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Ecn 200C – Micro Theory – Professor Giacomo Bonanno

ANSWERS TO PRACTICE PROBLEMS $\boxed{11}$

1. **(a)** Firm 1's profit function is

$$\pi_1(q_1,q_2) = [12 - (q_1 + q_2)]\, q_1$$

and firm 2's profit function is

$$\pi_2(q_1,q_2) = [12 - (q_1 + q_2)]\, q_2.$$

Thus firm 1's reaction function is

$$R_1(q_2) = 6 - \frac{q_2}{2}$$

and firm 2's reaction function is

$$R_2(q_1) = 6 - \frac{q_1}{2}.$$

The Cournot equilibrium is given by $q_1 = q_2 = 4$, with $\pi_1 = \pi_2 = 16$.

(b) If firm 1 installs the new technology, its profit function becomes

$$\tilde{\pi}_1(q_1,q_2) = [14 - (q_1 + q_2)]\, q_1 - F$$

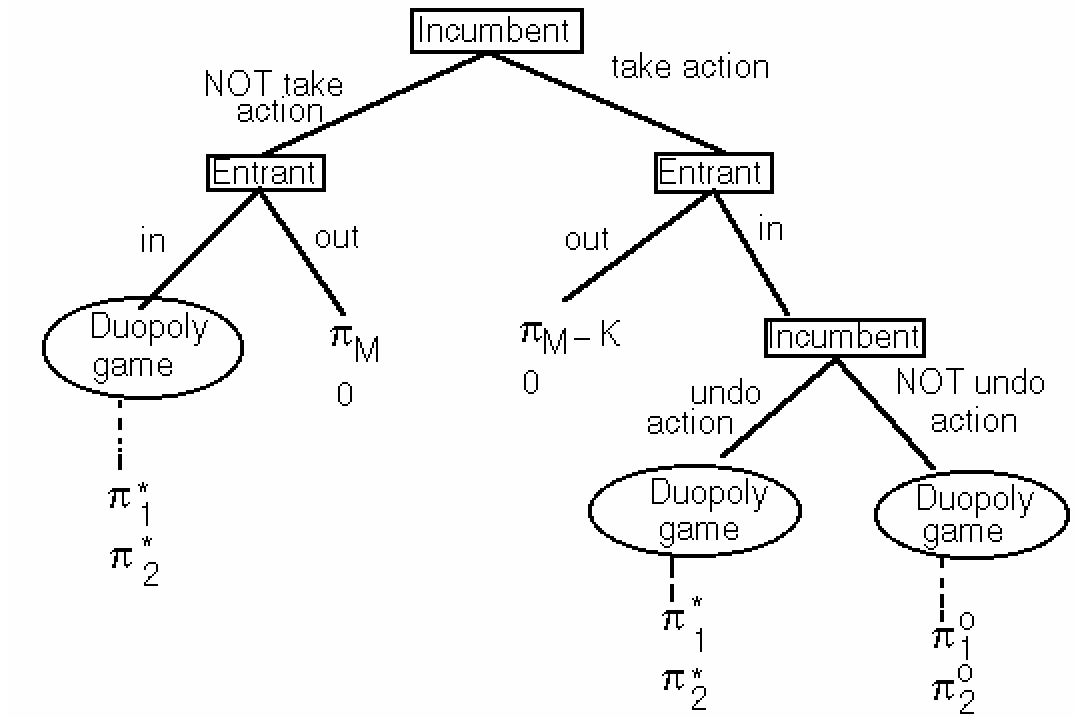
while firm 2's profit function is the same as before. Thus firm 2's reaction function does not change, while firm 1's reaction function becomes:

$$\tilde{R}_1(q_2) = 7 - \frac{q_2}{2}.$$

Thus the Cournot equilibrium is $q_1 = \dfrac{16}{3}$ and $q_2 = \dfrac{10}{3}$, with $\tilde{\pi}_1 = \dfrac{256}{9} - F$. Thus firm 1 should make the investment if $\dfrac{256}{9} - F > 16$, i.e. if $F < \dfrac{112}{9}$.

Note that making the investment increases firm 1's profit in two ways. First, firm 1's profit is higher at any fixed pair of outputs, because its unit cost of production has gone down. Second, firm 1 gains because firm 2's output is decreased. The reason why firm 2's output is lower is because by lowering its cost firm 1 altered its own incentives, in particular made itself "more aggressive" in the sense that $\tilde{R}_1(q_2) > R_1(q_2)$ for all q_2.

2. **(a)** The extensive game is as follows



There are two subgame-perfect equilibria.

First equilibrium: incumbent's strategy is "take action, undo action if entry"; entrant's strategy is "in, whether or not action was taken".

Second equilibrium: incumbent's strategy is "do not take action, undo action if it was taken and there was entry"; entrant's strategy is "in whether or not action was taken".

Thus both equilibria have entry. Since there is no sunk cost involved (the action can be undone) there cannot be entry deterrence in equilibrium.

3. Let *w* be the price set by the well owner. Then the refinery owner will choose *p* to maximize

$$\pi_R = (p - w - 1)(100 - 4p).$$

The solution is $p(w) = 13 + \frac{w}{2}$. The well owner anticipates this and chooses w to maximize

$$\pi_W = (w - 2)[100 - 4(13 + \frac{w}{2})] = (w - 2)(48 - 2w).$$

The solution is w = 13 and the refinery owner charges p = 13 + 13/2 = 39/2 = 19.5 to consumers.