Entry Deterrence and Predation

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November 29, 2016

Outline

Predatory Pricing and Entry Deterrence

- Firms might engage in practices that either limit entry into a market, or make rivals exit.
- Let's start with three stories.
  - American Airlines seems to lower prices before Southwest Enters.
  - Dupont built large Titanium Dioxide Plants (the stuff that makes toothpaste and paint really white) to deter other firms from expanding.
  - In the British Bus industry, dominant firms would lower prices to keep new entrants from coming in, or to push them out.

Predatory Pricing and Entry Deterrence Ctd.

Entry deterrence stories are about firms making investments in order to keep new firms out of the market.

There is a large difference between stories that depend on:

- Real Variables, such as investment in capacity, that have commitment power.
- Information, such as prices.

Preemptive Capacity Expansion

1. I might take an action that raises my capital stock K permanently, before a rival makes an entry decision, say at a cost K_1 for each additional unit of capital.
2. Let profits be $\pi_1^M(K_1)$ if firm 1 is a monopolist, and $\pi_1^D(K_1)$ and $\pi_2^D(K_1)$ for firms 1 and 2 if firm 2 enters.
3. Define K^0 as the capital level I would choose under duopoly.
4. I can pick the entry deterring level of capital $\bar{K}$ defined as:

$$\pi_2^D(\bar{K}) = F$$

   so my rival does not enter.
5. This is profitable if:

$$\pi_1^M(\bar{K}) - \bar{K} \geq \pi_1^D(K^0) - K^0 \tag{1}$$

Signaling through low prices

See section 9.1-9.4 in Tirole (pages 361-374).

1. Prices are kept low to keep new entrants out.
2. Hard to believe that these low prices are persistent: they can be quickly changed post entry.
3. Also difficult to believe that firms can credibly signal that they will engage in a price war post entry.

Price War Post-Entry

1. Suppose an entrant is considering entry or not. Let's assume that we are in a quantity setting (i.e. Cournot) game with an inverse demand curve $P = 10 - q_1 - q_2$. Marginal Costs are $c = 5$.
2. The incumbent announces the following policy:

$$q_1 = \begin{cases} 10 \text{ if there is entry} \\ 2.5(q^M) \text{ if there is no entry} \end{cases}$$

3. The entrant will choose not to enter if she believes that this is firm 1's strategy. But should she believe it?
4. No, this strategy is not subgame perfect: upon entry, the incumbent would prefer producing the Cournot quantity ($q_1 = \frac{5}{3}$), rather than $q_1 = 10$.
5. The game where quantities are chosen first, then the entry decision is made is less believable: building a new plant or store is much slower than altering your pricing gun.

Signaling through low prices (Milgrom and Roberts)

Prices are kept low to signal that the incumbent has low costs: Milgrom and Roberts (1982).

Information Structure

- Firm 1:

$$c_1 = \begin{cases} c_L \text{ with probability } x \\ c_H \text{ with probability } 1 - x \end{cases}$$

- Firm 2:
  Has cost c_2 (perfectly known to everyone).

Milgrom Roberts: Timing

Timing:

1. $t = 1$ The incumbent sets p^1 based on c_1. Receives profits $M_1^L(p^1)$ or $M_1^H(p^1)$.
2. $t = 2$ The entrant makes a entry choice.
3. $t = 2 + \epsilon$
   - If firm 1 is a monopolist, gets $\pi^M(c_1) = \begin{cases} M_1^H \\ M_1^L \end{cases}$.
   - If firm 2 has entered, firm receives profits from duopoly: $\pi_1^D(c_1, c_2) = \begin{cases} D_1^H \\ D_1^L \end{cases}$ and $\pi_2^D(c_1, c_2) = \begin{cases} D_2^H \\ D_2^L \end{cases}$.

Let's make things interesting: $D_2^H > 0 > D_2^L$.

Milgrom Roberts: Signalling

- The incumbent wants to signal c_1^L by setting a low price. Say the monopoly price for low cost firms $p_1^M(c_L)$.
- But the firm with c_H might also set price at $p_1^M(c_L)$ to fool firm 2 into thinking it is low cost.
- But this means that seeing $p_1^M(c_L)$ does not mean anything about costs.
- We will look at two types of equilibria: separating (high and low cost charge different prices), and pooling (both types charge the same price).

Milgrom Roberts: Full Information Benchmark

- It will be useful to start with the case where everyone knows firm 1's cost.
- In period 1: $p_1 = \begin{cases} p_1^M(c_L) \text{ if } c_L \\ p_1^M(c_H) \text{ if } c_H \end{cases}$.
- In period 2: Firm 2 enters if $c_1 = c_H$, and prices are either $p_1^M(c_L)$ if $c_1 = c_L$, or duopoly prices if $c_1 = c_H$.

Milgrom Roberts: Separating Equilibria

- In a separating equilibria, there will be a price p_1^L and p_1^H that each type will use.
- Clearly $p_1^H = p_1^M(c^H)$, may as well charge monopoly price if you won't signal anything.
- We have two incentive compatibility conditions:
  $\underline{IC^H:}$

$$M_1^H + \delta D_1^H \geq M_1^H(p_1^L) + \delta M_1^H$$
$$\underbrace{M_1^H - M_1^H(p_1^L)}_{\text{Cost of mimicking}} \geq \delta \underbrace{(M_1^H - D_1^H)}_{\text{Benefit of Mimicking}}$$

  $\underline{IC^L:}$

$$M_1^L + \delta D_1^L \geq M_1^L(p_1^L) + \delta M_1^L$$
$$M_1^L - M_1^L(p_1^L) \geq \delta(M_1^L - D_1^L)$$

  if p_1^L is really low, you could see why even a firm with cost c_L would not want to do it.

Most Profitable Separating Equilibrium

- What is the most profitable separating equilibrium: just satisfy IC^H.

$$M_1^H + \delta D_1^H = M_1^H(p_1^L) + \delta M_1^H$$
$$(1-\delta)M_1^H + \delta D_1^H = M_1^H(p_1^L)$$

- Notice that $p_1^L < p_m^L$, so firm 1 is worse off than if there is perfect information.

Pooling Equilibrium

- p_1 is the price charged by c_L and c_H.
- Need:

$$xD_2^L + (1-x)D_2^H < 0$$

  If I can't tell, I won't enter.
- We need different IC conditions;
  <u>IC^L:</u>

$$M_1^L(p_1^*) + \delta M_1^L \geq M_1^L + \delta D_1^L$$

  <u>IC^H:</u>

$$M_1^H(p_1^*) + \delta M_1^H \geq M_1^H + \delta D_1^H$$
$$\underbrace{M_1^H(p_1^*) - M_1^H}_{\text{Cost of sticking with equilibrium}} \geq \delta \underbrace{(M_1^H - D_1^H)}_{\text{Benefit of sticking to equilibrium}}$$

"Best" Pooling Equilibrium

- Best Pooling Equilibrium has the highest possible price, say both firms charge p_m^L (the monopoly price for the low cost firm).
- Need only to check that IC^H holds.
  <u>IC^H:</u>

$$M_1^H(p_m^L) + \delta M_1^H \geq M_1^H + \delta D_1^H$$

- If the costs of both firms are too different, you could imagine cases where this condition could fail.

Welfare Effects

- Notice that separating equilibrium will lower prices compared to the case where there is full information.
- Pooling equilibrium yields a mixed outcome: no duopoly entry, but lower prices than monopoly prices (for high type) in the first period.
- Prices need to convey a large amount of information: can be no other way to do this.
- Technically, we need so-called "single crossing properties" to yield this type of equilibrium.

Bankruptcy and Predation

- The story of signaling and preemptive investment is about conveying information about the future.
- In many predation cases, the worry is about firms exiting today, not because their expectations have changed.
- Can I charge low prices to force my rival into bankruptcy (or into merger).
- The issue is that I can get a loan to carry me over the period of predation.
- Need some form of imperfection in the credit market to make it difficult for a predated firm to be carried over.
- Nice set of stories in Shipping Cartels of this type of behavior.

Predation and the "Long Purse"

- Suppose there are two firms, one with capital K_A (firm A) and K_B (firm B), where $K_A < K_B$.
- Profits are:

$$\pi = \begin{cases} \pi^P - f \text{ if predation stage} \\ \pi^D - f \text{ if duopoly} \\ \pi^M - f \text{ if monopoly} \end{cases}$$

  Let's have $\pi^P = 0$, just to simplify this.
- Predation can happen if:

$$\begin{aligned} f + \delta f + \delta^2 f + \cdots + \delta^T f &< K_A \\ \frac{1-\delta^T}{1-\delta} f &< K_A \end{aligned}$$

  Let's choose the smallest T until firm A is forced to exit.
- Notice that if firm A expects a predation, then it will exit at $t = 1$.

Predation and the "Long Purse" Ctd.

- As well, predation can be profitable for firm B if:

$$\frac{1-\delta^T}{1-\delta} f + \frac{\delta^{T+1}}{1-\delta}(\pi^M - f) > \frac{1}{1-\delta}(\pi^D - f)$$

- The issue we have is that this begs the question of wether a bank would be willing to loan money to firm A in order to eliminate the possibility of predation: up to $\frac{1}{1-\delta}(\pi^D - f)$ in fact.
- Tirole has a nice story of what would underlie the inability for lending to occur in this scenario (section 9.7 pages 377-380). Some cost of checking a firm's credit that makes lending occur at an interest rate $r > (1-\delta)$.

Financial Inefficiency

- Entrepreneur has a project $\Pi \sim [\underline{\Pi}, \overline{\Pi}]$, which has some randomness to it, and could be asymmetric information, i.e., Π could be known by the entrepreneur but not the bank.
- E is the capital stock of the entrepreneur (equity), K is the capital requirement of the project. Thus, $D = K - E$ is the debt that the entrepreneur needs to take on.
- Interest Rate is given by r.
- Entrepreneur's Bankruptcy Decision

$$\tilde{\Pi} < (1+r)D \text{ then go bankrupt}$$
$$\tilde{\Pi} \geq (1+r)D \text{ then pay back the loan}$$

- Expected Profit for the Entrepreneur:

$$U(D,r) = \int_{(1+r)D}^{\overline{\Pi}} [\Pi - D(1+r)] df(\Pi)$$

Financial Inefficiency: Bank's problem

- The bank has a bankruptcy cost (say foreclosure cost) B.
- So upon bankruptcy, it gets $\Pi - B$ (the leftover profit).
- The bank's profit

$$\begin{aligned} V(D, r) = &(1+r)D[1 - F(D(1+r))] \\ &+ \int_{\underline{\Pi}}^{D(1+r)} (\Pi - B) df(\Pi) \end{aligned}$$

- Perfect Competition implies $V(D, r^*) = D(1 + r^0)$ for the market clearing interest rate r^*, and a cost of funds r^0 from another market for funds.
- It is clear that the market interest rate $r^* > r^0$, so there is a higher interest rate than the underlying one.
- Firms with higher E will have lower interest rates: lower possibility of bankruptcy.

Predation in Practice: How to measure it, and should we care

- Predation is difficult to think about: remember that we are punishing firms for prices that are too low.
- One needs to have a dynamic story of low prices today generating high prices in the future, once exit has occurred. This is a future that is posited, but never observed.
- This is the usual criticism that you hear about Amazon.
- Still there are two arenas where predation is prohibited:
  - Areeda-Turner Test for Predation (in Antitrust), as an anticompetitive practice.
  - Anti-dumping rules in international trade.

Areeda-Turner Test for Predation

- How to detect predation?
- Predation affects the probability of a rival exiting, which we will call $\chi_2(Q_1)$. This will be an increasing function of Q_1.
- As well, inducing exit raises firm 1's profits Π_1. In other words $\frac{\partial \Pi_1}{\partial \chi_2} > 0$.
- Let's look at the firm's first-order condition for pricing:

$$MR + \frac{\partial \Pi_1}{\partial \chi_2} \frac{\partial \chi_2}{\partial Q_1} = MC$$

- So the term $\frac{\partial \Pi_1}{\partial \chi_2} \frac{\partial \chi_2}{\partial Q_1}$ means that we will get lower prices than we would without the predation motive.
- In particular, MC is a natural lower bound on price, since MR is at least non-negative.
- Areeda and Turner:

$$P < MC$$

- Now typically marginal cost is hard to measure, so some version of average cost AC is used, where you need to be careful to net out fixed costs to do this right.

Anti-dumping

- In international trade, there are also rules against predatory pricing. These usual come under the guise of antidumping rules.
- For example, there are large subsidies that China is giving to solar panel manufacturers. Import tariffs of about 150 percent are being levied on these firms.
- The typical test of dumping is:

$$P < AC$$

- Notice that average cost is going to embed a lot of fixed costs, such as capital costs.
- In an industry with fluctuating prices, and high fixed costs, you will often see $P < AC$.
- In industries with learning-by-doing, you will also see $P < MC$.