

Entry Deterrence

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Suppose that the industry inverse demand curve was $P = a - bQ$ and we wanted to find out how much Incumbent (I) should produce (q_I) so that the Entrant (E) will not make positive profits.

$$\pi_E = (a - b(q_E + q_I)) \cdot q_E - cq_E - FC_E \leq 0$$

Notice that this is the same as forcing price in the residual demand to be below average total cost for the entrant.

$$P_E = ((a - bq_I) - b(q_E)) \leq \frac{cq_E + FC_E}{q_E} = ATC_E$$

See graph below for the intuition.

0.1 Entry Deterrence

Since the Incumbent is choosing q_I and the Entrant will be best responding to that, we have a Stackelberg problem, where the Incumbent is the first mover. Find the FOC with respect to q_E . The best response function (see Stackelberg notes for details)

$$q_E^* = \frac{a - c}{2b} - \frac{q_I}{2}$$

Now, we can find out what the Entrant's profit will be for every q_I by plugging the best response of the entrant $q_E^*(q_I)$ back into its profit function.

$$\begin{aligned}\pi_E &= \left(a - b \left(\frac{a - c}{2b} - \frac{q_I}{2} + q_I \right) - c \right) \cdot q_E - FC_E \leq 0 \\ \pi_E &= \left(a - b \left(\frac{a - c}{2b} + \frac{q_I}{2} \right) - c \right) \cdot \left(\frac{a - c}{2b} - \frac{q_I}{2} \right) - FC_E \leq 0 \\ \pi_E &= \left(\frac{a - c}{2} - \frac{bq_I}{2} \right) \cdot \left(\frac{a - c}{2b} - \frac{q_I}{2} \right) \leq FC_E \\ \pi_E &= b \left(\frac{a - c}{2b} - \frac{q_I}{2} \right)^2 \leq FC_E\end{aligned}$$

$$\left(\frac{a-c}{2b} - \frac{q_I}{2}\right) \leq \left(\frac{FC_E}{b}\right)^{\frac{1}{2}}$$

$$\frac{a-c}{b} - 2\left(\frac{FC_E}{b}\right)^{\frac{1}{2}} \leq q_I$$

Since q_I is greater than the Incumbent's monopoly quantity, it will want the least q_I :

$$q_I = \frac{a-c}{b} - 2\left(\frac{FC_E}{b}\right)^{\frac{1}{2}}$$

See graph below.

0.1.1 Numerical Example

Suppose $a = 10, b = 1, c_E = 2, FC_E = 4$. If the Incumbent were to deter entry, he would choose q_I so that:

$$\pi_E = (10 - (q_E + q_I)) \cdot q_E - 2q_E - 4 \leq 0$$

After finding the FOC with respect to q_E , the best response function of the Entrant will be:

$$q_E^* = \frac{10-2}{2} - \frac{q_I}{2}$$

Substituting back into the profit function so that now, it will be completely a function of q_I .

$$\pi_E = \left(10 - \left(4 - \frac{q_I}{2} + q_I\right) - 2\right) \cdot \left(4 - \frac{q_I}{2}\right) - 4 \leq 0$$

$$\pi_E = \left(4 - \frac{q_I}{2}\right) \cdot \left(4 - \frac{q_I}{2}\right) \leq 4$$

$$4 - \frac{q_I}{2} \leq 2$$

$$4 \leq q_I$$

This means that

$$q_E^* = 4 - 2 = 2$$

Now, lets test these numbers. Suppose $q_I = 4, q_E = 2$.

$$\pi_E = (10 - (q_E + 4)) \cdot q_E - 2q_E - 4$$

$$\pi_E = (10 - (6)) \cdot 2 - 2 \cdot 2 - 4 = 0$$

See graph below.

