1 ENTRY DETERRENCE AND PREDATION

1.1 Dynamic competition with complete information

Overview: *a) Illustrate first mover advantage when commitment is feasible. The role of irreversibility. b) Market structure issues, entry and exit, and possibility of excess capacity as a deterrent to entry. Similar ideas apply to advertising, or product proliferation. Effect of exit or product focusing on market structure. c) Taxonomy of strategies. d) Contracts with customers as a deterrence of entry. Capital renewal, war or attrition. Contestability. Dissipation of profits with a corresponding increase in gains to consumers.*

Dixit (EJ, 1980).

Spence (EJ, 1977) showed that firms hold idle capacity to deter entry. Dixit shows that Spence's result was due to the fact that his equilibrium was not subgame-perfect.

One incumbent and one potential entrant. Three-stage game:

- Stage 1: Capacity choice k_1 by firm 1.
- Stage 2: Entry decision by 2.
- Stage 3: Cournot or monopoly outcome.

Cost function: $C_i = w_i x_i + r_i k_i + F_i$, for $x_i \leq k_i$, where r_i is the cost per-unit of capacity and w_i is the average variable cost for output. The per-period revenue functions are $R_i(x_1, x_2)$. Firm 1 can add capacity after entry has occurred but it cannot reduce its capacity. Therefore, the marginal cost of firm 1 is w_1 if its output does not exceed k_1 and $(w_1 + r_1)$ if its output exceeds k_1.

The reaction function of firm 1 is the kinked curve shown in heavy lines in figure **??**. When the installed capacity is binding and the firm has to expand its capacity, its marginal cost increases and that is why the reaction function goes down.

The Nash equilibrium will be somewhere between T and V, see figure **??**. For a choice of $k_1 \leq T_1$, the post-entry equilibrium will be at T, while for $k_1 \geq V_1$, it will occur at V. For $T_1 \leq k_1 \leq V_1$ it will occur at the appropriate point on the heavy line segment lying between T and V. Here, the incumbent will produce output $x_1 = k_1$, and the entrant will choose the Stackelberg follower level of output. The incumbent firm can exercise leadership over a limited range by using its capacity choice to manipulate the initial conditions of the game. Capacity levels installed by firm 1 in stage 1 above V_1 are not credible threats.

To better understand the above arguments, first suppose that $k_1 \leq T_1$. Then, if firm 2 sets its x_2 on its best response curve with $x_1 = k_1$, firm 1 will have an incentive in stage 3 to produce more and in particular to go on its best response function with marginal cost $r+w$. So, $k_1 \leq T_1$ cannot be an equilibrium. Second, assume that $k_1 \geq V_1$. Then, if firm 2 sets its x_2 on its best response curve with $x_1 = k_1$, firm 1 will have an incentive in stage 3 to produce less and in particular to go on its best response function with marginal cost w. So, $k_1 \geq V_1$ cannot be an equilibrium. Finally, suppose that $k_1 \in [T_1, V_1]$ and x_2 is on the best response line of firm 2. Once firm 1 chooses such a k_1 it has no incentives to change it in stage 3. To see this, suppose firm 1 wants to unilaterally lower x_1. In this case, the marginal cost is w and the relevant best response for firm 1 is the higher one. But this suggests that the best response to x_2 is to produce more, not less. Now suppose that firm 1 wants to produce more than k_1. The marginal cost is $w + r$ and the relevant best response is the lower one. This suggests that the best response to x_2 is to produce less, not more. Therefore, once a k_1 in the $[T, V]$ segment is chosen, firm 1 has not incentive to unilaterally deviate in stage 3.

M_1 is the monopoly outcome under no threat of entry.

There are three cases to be considered. First note that π_2 is the highest at T and the lowest at V.

Case 1. If $\pi_2(T) < 0$, firm 2 will not enter. Firm 1 will choose $k_1 = M_1$.[1]

Case 2. If $\pi_2(V) > 0$, firm 1 cannot prevent entry. Then firm 1 will compute its profits along the TV segment and choose the best point.

Case 3. $\pi_2(T) > 0 > \pi_2(V)$. There exits a point B on the TV segment such that $\pi_2(B) = 0$. Case 3 can be further divided into the following three cases, see also Figure **??**:

i) If $T < B < M$ the incumbent's monopoly choice is sufficient to deter entry, i.e., $k_1 = M_1$. Entry is blockaded.

ii) $M < B < A$. Firm 1 sets $k_1 = B_1 > M_1$ and entry will be deterred. In this case $\pi_1(B_1, 0) > \pi_1(S)$. The incumbent sets excess capacity relative to the monopoly capacity in order to deter entry.

iii) $A < B < V$. Firm 1 sets $k_1 = S_1$. Entry is not deterred. Firm 1 is the Stackelberg leader and in this case $\pi_1(S) > \pi_1(B_1, 0)$.

[1] Given that firm 2 will not enter, firm 1 is a monopoly and its marginal cost is $r + w$ and the profit maximizing output is at M_1.

Capacity is never idle in this model. Bulow, Geanakoplos and Klemperer (EJ, 1985) show that excess capacity may reappear when the demand function is so convex that the reaction curves are upward sloping.

1.1.1 Contracts as an entry deterrence

Aghion and Bolton (AER, 1987).

There is one seller S_1 and one buyer B. The buyer has a unit demand with reservation price equal to 1. The cost is $C = 1/2$. A contract is (p_1, p_0), where p_1 is the delivery price and p_0 is the breach penalty. There is also an entrant whose cost C_e is uniformly distributed in $[0, 1]$.

Case 1. No contract is offered in period 1. If $C_e < 1/2$, then entry takes place and $p_{en} = 1/2$. If $C_e > 1/2$, then no entry takes place and $p_n = 1$. The surplus of the buyer is

$$S = \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times 0 = \frac{1}{4}.$$

Case 2: Contract is offered. The surplus of the buyer is $S = 1 - p_1$, whether delivery takes place or the contract is breached. If there is entry (in which case the contract is breached), the entrant offers p_2. The buyer pays $p_2 + p_0 \leq p_1$. In equilibrium, $p_2 = p_1 - p_0$. So the buyer pays $p_2 + p_0 = p_1$.

Buyer signs the contract if and only if

$$1 - p_1 \geq \frac{1}{4} \Rightarrow p_1 = \frac{3}{4}.$$

The probability of breach is $\Pr(\text{breach}) = p_1 - p_0$, because entry/breach occurs if and only if $C_e \leq p_2 = p_1 - p_0$. The expected profit of the incumbent is,

$$\pi(p_0) = \Pr(\text{entry/breach})\, p_0 + \Pr(\text{no entry/no breach}) \left(p_1 - \frac{1}{2}\right) =$$
$$(p_1 - p_0)\, p_0 + (1 - p_1 + p_0) \left(p_1 - \frac{1}{2}\right).$$

Taking the first order condition with respect to p_0, and using $p_1 = 3/4$, we can solve for the optimal breach price,

$$p_0 = \frac{1}{2}.$$

So, we can see that when there are no contracts the probability of entry is 1/2 and with contracts it is only 1/4. When $C_e \leq 1/4$ entry takes place. However, for $C_e \in [1/4, 1/2]$ entry is prevented, although the entrant has a lower cost than the incumbent. Therefore, contracts prevent entry to some extent but do not preclude it completely.

The buyer surplus is always the same, 1/4. Contracts make the incumbent better off and the entrant worse off. Social surplus goes down when contracts are allowed.

Essentially, the penalty transfers money from the entrant to the incumbent.