6304641597
Thanapun Kaewboran

① firm 1 ; $\pi_1 = TR_1 - TC_1$

$\pi_1 = (a - bq_1 - bq_2 - bq_3)q_1 - C_1$

$\frac{\partial \pi_1}{\partial q_1} = a - 2bq_1 - bq_2 - bq_3 = 0$

$a - bq_2 - bq_3 = 2bq_1$

$q_1 = \frac{a - bq_2 - bq_3}{2b}$

substitute ② into q_1

$q_1 = \frac{a - \left(\frac{a - bq_3}{3b}\right)b - bq_3}{2b}$

$q_1 = \frac{3a - a + bq_3 - 3bq_3}{6b}$

$q_1 = \frac{a - bq_3}{3b}$ ——— ①

substitute ③ into q_1

$q_1 = \frac{a - \left(\frac{a}{4b}\right)b}{3b}$

$q_1 = \frac{4a - a}{12b}$

$q_1 = \frac{a}{4b}$

firm 2 ; $\pi_2 = TR_2 - TC_2$

$\pi_2 = (a - bq_1 - bq_2 - bq_3)q_2 - C_2$

$\frac{\partial \pi_2}{\partial q_2} = a - bq_1 - 2bq_2 - bq_3 = 0$

$a - bq_1 - bq_3 = 2bq_2$

substitute ① into $2bq_2$

$2bq_2 = a - \left(\frac{a - bq_2 - bq_3}{2b}\right)b - bq_3$

$2bq_2 = \frac{2a - a + bq_2 + bq_3 - 2bq_3}{2}$

$4bq_2 = a + bq_2 - 2bq_3$

$3bq_2 = a - bq_3$

$q_2 = \frac{a - bq_3}{3b}$ ——— ②

substitute ③ into q_2

$q_2 = \frac{a - \left(\frac{a}{4b}\right)b}{3b}$

$q_2 = \frac{4a - a}{12b}$

$q_2 = \frac{a}{4b}$

firm 3 ; $\pi_3 = TR_3 - TC_3$

$\pi_3 = (a - bq_1 - bq_2 - bq_3)q_3 - C_3$

$\frac{\partial \pi_3}{\partial q_3} = a - bq_1 - bq_2 - 2bq_3 = 0$

$a - bq_1 - bq_2 = 2bq_3$

$q_3 = a - bq_1 - bq_2$

substitute ① & ② into q_3

$q_3 = \frac{a - b\left(\frac{a - bq_3}{3b}\right) - b\left(\frac{a - bq_3}{3b}\right)}{2b}$

$q_3 = \frac{3a - a + bq_3 - a + bq_3}{6b}$

$q_3 = \frac{a + 2bq_3}{6b}$

$6bq_3 = a + 2bq_3$

$4bq_3 = a$

$q_3 = \frac{a}{4b}$

Equilibrium price ; $P = a - bQ$

$P = a - b(q_1 + q_2 + q_3)$

$P = a - b\left(\frac{a}{4b} + \frac{a}{4b} + \frac{a}{4b}\right)$

$P = a - \frac{3a}{4}$

$P = \frac{a}{4} = 0.25a$

firm 1 ; $\pi_1 = P \cdot q_1 - C_1$

$= 0.25a \cdot \frac{a}{4b} - C_1$

$= \frac{a^2}{16b} - C_1$

firm 2 ; $\pi_2 = P \cdot q_2 - C_2$

$= 0.25a \cdot \frac{a}{4b} - C_2$

$= \frac{a^2}{16b} - C_2$

firm 3 ; $\pi_3 = P \cdot q_3 - C_3$

$= 0.25a \cdot \frac{a}{4b} - C_3$

$= \frac{a^2}{16b} - C_3$

6304641597
Thanapun Kaewboran

2 Assume $q_1 + q_2 + q_3 + q_n = A$

$$P = a - b(q_1 + q_2 + q_3 + \ldots + q_n)$$
$$P = a - bq_1 - bq_2 - \ldots - bq_n$$

$$\pi_1 = (a - bq_1 - bq_2 - bq_3 - \ldots - bq_n)\, q_1 - C_1$$
$$\vdots$$
$$\pi_n = (a - bq_1 - bq_2 - bq_3 - \ldots - bq_n)\, q_n - C_n$$

$$\frac{\partial \pi_1}{\partial q_1} = a - bq_1 - bq_2 - bq_3 - \ldots - bq_n = 0$$

$$q_1 = \frac{a}{2b} - 0.5(q_2 + q_3 + \ldots + q_n)$$

$$q_n = \frac{a}{2b} - 0.5(q_2 + q_3 + \ldots + q_{n-1})$$

$$\therefore\ q_1 - 0.5q_1 = \frac{a}{2b} - 0.5(q_2 + q_3 + \ldots + q_n)$$

$$0.5q_1 = \frac{a}{2b} - 0.5A$$

$$q_1 = \frac{a}{b} - A \quad \text{———} \ 1$$

$$q_2 = \frac{a}{b} - A$$

$$q_3 = \frac{a}{b} - A$$

$$\vdots$$

$$q_n = \frac{a}{b} - A$$

Since $A = q_1 + q_2 + q_3 + \ldots + q_n$

$$A = n\left(\frac{a}{b} - A\right)$$
$$A = n\left(\frac{a}{b}\right) - nA$$
$$A + nA = n\left(\frac{a}{b}\right)$$
$$(1+n)A = n\left(\frac{a}{b}\right)$$
$$A = \frac{na}{(1+n)b}$$

substitute A into 1

$$q_1 = \frac{a}{(1+n)b}$$

$$\therefore\ q_i = \frac{a}{(1+n)b}$$

Equilibrium price ; $P = a - b(A)$

$$P = a - b\left(\frac{na}{(1+n)b}\right)$$
$$P = a - \left(\frac{n}{1+n}\right)a$$
$$P = \frac{a(1+n) - na}{1+n}$$
$$P = \frac{a}{1+n}$$

$$\pi_i = P \cdot q_i - C_i$$
$$\pi_i = \frac{a}{1+n} \cdot \frac{a}{(1+n)b} - C_i$$
$$\pi_i = \frac{a^2}{(1+n)^2 b} - C_i$$

6304641597
Thanapun Kaewboran

③ If $n \to \infty$; it will make $q_i = \frac{a}{(1+n)b}$ $\longrightarrow$ nearly zero and each firms will sell at q nearly zero unit

; it will make $A = nq_i \longrightarrow$ nearly zero Q of every firms combined will be nearly $\longrightarrow \infty$ units

; it will make $P = \frac{a}{1+n} \longrightarrow$ nearly zero   When supply increase, price will decrease $\longrightarrow$ nearly zero.

; it will make $\pi_i = \frac{a^2}{(1+n)^2 b} - C_i \longrightarrow -C_i$ Each firm will lose its profit

If $n = 1$; it will make $q_i = \frac{a}{(1+n)b} = \frac{a}{2b}$ Since $Q = \frac{a}{2b} < Q = \frac{na}{(1+n)b}$, monopoly will sell less quantity

; it will make $A = nq_i = Q$ Since $n=1$, the firm will be a monopoly.

; it will make $P = \frac{a}{1+n} = \frac{a}{2}$ Since $P_M = \frac{a}{2} > P = \frac{a}{1+n}$, monopoly will set a higher price.

; it will make $\pi_i = \frac{a^2}{(1+n)^2 b} - C_i = \frac{a^2}{4b} - C_i$, which higher than $\pi_i = \frac{a^2}{(1+n)^2 b}$

As a result, a monopoly will get higher profit.