

Entry Deterrence and Predatory Strategies I

Industrial Organization
K. Graddy

Outline

- Barriers to Entry
- Contestable Markets (Again)
- Strategic Entry deterrence (and accommodation)
- Capacity expansion in the titanium dioxide industry

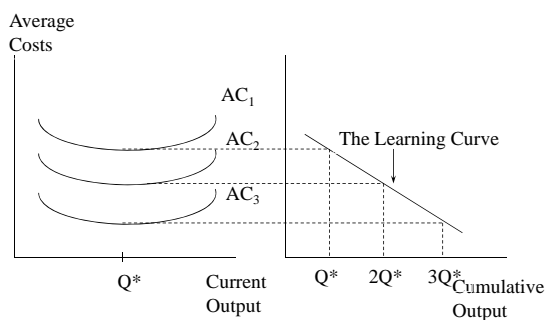
Defining Barriers to Entry (BTE)

- Bain defined a BTE as anything which allows incumbent firms to earn supernormal profits without the threat of entry. He asserted that there are four elements of market structure which give rise to barriers to entry:
 - Economies of scale
 - Absolute cost advantages
 - Scarce resources
 - Legal barriers
 - Patents
 - learning

Learning

- Learning occurs when the cost of producing a given level of output falls with the experience of doing so period by period
- Learning occurs when costs depend on cumulative output

Learning



- Product Differentiation
 - Location
 - Switching costs
 - Complementary goods
- Capital Raising Requirements

- Von Weizsacker defined a BTE as a cost of producing that must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry
 - BTE imply a distortion in the allocation of resources from the social point of view
 - Oligopoly theory suggests sunk costs (both exogenous and endogenous!) and imperfect or asymmetric information are the main barriers to entry under von Weizsacker's definition

Ultra Free Entry: Contestable Markets (Baumol 1982)

- Assumptions
 - Homogeneous goods
 - Firms set prices
 - No sunk costs
 - Free entry and exit
 - Entrant may enter and undercut rival before incumbent is able to respond

- Results: With increasing returns to scale the following conclusions are predicted
 - There is a unique operating firm in the industry
 - This firm makes zero profits
 - Average-cost pricing prevails
- In the absence of competition, potential entry is very effective in disciplining incumbent firms -- this theory presents a strong argument against regulation or nationalization of utilities
- Criticism: Generally believed that prices adjust more rapidly than decisions about quantity or entry

strategic entry deterrence refers to any action taken by an existing business in a particular market that discourages potential entrants from entering into competition in that market.

Schelling's definition of Strategy

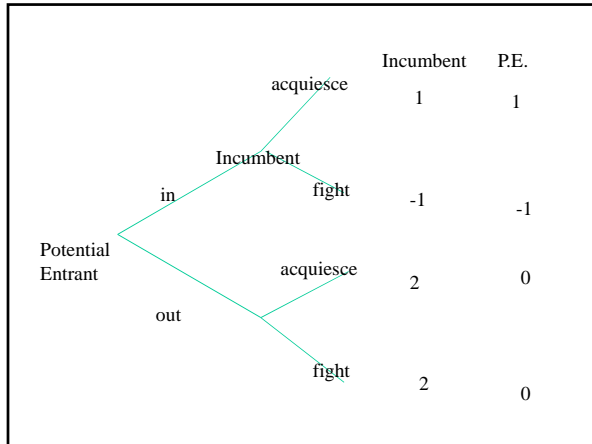
- A strategic move is one that influences the other person's choice, in a manner favorable to one's self, by affecting the other person's expectations of how one's self will behave.
- Schelling (1960)

Strategic Entry Deterrence

- A firm fights entry now to limit entry and make higher profits later
 - Stage 1: Potential entrant decides whether to enter (IN) or not enter (OUT)
 - Stage 2: Incumbent decides whether to fight or acquiesce.
- Two Nash equilibria, (IN, ACQUIESCE) and (OUT, FIGHT)
- Entrant would like to establish (OUT, FIGHT), but not credible, so no predation occurs

Predatory Pricing

- When a firm lowers its price in order to drive rivals out of business and/or scare off potential entrants, and then raises its price when its rivals exit the market.
- The Problem with Predatory Pricing:
 - The inability to commit
 - The strategies do not belong a subgame perfect Nash equilibrium
 - (SPNE Strategies that are best responses in all subgames)



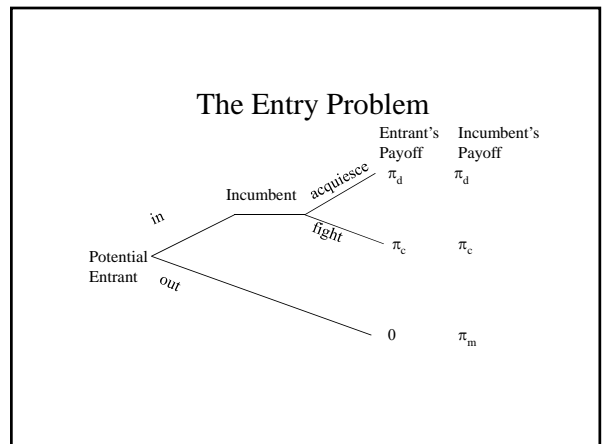
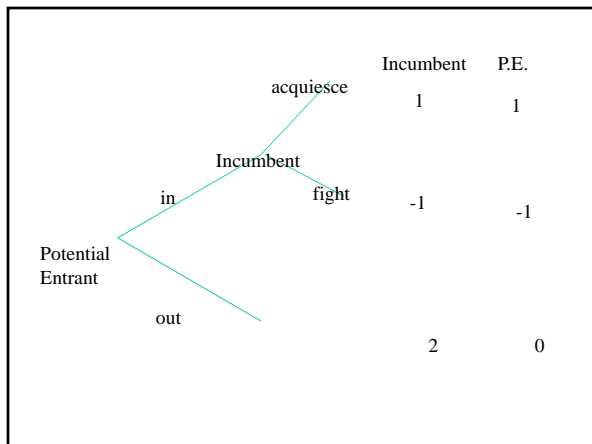
2 Nash Equilibria

- 1) In, Acquiesce
 - Need to check two things
 - If the potential entrant goes in, it is optimal for the incumbent to acquiesce
 - If the incumbent acquiesces, it is optimal for the potential entrant to go in

2 Nash Equilibria

- 2) Out, Fight
 - Again, need to check two things
 - If the potential entrant stays out, it is optimal for the incumbent to fight (it actually doesn't matter, as he gets 2 either way)
 - If the incumbent fights, it is optimal for the potential entrant to stay out
 - But, we are uncomfortable with this equilibrium. If "by accident" the potential entrant enters, the incumbent will acquiesce

- This equilibrium is not subgame perfect
- What we really mean, is that it is not a credible threat for the incumbent to say that he will fight, because if the incumbent enters, it also makes sense for the incumbent to acquiesce.



Situations in which Predation May Occur

- Owners appoint managers with managerial rather than profit objectives
- Self-crippling devices: locking customers in LT contracts at low prices
- Repeated interaction
 - With *incomplete* information about incumbent's payoffs
 - With imperfect financial markets
- Strategic precommitment
 - Example: building excess capacity

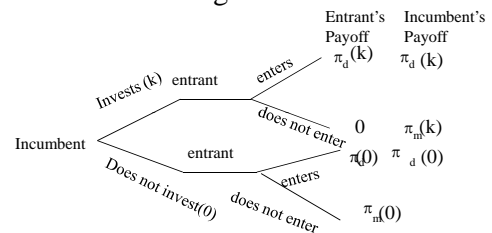
Strategic Pre-commitment

- When an incumbent chooses to invest in a sunk cost (K) in order to deter entry.

Strategic Precommitment

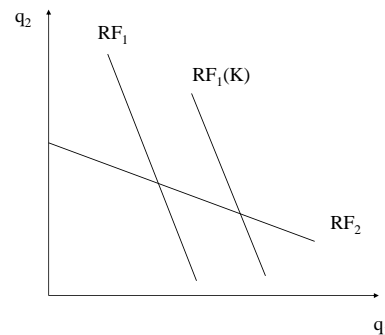
- Assume investment in K is sunk
 - Stage 1: Incumbent chooses K
 - Stage 2: Entrant decides whether to enter
 - Stage 3: Post-entry output/price game delivers payoffs $\pi(K)$
- Entry is deterred if $\pi_d(K) < 0$ and $\pi_m(K) > \pi_d(0)$
- Entry is accommodated if $\pi_d(K) < 0$ and $\pi_m(K) < \pi_d(0)$
- Entry is blockaded if $\pi_d(0) < 0$

Strategic Precommitment



Examples of K

- Capacity which reduces marginal costs of incumbent and shifts out RF_1
- Experience
- Customer good-will
- Advertising
- Research and development (which reduces mc)



How K effects firm 2

- Incumbent chooses a level of K, so as just to deter entry (so that firm 2's profits would be just zero if it entered):

$$\pi_2(K, x_1^*(K), x_2^*(K)) = 0$$

How does π_2 vary in K?

First note that

since firm 2 maximized profits in the 2nd period

$$\frac{\partial \pi_2}{\partial x_2}(K, x_1^*(K), x_2^*(K)) = 0, \text{ so}$$

$$\frac{d\pi_2}{dK} = \frac{\partial \pi_2}{\partial K} + \frac{\partial \pi_2}{\partial x_1} \frac{\partial x_1^*}{dK}$$

Direct effect Strategic effect

- Direct effect: If by changing K, firm 1 has a direct effect on firm 2's profits
- Examples of direct effects:
 - If firm 1 accumulates a greater clientele, has a negative direct effect
- Strategic effect: K changes firm 1's ex post behaviour, thus affecting firm 2's profits
 - Accumulation of greater clientele leads to less aggressive pricing- makes firm 1 soft
 - High prices from firm one increase firm 2's profits, overall strategic affect is positive
 - The sign of the strategic effect is related to investment making firm 1 tough or soft and to the slope of the reaction functions

- Suppose K is advertising:

- If advertising makes firms price less aggressively, firm one is "soft", which results in a positive strategic effect

$$\frac{\partial \pi_2}{\partial p_1} \frac{\partial p_1^*}{dK}$$

$$> 0 \quad > 0$$

- Suppose K is capacity expansion

- If capacity expansion makes firms produce more, firm one is "tough" and we have a negative strategic effect

$$\frac{\partial \pi_2}{\partial x_1} \frac{\partial x_1^*}{dK}$$

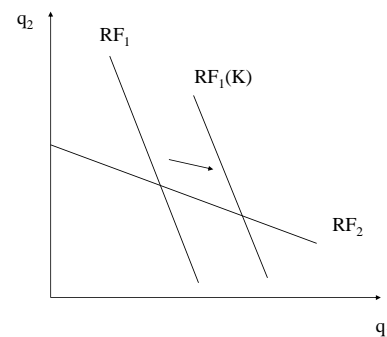
$$< 0 \quad > 0$$

Animal taxonomy

- Firms might
 - Over-invest in capacity to deter entry (top dog: be big to look tough) (Example 1)
 - Under-invest in advertising to deter entry (lean and hungry: small to look tough)
 - Over-invest in advertising to accommodate entry and create soft price competition after entry (fat cat: big to look soft) (Example 2)
 - Under-invest in capacity to accommodate entry (small to look soft) (puppy dog)

Example 1

- Suppose firm 1 chooses an investment K that lowers its second-period marginal cost. In the second period, a higher K shifts firm 1's reaction curve to the right. Investment raises firm one's optimal quantity, which hurts firm 2. Negative strategic effect. (Spence and Dixit case)



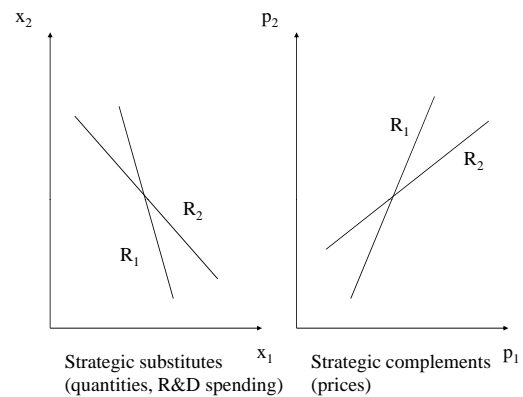
Example 2

- Suppose K is firm 1's pre-entry clientele. The direct effect reduces firm 2's potential market. Strategic effect has the opposite impact on firm 2's profit if firm 1 cannot price discriminate. The fact that firm 1 has a captive audience induces it to raise its overall price, thus inducing entry.
- positive strategic effect

- The actual strategy a firm uses if it wishes to accommodate or deter entry depends upon whether investment makes the incumbent tough or soft AND which way the reaction curves slope
- In quantity competition, reaction curves slope downwards
- In price competition, reaction curves slope upwards
- For complete taxonomy, see (Fudenberg and Tirole, AER, 1984)

Table 1 -- Fudenberg and Tirole AER 1984

Slope of Reaction Curves	Investment Makes Incumbent:	
	Tough	Soft
Upward	Case IV A: Puppy Dog D: Top Dog	Case I A: Fat Cat D: Lean and Hungry
Downward	Case III D: Top Dog A: Top Dog	Case II D: Lean and Hungry A: Lean and Hungry



Case I: Goodwill

- Investment is in Goodwill or Advertising
- Competition takes place on prices $\frac{\partial \pi_2}{\partial p_1} \frac{\partial p_1^*}{dK}$
 - So reaction curves slope upwards
 - Investment Makes Incumbent Soft $> 0 > 0$
- Overinvest to Accommodate Entry (fat cat)
- Underinvest to Deter Entry (lean and hungry)

Case II: R&D

- Investment is in capital (K)
- Competition takes place in R&D spending
 - So reaction curves slope downwards $\frac{\partial \pi_2}{\partial R \& D_1} \frac{\partial R \& D_1^*}{dK}$
 - Investment makes incumbent soft $< 0 < 0$
- Underinvest to Deter Entry (Lean and Hungry)
- Underinvest to Accommodate Entry (Lean and Hungry)

Case III: Capacity

- Investment is in capital (K)
- Competition takes place in quantities
 - So reaction curves slope downwards
 - Investment makes incumbent tough $\frac{\partial \pi_2}{\partial x_1} \frac{\partial x_1^*}{dK} < 0 > 0$
- Overinvest to Deter Entry (Top dog)
- Overinvest to Accommodate Entry (Top Dog)

Titanium dioxide industry

- Dupont in 1972 had two options
 - A “maintain” strategy that would involve investing \$192 M in new capacity between 1972 and 1985 to increase market share to 45%
 - A “growth” strategy that would involve investment \$394 million over the same period to achieve a 1985 target share of 64%. This strategy would require approximately 500,000 tons of new capacity

History and Market Structure

- National lead began production in the US in 1918. Du Pont entered through acquisition in 1931. By 1955 American Cyanamide and Glidden(acquired by SCM) had joined their ranks
- Market shares: DuPont: 36%, National Lead: 24%, American Cyanamide: 15%, SCM: 10%
- 4-firm concentration ratio: 85%

- Titanium dioxide: White chemical agent used in paint, paper, plastics, synthetic fibers. No suitable alternative; expensive to import
- Two technologies
 - Batch process sulfate: produces large amounts of ecologically hazardous waste
 - Continuous process chloride: uses either ilmenite (low-grade) or rutile (high-grade) feedstock
- Economies of scale: a doubling of plant size cut costs for the sulfate process by 7.5% and for the chloride process by 14.3%

- Position in 1972:
 - New pollution control legislation sharply increased waste disposal costs which was quickly making the batch sulfate process not economically viable
 - Sudden shortage of rutile sharply increased ore prices
 - As the only producer using ilmenite chloride technology for most of its output, these two shocks combined with DuPont’s greater average scale per plant resulted in Du Pont’s costs being 21-23% lower than its competitors’ costs
 - Sales growth projected at 3% per annum. Demand is pro-cyclical. Prices generally stable.

Investment Considerations

- Capital constraints: DuPont was not capital constrained, though in order to finance investment from cash flow, might prefer to expand in phases rather than all at once
- For a plant with an annual capacity of 150,000 tons, there is a lag of at least four years between the decision to construct and the date on which the plant can be started
- Existing plants can be expanded rather quickly and easily. Assume a total of 100,000 tons of capacity can be added in this manner

Initial Strategy

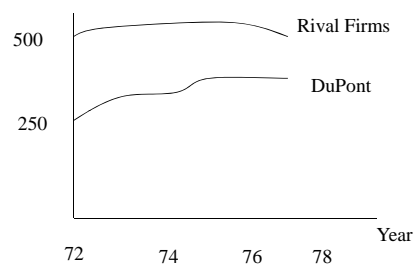
- Blow everyone else out of the market by capacity pre-emption.
- Specifically, they forecast that demand would increase by 377,000 tons.
- Apart from National Lead, all competitors would have closed their sulfate units, eliminating 160,000 tons of existing capacity. Create room for 537,000 tons of new capacity, of which DuPont intended to add 94%

Epilogue

- Initially Dupont decided to expand existing plants, but announced it would begin work on a new plant in 1975.
- Kerr-McGee announced in 1974 that it would build a 50,000 ton plant; Dupont then responded that it had begun construction of a 130,000 tons, and located near the proposed Kerr-McGee plant; announcement was false.
- Economic downturn in 1974, shortage of corporate capital induced Du Pont to delay other projects, but commitments induced it to go ahead with first 130,000 tons plant, which went on-line in 1979.
- Exercise was not profitable for DuPont

- In Ghamewat's words: "preemption is a hazardous process in which miscalculations can depress profitability for the entire industry – for years to come" (1984)
- But...

Titanium Dioxide Capacity (000 tons)



- As of 2000, a market share between 55% and 60% had been maintained since the late 1970s.
- By 1985, 5 of the firms competing with Dupont in the domestic market had exited
 - Three by acquisition,
 - One by cessation of operations
 - One by shutting down US plants

Conclusion

- BTE
- Entry Deterrence
 - Contestable Markets
 - Strategic Deterrence and Accommodation
- Example of Titanium Dioxide industry