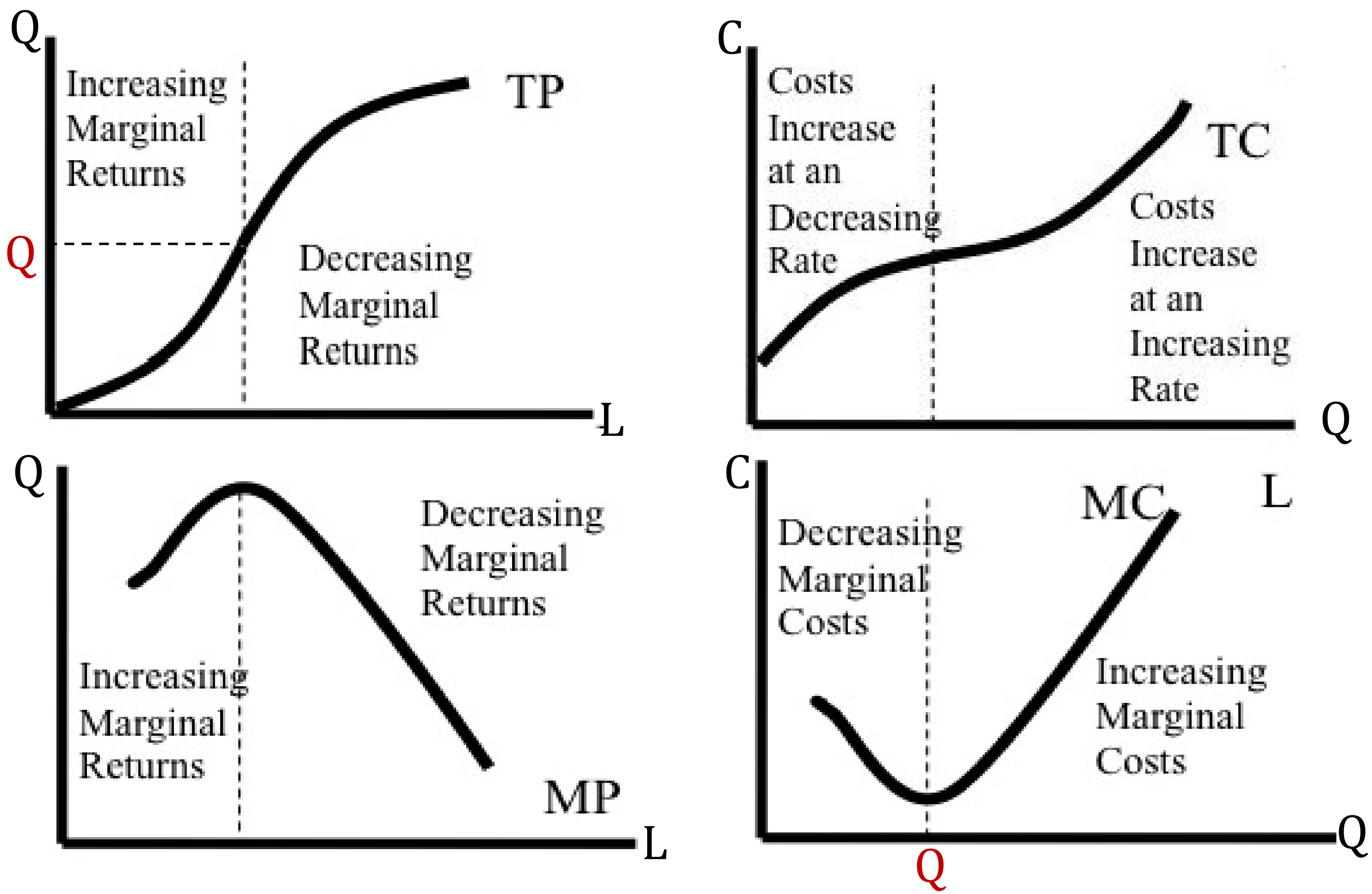
Introductory Microeconomics

Tutorial 10

Nhan La

Production functions



Market competition

- Perfectly competitive market:
  - Total revenue: $TR = P \times Q$
  - Marginal/Average revenue: $AR = MR = \frac{TR}{Q} = P$

- Imperfectly competitive market:
  - Total revenue: $TR(Q) = P(Q) \times Q$
  - Average revenue: $AR(Q) = \frac{TR(Q)}{Q} = \frac{P(Q) \times Q}{Q} = P(Q)$
  - Marginal revenue:

$$MR(Q) = \frac{\partial TR(Q)}{\partial Q} = \frac{\partial P(Q) \times Q}{\partial Q} = P(Q) + Q\,\frac{\partial P(Q)}{\partial Q} = AR(Q) + Q\,\frac{\partial P(Q)}{\partial Q}$$

Price and quantity decision

- $P(Q) = AR$
  - *Market demand curve*

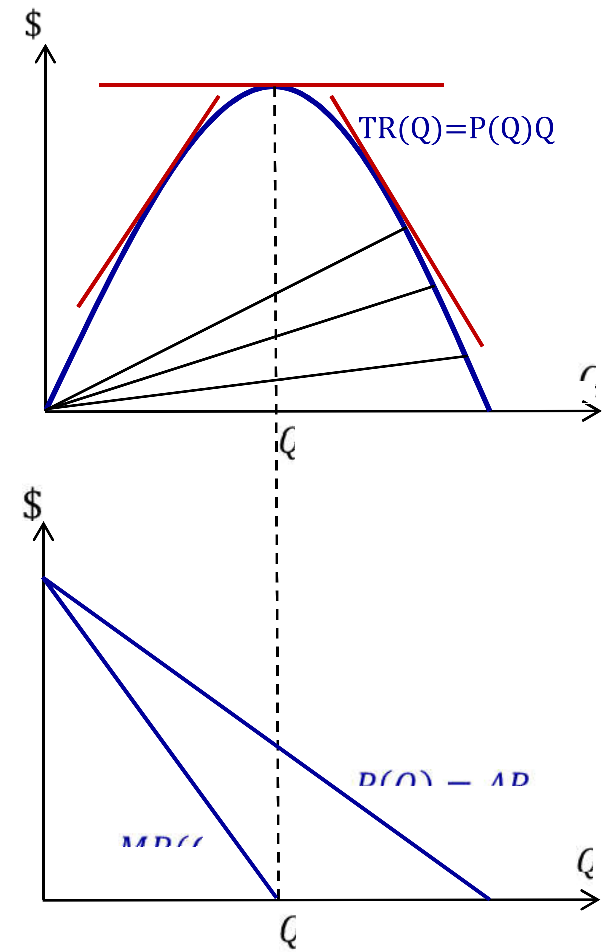
- $TR(Q) = P(Q) \times Q = AR(Q) \times Q$
  - Concave $TR(Q)$

- $MR(Q) = AR(Q) + Q\dfrac{\partial P(Q)}{\partial Q}$
  - $MR(Q) < AR(Q)$

- $MR(Q) > 0 \Rightarrow \varepsilon_D < -1$

$$P(Q) + Q\frac{\partial P(Q)}{\partial Q} > 0$$

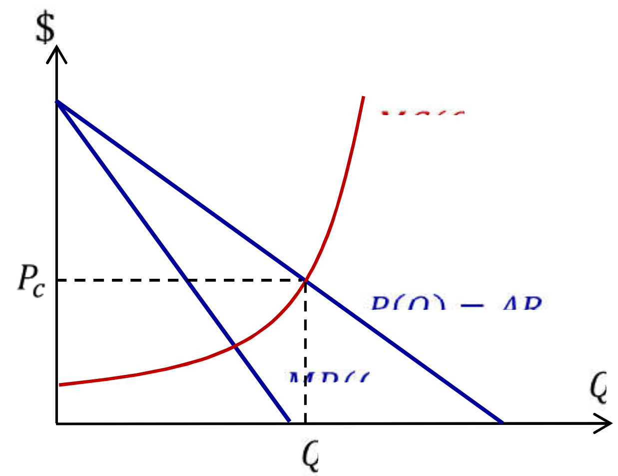
$$\Rightarrow P(Q) > -Q\frac{\partial P(Q)}{\partial Q} \Rightarrow \frac{P}{Q}\frac{\partial Q}{\partial P} < -1$$



Profit maximisation

- Perfectly competitive market:

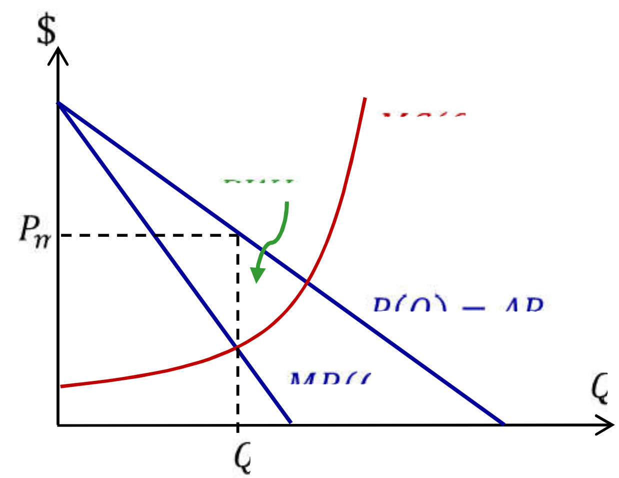
$$P(Q) = MC(Q)$$



- Imperfectly competitive market:

$$MR(Q) = MC(Q)$$

- Dead weight loss



Profit maximisation

- Imperfectly competitive market:

$$\frac{P(Q) - MC(Q)}{P(Q)} = \frac{1}{\varepsilon_D}$$

- The ability of firm to set $P(Q)$ over $MC(Q)$ depends on ε_D (absolute)
- $\varepsilon_D = 2$ (less elastic)

$$\frac{P(Q)-MC(Q)}{P(Q)} = \frac{1}{2} \Rightarrow P(Q) = 2MC(Q)$$

- $\varepsilon_D = 20$ (more elastic)

$$\frac{P(Q)-MC(Q)}{P(Q)} = \frac{1}{20} \Rightarrow P(Q) = \frac{20}{19}MC(Q)$$

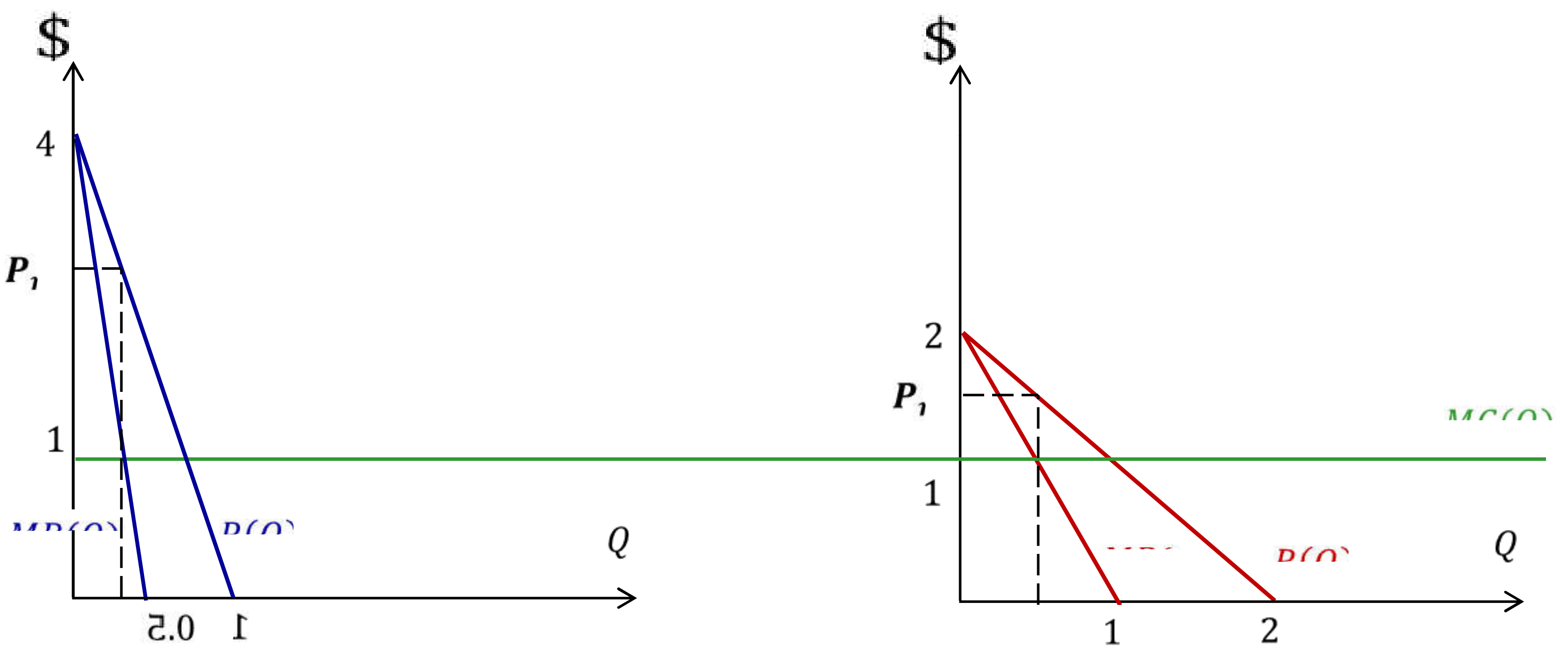
Profit maximisation

$P(Q) = 2 - 4Q$

$MR(Q) = 2 - 8Q$

$P(Q) = 2 - Q$

$MR(Q) = 2 - 2Q$



Task 1

$Q = 120 - P;$ $FC = 0;$ $VC(Q) = 20Q$

a) What is a monopolist's profit-maximising quantity Q_M and profits Π?

- Inverse demand function: $P(Q) = 120 - Q$

  Total revenue: $TR(Q) = P(Q) \times Q = 120Q - Q^2$

  Marginal revenue: $MR(Q) = \frac{\partial TR(Q)}{\partial Q} = 120 - 2Q$
- Total cost: $TC(Q) = FC + VC(Q) = 20Q$

  Marginal cost: $MC(Q) = \frac{\partial TC(Q)}{\partial Q} = 20$. Also note: $ATC(Q) = \frac{TC(Q)}{Q} = 20$
- Monopolist maximised profit by setting: $MR = MC$

$\Rightarrow 120 - 2Q_M = 20$

$\Rightarrow Q_M = 50; P_M = 120 - 50 = 70$

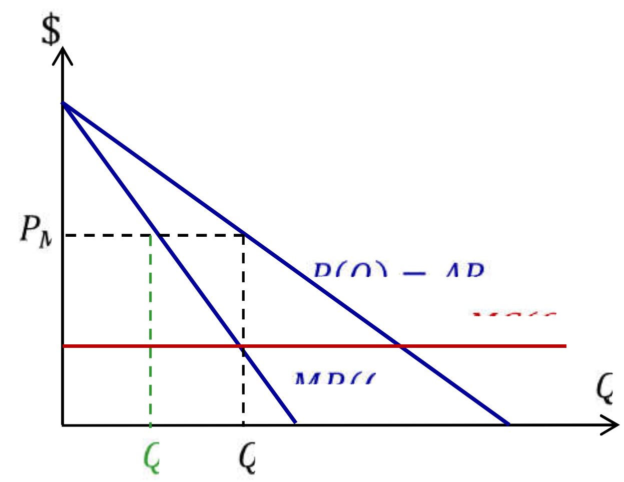
$\Rightarrow \Pi = TR - TC = [P_M - ATC(Q_M)]Q_M = [70 - 20]50 = 2500$

Task 1

$Q = 120 - P;$ $FC = 0;$ $VC(Q) = 20Q$

b) Suppose there are two firms {A,B} in this industry with identical cost functions (as above) who are thinking of colluding to maintain the monopoly quantity. What profits would they be able to make if they split the monopoly quantity equally, i.e., $Q_A = Q_B = Q_M/2$?

- $Q_A = Q_B = \frac{Q_M}{2} = 25$
- $P_A = P_B = P_M = 70$
- $\Pi_A = \Pi_B = [P_A - ATC(Q_A)]Q_A = 1250$
- $\Pi_B = \Pi_A = 1250$



Task 1

c) Is the cartel as described in part (b) sustainable if the firms interact only once? Explain. (Do the firms have incentives to diverge from $Q_A = Q_B = \frac{Q_M}{2} = 25$?)

- $P(Q) = 120 - Q = 120 - (Q_A + Q_B)$
- Firm A profit:

$$\Pi_A = [P_A - ATC(Q_A)]Q_A = [120 - Q_A - Q_B - 20]Q_A = (100 - Q_B)Q_A - Q_A^2$$

- Consider:

$$\frac{\partial \Pi_A}{\partial Q_A} = 100 - Q_B - 2Q_A$$

- At $Q_A = Q_B = \frac{Q_M}{2} = 25$:

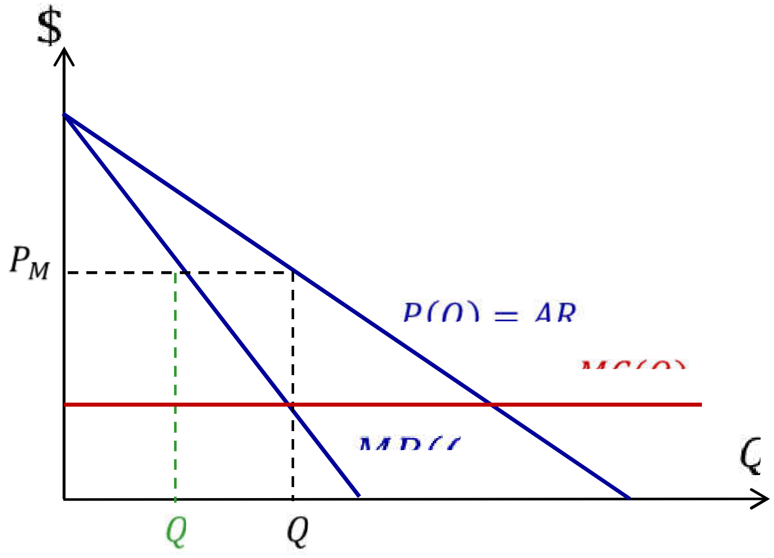
$$\frac{\partial \Pi_A}{\partial Q_A} = 100 - 25 - 2 \times 25 = 25$$

- Firm A can increase the current share of the cartel above 25 to make higher profit.

Task 1

d) What is the intuition behind the duopoly case being a strategic situation? On a related note, what is the intuition for your result in part (c)?

- Firms face a downward sloping demand
- Increase $Q \Rightarrow$ Lower $P \Rightarrow$ Change Π
- $\frac{\partial \Pi_A}{\partial Q_A} = 100 - Q_B - 2Q_A$
- Marginal gain $\lesseqgtr$ Inframarginal loss



Task 1

e) In game-theoretic terms, how would we view these (cartel) strategies $Q_A = Q_B = \frac{Q_M}{2} = 25$?

Not a Nash Equilibrium

Task 1

f) Write down each firm's best response function, and derive the Nash Equilibrium quantities.
How would a firm choose the quantity in relation to the other firm?

- For firm A:

$TR(Q_A) = P \times Q_A = (120 - Q_A - Q_B)Q_A = (120 - Q_B)Q_A - Q_A^2$
$MR(Q_A) = 120 - Q_B - 2Q_A$
To maximise profit: $MR(Q_A) = MC$
$\Rightarrow 120 - Q_B - 2Q_A = 20$
$\Rightarrow Q_A = \frac{100 - Q_B}{2}$: Firm A best response to Q_B set by firm B

- Similarly, firm's B best response to Q_A set by firm A:

$Q_B = \frac{100 - Q_A}{2}$

Task 1

f) Write down each firm's best response function, and derive the Nash Equilibrium quantities.
How would a firm choose the quantity in relation to the other firm?

- Both firms look symmetric in behaviors: $Q_A = Q_B$

$\Rightarrow Q_A = \frac{100-Q_B}{2} = Q_B$

$\Rightarrow Q_A = Q_B = \frac{100}{3} = 33.3$

- Nash Equilibrium {33.3, 33.3}