BACHELOR OF ECONOMICS
THAMMASAT UNIVERSITY

Topic 9

Monopoly

Topic 9 Overview

Microeconomics Theory (EE311): 1/2021

- What is Monopoly?
- Monopoly Profit Maximisation
- Market Power
- The Social Costs of Monopoly Power
- Comparative Static

Student Manual

9.1 What is Monopoly?

High cost to entry

Market Region

Firm

Service: *Space Tourism*

Price Maker: *Set its price, p*

No close substitute

Read more: What will it cost to fly Virgin Galactic to space?
https://www.nytimes.com/2021/07/11/science/cost-to-fly-virgin-galactic-space.html

What causes monopolies?

- A legal fiat; e.g. alcohol industry

- A patent; e.g. new drug or vaccine

  Patent argument:
  1) Monopoly profits are a reward for a risky investment decision by an entrepreneur
  2) Patent protection is to encourage innovation

  Source: Varian (2014)

- Sole ownership of a resource; e.g. a toll highway

- Formation of a cartel; e.g. OPEC

- Large economies of scale; e.g. local utility companies.

9.2 Monopoly Profit Maximisation

Given the inverse demand function ($p(Q)$),
the monopoly profit maximisation problem:

$$\max_{\{Q \geq 0\}} \quad \pi(Q) = p(Q)Q - TC(Q) \tag{9.1}$$

First-order condition:

$$\frac{d\pi(Q)}{dQ} = 0: \qquad p(Q) + Q\frac{dp(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0 \tag{9.2}$$

$$p(Q) + Q\frac{dp(Q)}{dQ} = \frac{dTC(Q)}{dQ} \tag{9.3}$$

$$MR(Q) = MC(Q) \tag{9.4}$$

Monopoly optimal choice

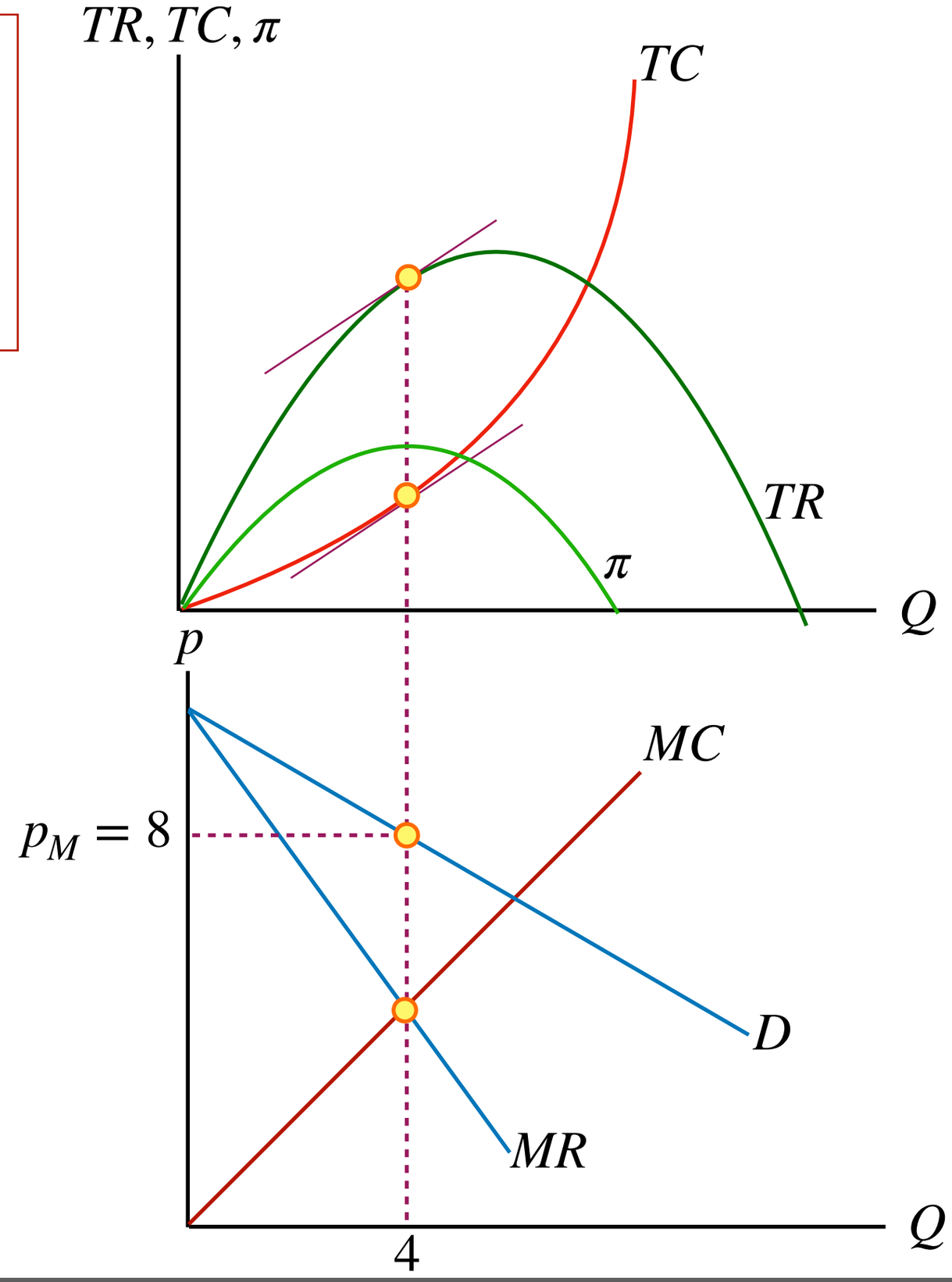
Example 9.1: Suppose monopolist faces a linear demand curve, $p(Q) = 12 - Q$, and a quadratic short-run cost function,

$$TC(Q) = \frac{1}{2}Q^2 .$$

The firm's profit maximisation is

First-order condition:

Second-order condition:



MR in terms of elasticity

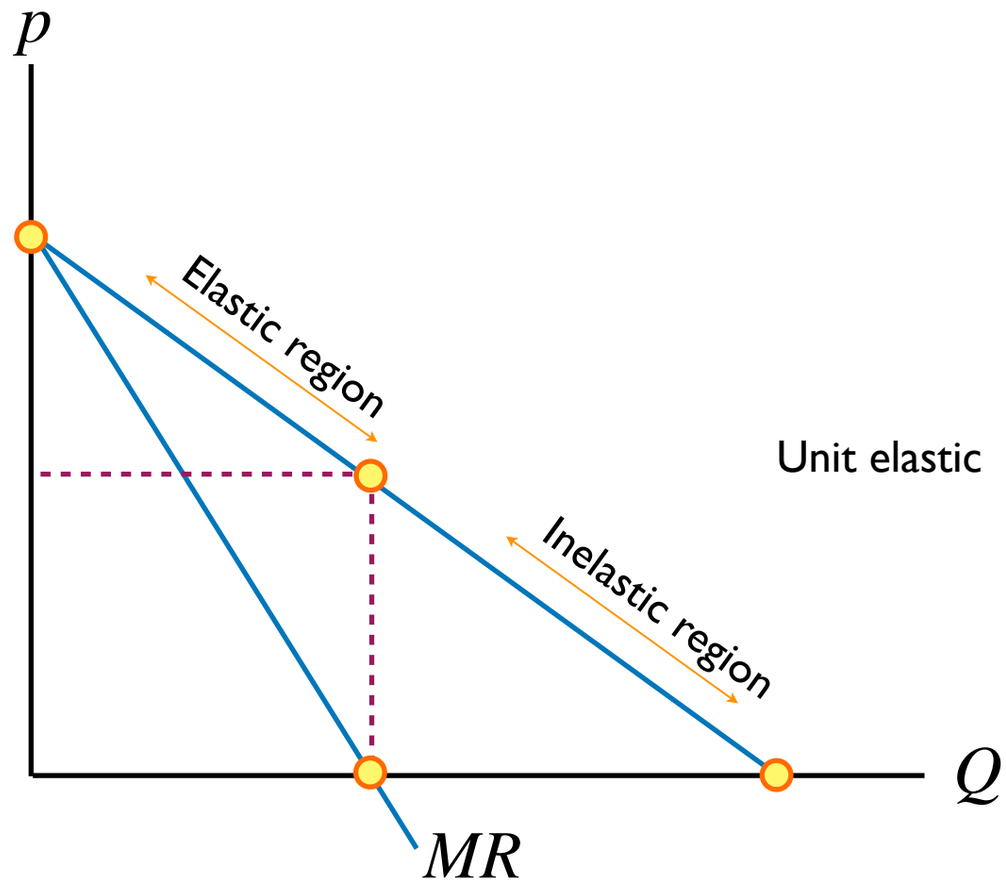
Note that: $TR = p(Q)Q$ (9.8)

$$MR = \frac{dTR}{dQ} = p(Q)Q + Q\frac{dp(Q)}{dQ} \quad (9.9)$$

$$MR = p\left[1 + \frac{Q}{p}\frac{dp}{dQ}\right]$$

$$MR = p\left[1 + \frac{1}{\frac{p}{Q}\frac{dQ}{dp}}\right]$$

$$\boxed{MR = p\left[1 + \frac{1}{\epsilon}\right]} \quad (9.10)$$



- The monopolist will want to be on the left of the midpoint, where marginal revenues are positive.
- The monopolist will avoid the inelastic portion of the demand curve by decreasing output until MR is positive.

Definition 9.1:
Market Power is the ability of a firm to charge a price above marginal cost and earn a positive profit.

Lerner Index (L_n): the ratio of the difference between price and marginal cost to the price. Lerner index is used to measure monopoly power.

Source: Perloff (2007)

Sources of Market Power:

All else the same, the demand curve a firm faces becomes more elastic as:

- *Better substitutes* for the firm's product are introduced,
- *More firms* enter the market selling the same product, or
- Firms that provide the same service *locate closer* to this firm.

Markup pricing and Lerner Index

Recall (9.3):

$$p(Q) + Q\frac{dp(Q)}{dQ} = \frac{dTC(Q)}{dQ}$$

$$p\left[1 + \frac{Q}{p}\frac{dp}{dQ}\right] = MC$$

$$p\left[1 + \frac{1}{\frac{p}{Q}\frac{dQ}{dp}}\right] = MC$$

(9.11)

Rearrange (9.11), then we obtain

$$p + p\frac{1}{\epsilon} = MC$$

$$p - MC = -p\frac{1}{\epsilon}$$

(9.12)

Markup pricing

Example 9.2: The general form of a constant elasticity demand curve is $Q = ap^{-b}$. At every on such a curve, the price elasticity of demand equals $-b$. Suppose a monopolist has a constant marginal cost $MC = \$50$.

Take logarithm on a constant elasticity demand curve, then we obtain

(9.13)

Take derivative on (9.13):

(9.14)

a) What is the optimal p when $Q = 100p^{-2}$?

Recall (9.11):

$$p = \frac{MC}{1 + \frac{1}{\epsilon_d}} =$$

b) What is the optimal p when $Q = 100p^{-5}$?

$$p = \frac{MC}{1 + \frac{1}{\epsilon_d}} =$$

- Markup is lower the more elastic demand is.

Markup pricing

Example 9.3:

Discount Store: *Lotus, Big-C*

- The elasticity of demand for any one supermarket is often as large as −10.

$$p = \frac{MC}{1 + \frac{1}{\epsilon_d}} =$$

- The manager of a typical supermarket should set prices about 11% above marginal cost.

Convenient Store: *7-Eleven, Family Mart*

- The elasticity of demand for a convenience store is about −5.

$$p = \frac{MC}{1 + \frac{1}{\epsilon_d}} =$$

- The markup equation implies that its prices should be about 25% above marginal cost.

Source: Adapted from Pindyck & Rubinfeld (2013)

Lerner Index

Example 9.4: Apple's Lerner index

iPhone 13 Pro: *6.7-inch display*

$$MC = \$200$$

$$P = \$999$$

$$L_n = \frac{p - MC}{p} =$$

iPad mini: *64 GB*

$$MC = \$180$$

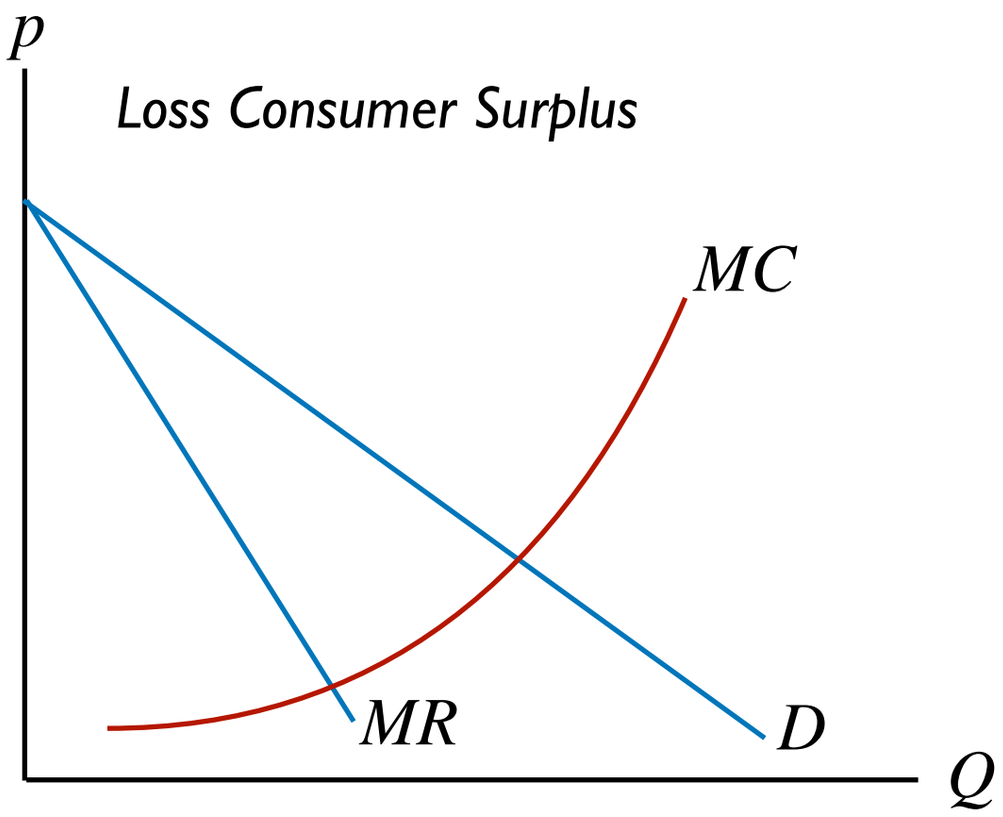
$$P = \$499$$

$$L_n = \frac{p - MC}{p} =$$

- The Lerner Index is a positive number ($L \geq 0$), increasing in the amount of market power.
- A perfectly competitive firm has a Lerner Index equal to zero
- A monopolist will have a Lerner Index greater than zero
- A larger Lerner Index indicates more market power.

9.4 The Social Costs of Monopoly Power

The Inefficiency of Monopoly



- A market is ***Pareto efficient*** if it achieves the maximum possible total gains-to-trade. Otherwise a market is *Pareto inefficient*.
- The efficient output level Q_c satisfies $P = MC$ Total gains-to-trade is maximised.
  - The market is ***Pareto inefficient***: $MC(Q_m + 1) < P(Q_m + 1)$ so both seller and buyer could gain if the $(Q_m + 1)$ th unit of output was produced.

	Perfect Competition	Monopoly
Equilibrium concept:	$P = MC$	$MR = MC$
Price:		
Output level:		
Deadweight Loss:		

Note that ***Pareto improvements*** exist for all units of output between perfect competition and monopoly output.

Natural Monopoly

Definition 9.2:

Natural monopoly — situation in which one firm can produce the total output of the market at lower cost than several firms could.

If the cost for any firm to produce q is $TC(q)$, the condition for a natural monopoly is

$$TC(Q) < TC(q_1) + TC(q_2) + \ldots + TC(q_n) \tag{9.15}$$

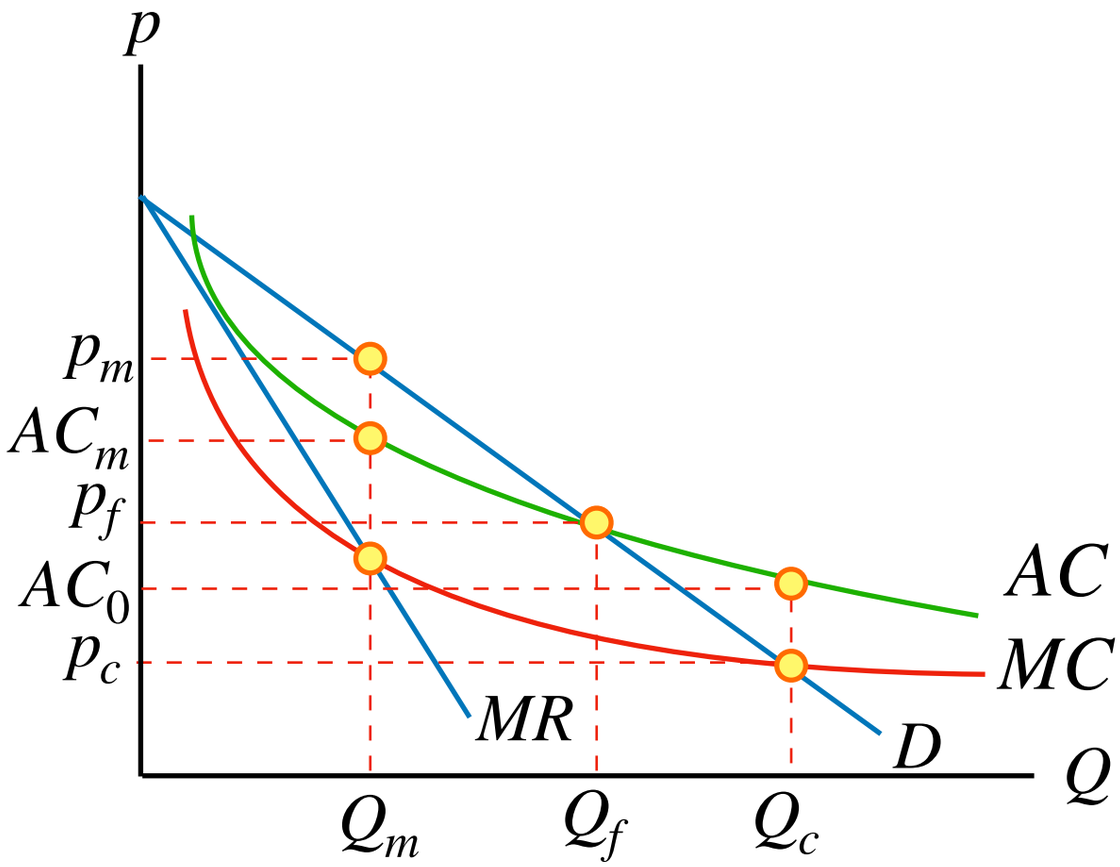
where $Q = q_1 + q_2 + \ldots + q_n$ is the sum of the output of any $n \geq 2$ firms.

Source: Perloff (2013)

Energy Grid

Rail network

Natural Monopolies and regulation



Case 1: No regulation

- If left alone, a monopolist produces Q_m and charges p_m .
  Obtain maximum profit:

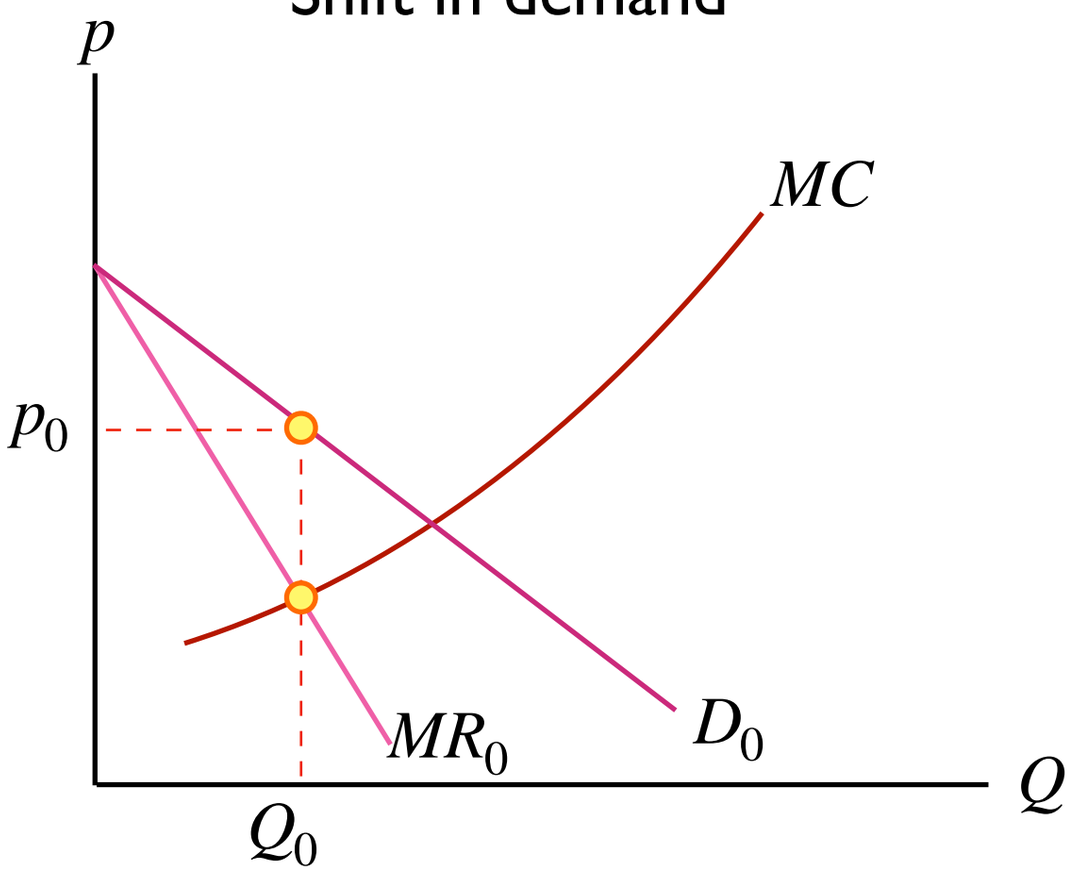
A firm is a natural monopoly because it has:

- *Economies of scale* (declining average and marginal costs) over its entire output range.
- *Structural Barriers to Entry* – incumbent firms have (high fixed) cost or demand advantages that would make it unattractive for a new firm.

Case 2: Regulation (*How to regulate?*)

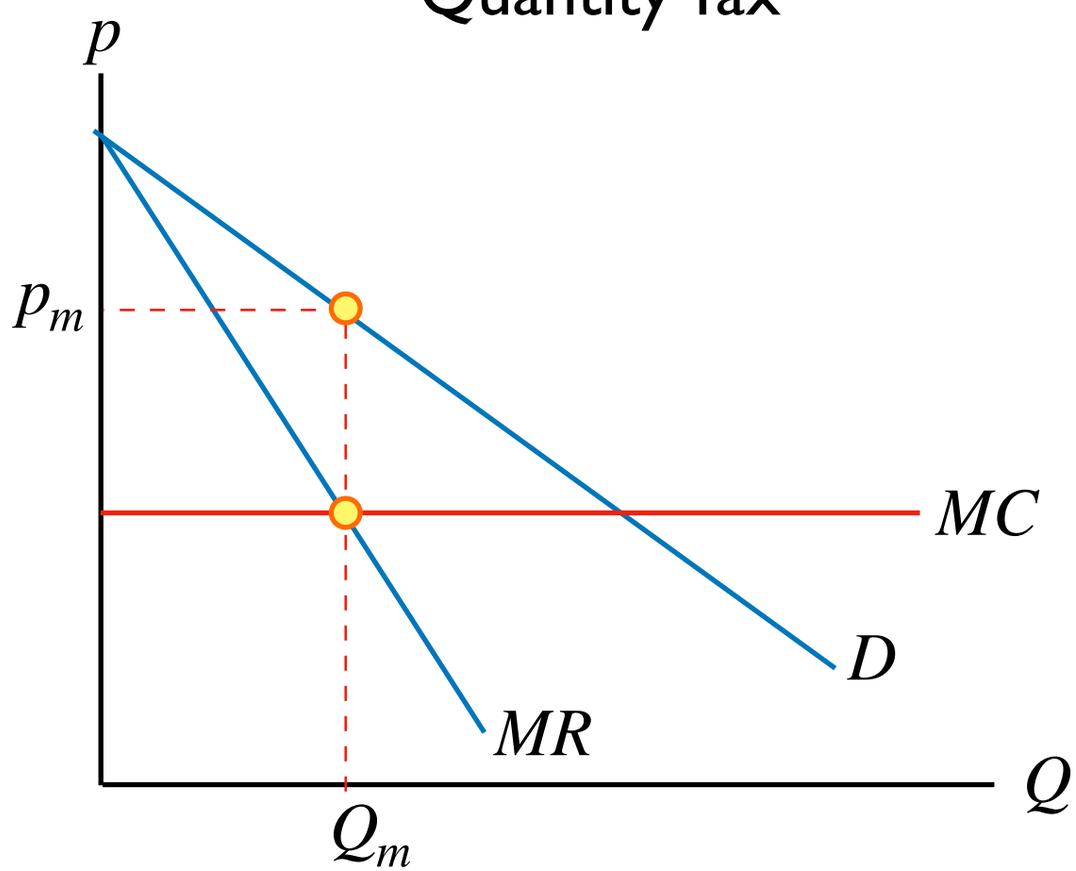
- If price were regulated to be p_c the firm would lose money ( ) and go out of business.
- Setting the price at p_f yields the largest possible output / the firm's remaining in business; *excess profit is zero*.
- *Or*, nationalise and subsidise.

Shift in demand



- The new marginal revenue curve MR_1 intersects marginal cost at a higher output level Q_1.
- Price rises from P_0 to P_1
- *Note:* the effect of shift in demand depends on elasticity of demand.

Quantity Tax



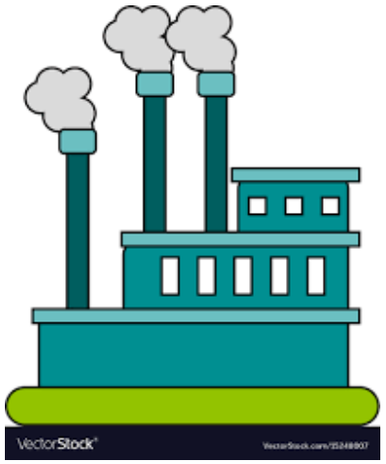
The quantity tax causes

- A drop in the output level
- A rise in the output's price
- A decline in demand for inputs

Multiplant Monopoly

How a monopolist would allocate production across the plants.

Industrial site: Vietnam



Cost: TC_1

Output: Q_1

Industrial site: Thailand

Cost: TC_2

Output: Q_2

Total Output: $Q_T = Q_1 + Q_2$

Profit: $\pi = pQ_T - TC_1(Q_1) - TC_2(Q_2)$

Multiplant Monopoly

Given the inverse demand function, $p(Q)$.
The multiplant monopolist profit maximisation problem:

$$\max_{\{Q_1,Q_2\}} \quad \pi(Q_T) = pQ_T - TC_1(Q_1) - TC_2(Q_2) \tag{9.16}$$

First-order condition:

(9.17)

(9.18)

Multiplant Monopoly

Example 9.5: A multiplant monopolist operates two plants, with the total cost functions:

Plant A: $TC_1(Q_1) = 10Q_1^2,$ (9.19)

Plant B: $TC_2(Q_2) = 20Q_2^2\,.$ (9.20)

The firm faces the market demand:

$$p = 700 - 5Q_T \tag{9.21}$$

Problem:

a) Find the optimal division of the monopolist's quantity between its two plants

b) Find the monopolist's optimal total quantity and price.

Using (9.17) and (9.18):

(9.22)

(9.23)

(9.24)

Multiplant Monopoly

Rearrange (9.23) and (9.24):

(9.25)

(9.26)

Setting system (9.25) and (9.26) in Matrix form:

(9.27)

Using Cramer's rule:

Thus, of the total quantity of 30, plant A produces 20 units, while plant B produces 10 units. Also, the monopolist price is 500 per unit.