventor monopoly rights to sell the invention for a period of time.
- Absolute cost advantage
  - No other firm can produce at a cost that incumbent firm faces.
- Economies of large scale production that require large capital expenditures
  - The existence of large sunk costs and the threats of strategic behavior (such as vigorous price cutting) may deter entry.
- Product differentiation
  - Brand loyalty to an existing firm could be hard to overcome; a prospective entrant might have higher marketing costs.
  - The incumbent firm has a *first–mover advantage*, and thus lower marketing costs.

Monopoly

A **monopoly** is the only supplier of a product for which there is no close substitute.

- A monopolist faces a downward-sloping demand curve
  - Therefore, it can raise prices above its marginal cost
  - However, the more it sells the lower the price it receives
- The demand curve constrains a monopolist's behavior
  - A monopolist can only choose price or quantity, but not both
  - If it chooses quantity, price is determined by the demand curve. If it chooses price, quantity is determined by the demand curve

The demand curve facing a monopoly



- Initially the monopoly produces at (p_0, Q_0).
- To produce one more unit of output price, it has to decrease price to p_1. Monopoly compares B to A to decide whether marginal revenue (MR) is positive.
- Since the monopoly must lower the price to sell more units, the MR is always less than the price for a monopoly (remember, under perfect competition $p = MR$).

Analysis of Monpolies

The predictions of economic theory depend on what kind of monopoly we are looking at. The types of monopolies are determined by the following questions:

1. What does the monopolist know?
2. What can the monopolist control?

We will consider different versions of monopolies with different answers to (1) and (2). We start with the analysis of "regular" monopoly:

1. The monopolist knows the aggregate demand function, $D(p)$.
2. The monopolist sets a per-unit price. Buyers may purchase any amount at that fixed price per unit.

Monopoly profit maximization

Suppose $C(Q)$ is the total cost function of monopolist. Then the profit maximization problem of a monopolist can be written as:

- $\max_Q \ \pi = p(Q)Q - C(Q)$

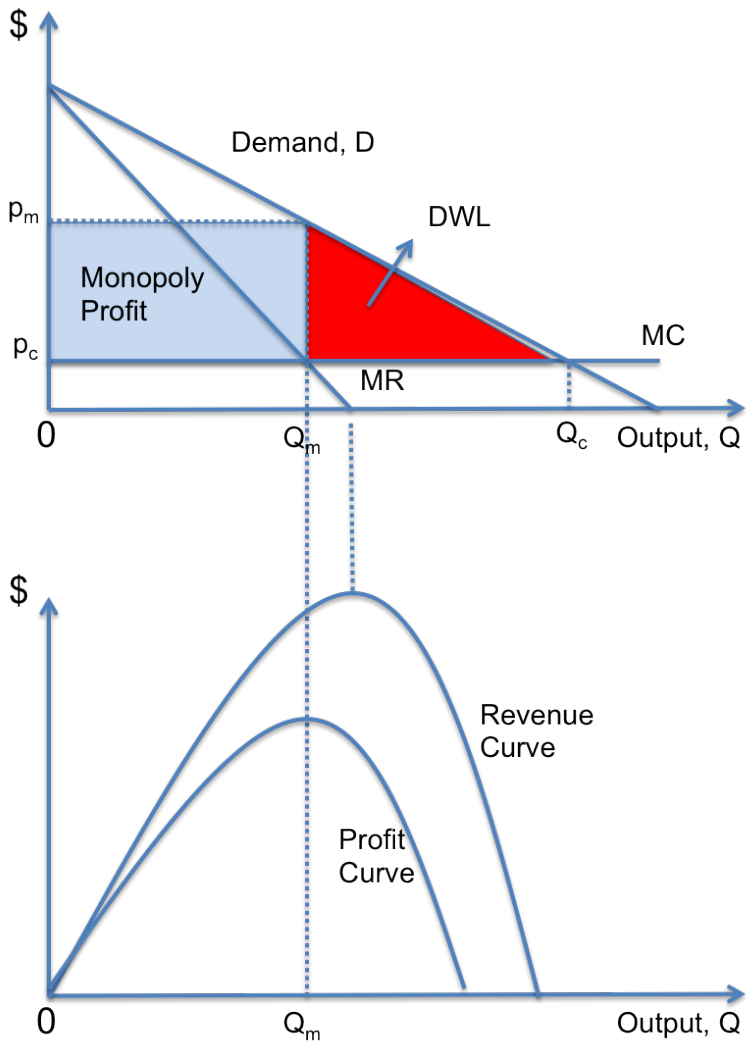
The FOC of this problem is:

- $\frac{\partial \pi}{\partial Q} = \underbrace{p(Q) + Qp'(Q)}_{MR} - \underbrace{C'(Q)}_{MC} = 0$
- $MR = MC$

Thus, a profit-maximizing monopolist determines its optimal quantity at a level where marginal revenue is equal to marginal cost.

I won't derive this, but the second-order condition of this problem is that the marginal revenue curve has to intersect the marginal cost curve from above.

Monopoly profit maximization: graphical analysis



- (Q_c, p_c) is competitive equilibrium, at $p = MC$.
- (Q_m, p_m) is monopoly equilibrium, at $MR = MC$.
- $Q_m < Q_c$, whereas $p_m > p_c$.
- $\pi > 0$, and $DWL > 0$.
- Maximum profit is at $MR = MC$.
- Maximum revenue is at $MR = 0$.

Price-cost margin and the Lerner index

Question: How much can a monopoly raise price above MC?

The answer depends on the price elasticity of demand. To observe this rewrite the marginal revenue of a monopolist as:

- $MR = p(Q) + p'(Q)Q$
- $MR = p[1 + \underbrace{p'(Q)\frac{Q}{p}}_{\frac{1}{\epsilon}}]$
- $MR = p(1 + \frac{1}{\epsilon})$
- $\begin{cases} MR \geqslant 0, & \text{if } \epsilon \leqslant -1; \\ MR < 0, & \text{if } -1 < \epsilon < 0. \end{cases}$

A monopolist always produces in the elastic portion of the demand curve.

Price-cost margin and Lerner index

At the optimum,

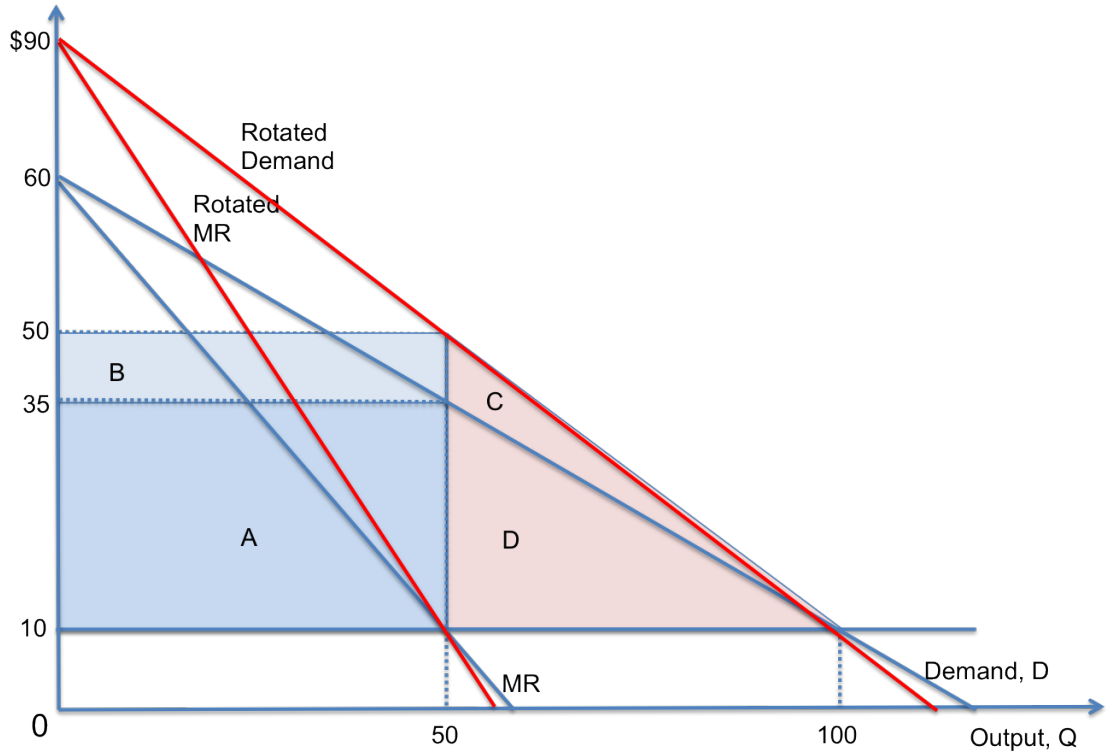
- $MR = p(1 + \frac{1}{\epsilon}) = MC$
- $p - MC = -\frac{p}{\epsilon}$
- $\frac{p-MC}{p} = -\frac{1}{\epsilon}$

$\frac{p-MC}{p}$ is the **price-cost margin**, also known as the **Lerner Index**.

The price-cost margin of a monopolist depends solely on the price elasticity of demand. The less elastic demand is, the higher is the price-cost margin will be .

At the extreme, if , $\epsilon = -\infty$, the price-cost margin is zero (i.e., $p = MC$).

Effects of ϵ on monopoly profits and DWL



As the demand curve at the monopoly equilibrium price & quantity becomes less elastic,

- the monopolist increases its price and makes more profits, and
- due to the higher Lerner index, deadweight loss increases.

Price discrimination

Some definitions:

- **Nonuniform pricing** refers to charging customers different prices for the same product.
  - Or charging the same consumer a price that varies depending on quantity.
- **Nonlinear price schedule:** a price schedule is nonlinear when the price paid depends on the amount purchased.
- **Price discrimination** refers to a nonuniform pricing policy used by a firm with market power to maximize its profits. The three types of price discrimination are:
  - First-degree price discrimination (perfect price discrimination)
  - Second-degree price discrimination
  - Third-degree price discrimination

Profits and price discrimination

Q: Why does price discrimination allow a monopolist to increase its profits?

A: A price discriminating monopolist is able to increase its revenue from the last unit of output without incurring a decrease in revenue from existing units of output.

To see this formally, consider the marginal revenue, MR, of a regular monopolist

- $MR = \frac{\partial [p(Q)Q]}{\partial Q} = p(Q) + Q\frac{\partial p(Q)}{\partial Q} = \underbrace{p(Q)}_{1(+)} + \underbrace{Qp'(Q)}_{2(-)}$

where $p'(Q) < 0$ is the slope of the inverse demand curve. The two terms of MR revenue represent:

1. the increase in revenue from selling one more unit.
2. the decrease in revenue from all existing units, (since $p'(Q) < 0$).

Profits and price discrimination

- $MR = \underbrace{p(Q)}_{1(+)} + \underbrace{Qp'(Q)}_{2(-)}$

Any type of price discrimination can be viewed as an attempt to minimize the second effect on marginal revenue from expanding sales – and hence increase profits.

Conditions for price discrimination

There are three conditions needed for a successful price discrimination:

1. A firm must have market power – the ability to set the price above marginal cost.
2. A firm must be able to identify whom to charge a higher price – it must know, or infer, consumers' willingness to pay, and WTP must vary across consumers or units
3. A firm must be able to prevent, or limit, resales by customers who pay the lower price to those who pay the higher price.

Analysis of a price-discriminating monopoly

1. What does the monopolist know?
2. What can the monopolist control?

Recall that different answers to (1) and (2) would imply different versions of monopoly. In the following we consider a perfectly price-discriminating monopoly:

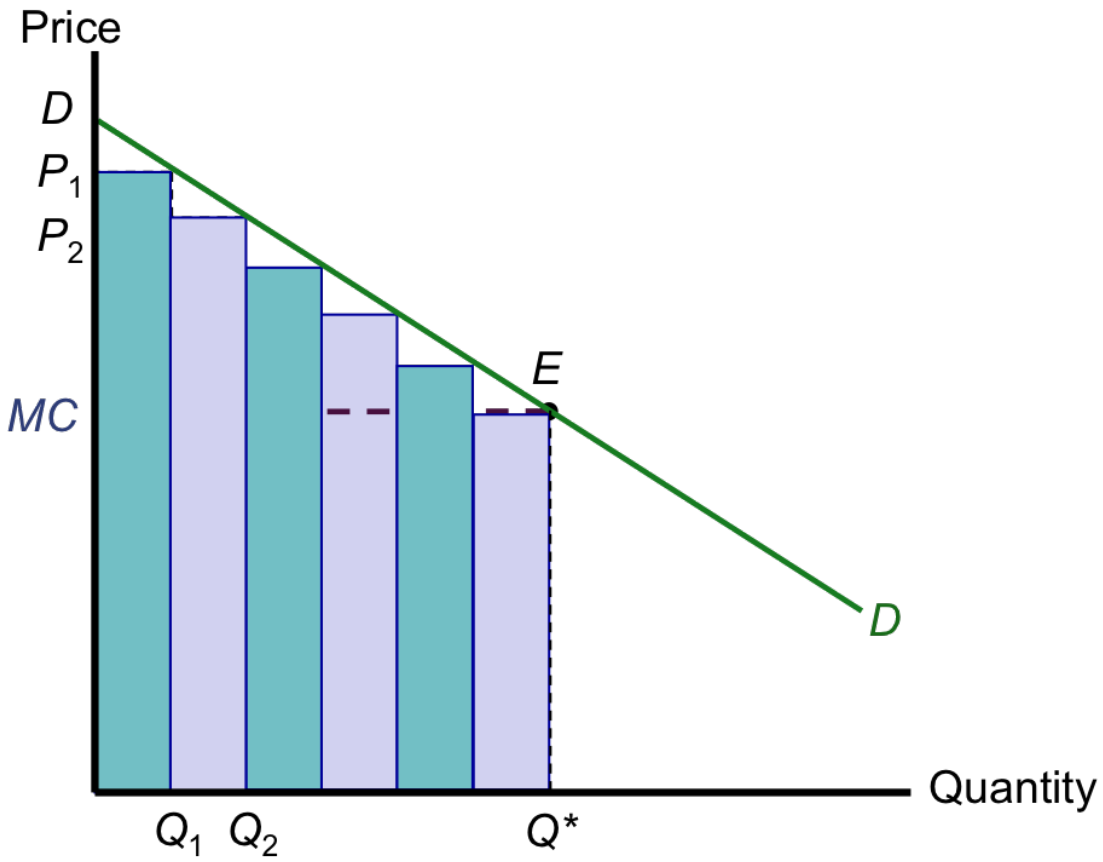
1. The monopolist knows each person's individual demand function.
2. The monopolist may set a different per-unit price for each person. Also, the monopolist may charge each person a different lump-sum fee. Each buyer must pay her individualized lump-sum fee before being allowed to purchase anything. If she pays the fee, she may purchase any amount at her individualized, fixed, price per unit.

First-degree price discrimination

With perfect price discrimination consumers are left with no surplus. There are three alternative but equivalent ways of perfect price discrimination:

1. Each consumer buys one unit, but each of them pays a different amount.
2. Each consumer buys more than one unit, but pays different amount for each unit.
3. Two-part tariff: Each consumer pays a lump sum fee for the right to purchase plus a uniform per-unit charge for each unit consumed.

Perfect price discrimination



- The monopoly charges a different price to each buyer. Q_1 units are sold at P_1, and $Q_2 - Q_1$ units at P_2.

First-degree price discrimination: two-part tariffs

Suppose each consumer pays a lump sum fee, F, for the right to purchase, plus a uniform per-unit charge, p, for each unit consumed.

- The description of fee structure is similar to the way discount stores like Costco and Sam's Club work. Amusement parks and the Minnesota State Fair have a similar fee structure. Consumers must pay a fixed fee to be eligible for subsequent purchases.
- This model can also be thought of as a description of firms that sell two goods that must be used together.
  - Monsanto's Roundup Ready® crop, used with Roundup® herbicide.
  - HP printers must be combined with HP ink cartridges to print things.

Then firm's problem is to pick optimal the F and p. If all consumers were identical, and the firm knew the demand curve for a representative consumer, then an optimal two-part tariff allows monopolist to extract all of the consumer surplus. (How?)

Optimal two-part tariff

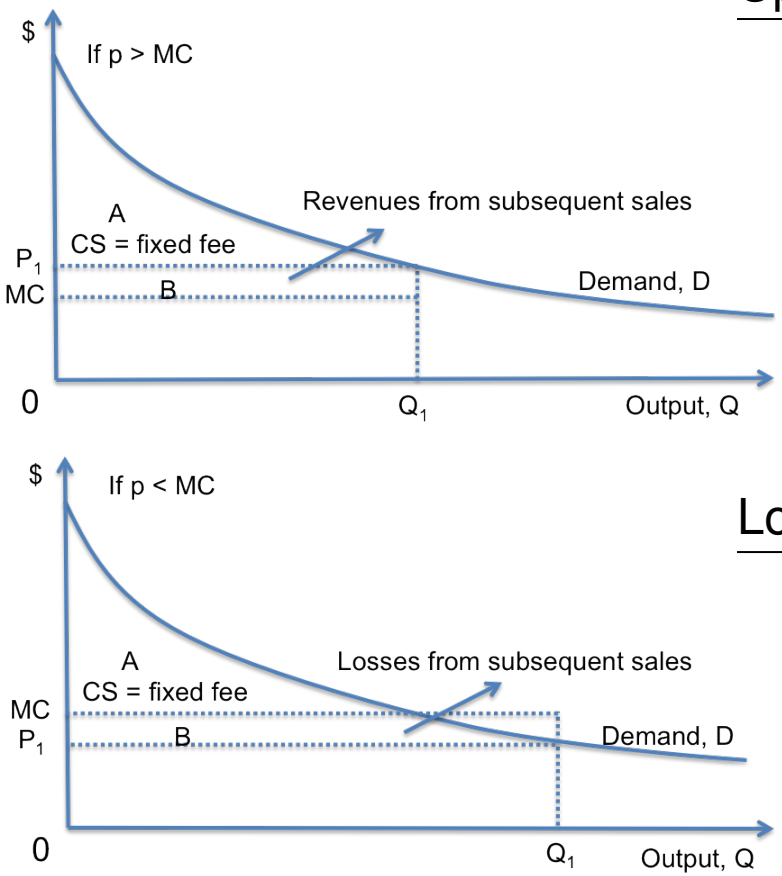
What combination of F and p would maximize the firm's profits?

The answer follows from a few simple observations:

- *Observation 1:* Given any value of p, if the consumer pays a fixed fee, F, (e.g., HP printer), the subsequent purchases (e.g., purchases of cartridges) are independent of the fee (the fee is a sunk cost)
- *Observation 2:* Given any value of p, a consumer will pay a fee only if it is no greater than the surplus that she would obtain if there were no fixed fee and the subsequent purchase price were p. Otherwise she is better off not transacting.

Based on these observations, for any given value of p the monopolist will set $F = CS$. If $F > CS$ the consumer won't buy anything and if $F < CS$ monopolist is not maximizing its profit. So the remaining question is: *What is the optimal price* p^* *when* $F = CS$*?*

Optimal two-part tariffs: finding the optimal price, p^*.



Upper Figure:

- The monopolist's profit is $A + B$.
  - A = CS captured via fixed fee.
  - B = profits from subsequent sales.
- Note that lowering the price slightly would increase profits.

Lower Figure:

- The monopolist's profit is $A - B$.
  - A = CS captured via fixed fee.
  - B = losses from subsequent sales.
- Note that increasing the price slightly would increase profits.

Thus $p^* = MC$.

Third-degree price discrimination: market segmentation

A more realistic (and very common) version of price discrimination is one in which the monopolist is able to break the market into two or more segments, each with known demand, and can prevent resale between segments. The key features of this type of price disrimination are again determined by two questions:

1. What does the monopolist know?
2. What can the monopolist control?

For a third-degree price discriminating monopoly the answers are:

1. The monopolist knows the aggregate demand function in each market segment, $D_1(p)$ and $D_2(p)$.
2. The monopolist sets a per-unit price in each of the market segments. Buyers may purchase any amount at the fixed price per unit for their segment. Buyers cannot switch segments or resell the goods between segments.

Optimum decision: third degree price discrimination

Suppose $c(Q)$ is the monopolist's total cost function. The profit maximization problem can be written as:

- $\max_{q_1, q_2} \pi = p_1(q_1)q_1 + p_2(q_2)q_2 - C(q_1 + q_2)$

The FOCs are:

1. $\frac{\partial \pi}{\partial q_1} = p_1(q_1) + q_1 p_1'(q_1) - c'(q_1 + q_2) = 0$
2. $\frac{\partial \pi}{\partial q_2} = p_2(q_2) + q_2 p_2'(q_2) - c'(q_1 + q_2) = 0$

So the optimality condition (assuming without derivation that the SOSCs hold) is:

1. $MR_1 = MC(q_1 + q_2) = 0$
2. $MR_2 = MC(q_1 + q_2) = 0$

The role of demand elasticites

- $MR_1 = p_1(1 + \frac{1}{\epsilon_1})$
- $MR_2 = p_2(1 + \frac{1}{\epsilon_2})$

At the optimum:

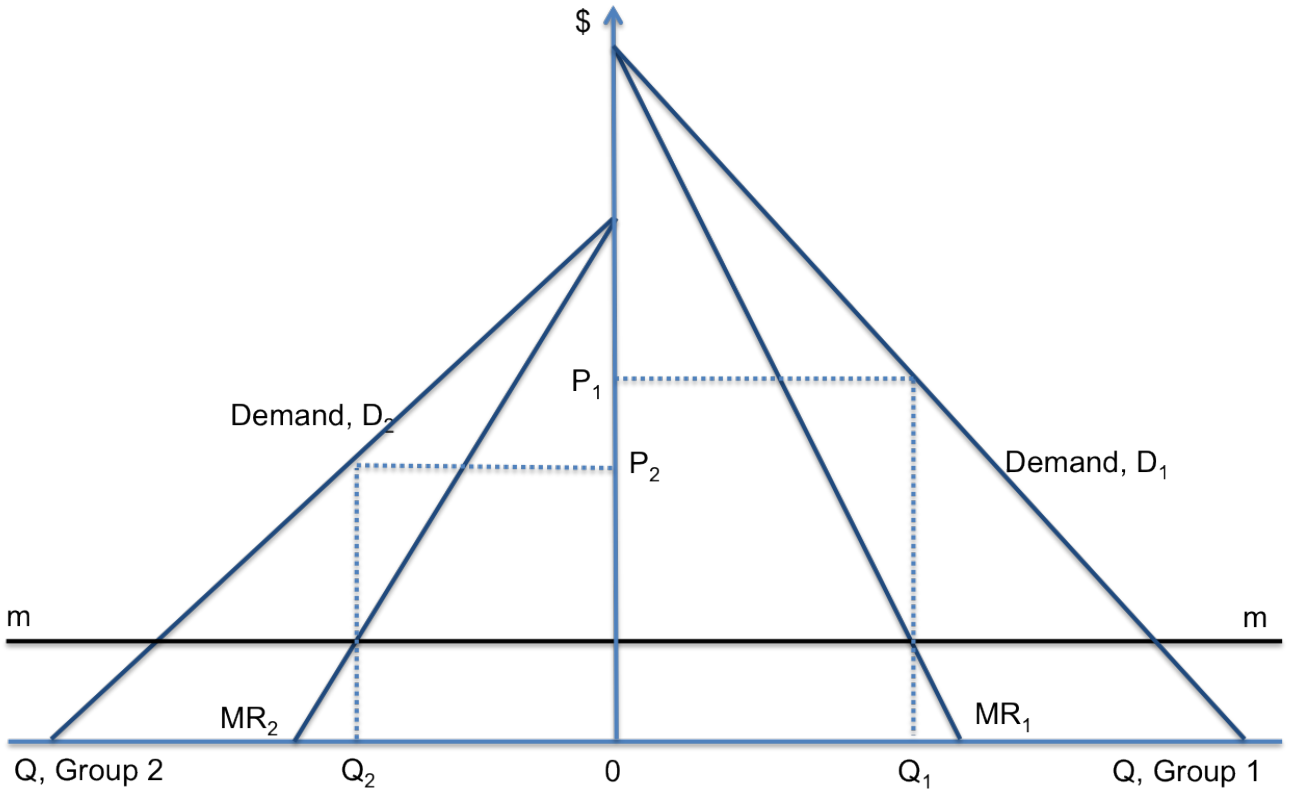
- $p_1(1 + \frac{1}{\epsilon_1}) = p_2(1 + \frac{1}{\epsilon_2})$
- $\frac{p_1}{p_2} = \frac{1+1/\epsilon_2}{1+1/\epsilon_1}$

For example: suppose $\epsilon_1 = -\infty$ and $\epsilon_2 = -2$, then the price ratio is:

- $\frac{p_1}{p_2} = \frac{1+1/(-2)}{1+1/-\infty}$
- $\frac{p_1}{p_2} = \frac{1-1/2}{1} = 1/2 \rightarrow p_2 = 2p_1$.

A market-segmenting monopolist always charges higher prices to the market segment with the more-inelastic demand.

Graphical analysis: Third degree price discrimination



- The equilibrium outcomes in each market are (Q_1, P_1) and (Q_2, P_2)
- At each quantity, group 1 is willing to pay a higher amount than group 2. Since group 1's demand schedule is more inelastic, $P_1 > P_2$.

Second-degree price discrimination

A second-degree price discriminating monopoly charges different consumers different prices without knowing each individual's demand curve. Common forms of second-degree price discrimination are **bundling** and **tie-in-sales**.
Again, we ask:

1. What does the monopolist know?
2. What can the monopolist control?

For a second-degree price discriminating monopoly the answers are:

1. The monopolist knows the *distribution* of valuations among consumers.
2. The monopolist is able to bundle different goods and sell these bundles at prices that are less than the sum of the prices of the individual goods.

Second degree price discrimination

Suppose there are two products, $Prod_1$ and $Prod_2$. **Bundling** refers to the marketing practice where, if consumers buy one product, say $Prod_1$, they are required to buy the other, $Prod_2$. Examples are:

- Film distributors bundle movie sales to theaters.
- Microsoft bundles sales of office products (Word, Excel, PowerPoint,Access,etc.)

Suppose a firm has a monopoly over both products. Also suppose that there are two types of customers, A and B. The intuition behind bundling is that if, for example, type A customers value $Prod_1$ more than $Prod_2$, and type B customers value $Prod_2$ more than $Prod_1$, the monopolist can increase its profits having different types of customers to buy the less-valued product together with the highly-valued product.

Note: Bundling is profitable *only* when the valuations of the types of consumers are negatively correlated.

Second degree price discrimination: an example

Suppose there are only two consumers and their valuations are:

Products	Valuations of A	Valuations of B
$Prod_1$	9,000	10,000
$Prod_2$	3,000	2,000
Bundle	12,000	12,000

If the monopolist sells the products separately, it maximizes revenue at

- $Prod_1$ = 9,000, so that $TR_1 = 18,000$
- $Prod_2$ = 2,000, so that $TR_2 = 4,000$
- $TR = 18,000 + 4,000 = \underline{22,000}$.

If it bundles the products, it maximizes revenue at

- Bundle = 12,000, so that $TR = \underline{24,000}$

The monopolist is better of with bundling. Note that it could have charged $11,500$ for the bundle (less than the sum of consumers, valuations of each product), and still be better off ($23,000 > 22,000$).