Extensive Form Games

IBM vs Telex: Entry Deterrence (Limiting Pricing)

In the late 1960s IBM controlled the entire market for computers. Telex was an upstart that threatened to enter the market. Telex made a nearly perfect substitute for IBM computers and all Telex's products were plug compatible with the IBM computers (i.e., could be plugged right into IBM machines). IBM wrote an internal memo entitled "Operation Smash" which outlined IBM's response to "smash" Telex by offering low prices if Telex entered the market.

If Telex doesn't enter the market, Telex earns 1 and IBM keeps its monopoly earning 5.

If Telex enters and IBM "smashes", the both earn 0.

If Telex enters and IBM accommodates, they each earn 2.

Draw the extensive game and solve for the Subgame Perfect Equilibrium. Was the memo's threat real?

Commitment Matters 1: Coke vs Pepsi

Assume Coke is a monopolist in a market and Pepsi is deciding whether to enter (E) the market or not (N). If Pepsi enters, it pays entry cost, c = 10. If Pepsi stays out, it earns zero and Coke, the incumbent, earns monopoly profits of 100. If Pepsi enters, Coke can either fight (F) using a marketing campaign which costs, k = 25, or it can cooperate (C) with Pepsi. If Pepsi enters and Coke cooperates, then Coke's payoff is 50 and Pepsi's payoff is 50 minus the entry fee (i.e., payoff is 40). If Pepsi enters and Coke fights, then Coke earns 70 – k = 45 and Pepsi's payoff is -10 (i.e., Pepsi earns nothing but still paid the entry cost).

Draw the extensive game and solve for the Subgame Perfect Equilibrium.

Commitment Matters 2: Coke vs Pepsi

Assume again that Coke is a monopolist in a market and Pepsi is deciding whether to enter (E) the market or not (N). If Pepsi enters, it pays entry cost, c = 10. If Pepsi stays out, it earns zero and Coke, the incumbent, earns monopoly profits of 100. If Pepsi enters, Coke can either fight (F) using a marketing campaign or it can cooperate (C) with Pepsi. Unlike before, however, suppose Coke can split up the costs, k, of the marketing campaign into two components. Coke can develop and record the ads at cost, a = 10, and then later chose to buy ad time on radios, TV, etc., at a cost, v = 15. The total cost, k = a + v = 10 + 15 = 25, just like before. But, breaking up the costs means Coke can now chose to develop the ad (AD) or not (NA) before Pepsi makes any decision about entering the market.

If Coke doesn't develop the ad first, then the game looks just like it did in the previous problem (since "fighting" will still require them to make and run the ad all at once at a cost of k = 25). If, however, Coke develops the ad first (at cost, a = 10) Pepsi can still choose to enter or not. If Pepsi enters and Coke cooperates, then Coke's payoff is 50 – a = 50 – 10 = 40, and Pepsi's payoff is 50 minus the entry fee (i.e., payoff is 40). If Pepsi enters and Coke fights, then Coke buys the ad space, paying an additional cost, v = 15, and earns 70 – k = 45 and Pepsi's payoff is -10 (i.e., Pepsi earns nothing but still paid the entry cost).

Draw the extensive game and solve for the Subgame Perfect Equilibrium.

What's different now and why?

What does this game teach us about being the importance and timing of convincing your opponent that you are committed to a strategy?

Limit Pricing Again

A firm, Player 1, is considering entering a market currently dominated by a monopolist, Player 2. If P1 enters, P2 can either cooperate with P1 or fight. If P1 doesn't enter, then it earns zero and the monopolist earns monopoly profits. If P1 does enter, it must pay an entry cost, C = 50, and faces two different possible scenarios:

(1) If the two firms cooperate, the both charge the same price and split the market. In particular they produce the same total market quantity as the monopolist did, Q^M, but each produces half, $Q^M = q_1^D + q_2^D$. This means that that consumers pay the same under the monopolist and under the duopoly when they cooperate, $P^M = P_1^D = P_2^D$. P2 will earn half its monopoly profits. P1 will earn the same minus the entry cost, C.
(2) The incumbent, P2, fights by pricing at marginal cost. Assuming both firms have the same marginal costs, then this will earn the incumbent zero profit, but an entrant would also earn zero and still have to pay the entry cost, C, so profits would be negative.

Finally, we'll assume that both firms have constant marginal costs.

The following equations describe this situation:

No-Entry & Monopoly profits:

$$\pi_1 = 0$$
$$\pi_2^M = \left(P^M - mc^M\right)Q^M$$

Cooperative profits:

$$\pi_1^D = \left(P^D - mc_1\right)q_1^D - C$$
$$\pi_2^D = \left(P^D - mc_2\right)q_2^D$$

Fight profits:

$$\pi_1^F = \left(P_1^F - mc_1\right) q_1^F - C$$
$$\pi_2^F = \left(P_2^F - mc_2\right) q_2^F$$

For the example in class, suppose the following:

Market Demand curve: $P = 200 - Q$

Constant Marginal costs: $mc_1 = mc_2 = \$100$

You should be able to figure out all the rest: Q, P, profits, etc.

Draw the extensive game and solve for the Subgame Perfect Equilibrium.

Redo the problem assuming player 1 has lower marginal costs, $mc_1 = \$20$, but player 2 still has $mc_2 = \$100$. Draw the extensive game and solve for the Subgame Perfect Equilibrium.

For Posting After Class

For the case of equal marginal costs,

Equal Marginal Costs				
	P = A - B*Q		A =	200
			B =	1
mc1 (entrant) =	100		Entry C =	50
mc2 (incumbent) =	100			
	Monopoly	Collude	Fight	
q1	0	25	0	
P1	$ -	$ 150.00	$ -	
Profit 1	$ -	$1,200.00	$ -	
q2	50	25	50	
P2	$ 150.00	$ 150.00	$ 100.00	
Profit 2	$2,500.00	$1,250.00	$ -	

For the case where mc1 < mc2 by enough to matter,

Entrant Has Lower MC				
	P = A - B*Q		A =	200
			B =	1
mc1 (entrant) =	20		Entry C =	50
mc2 (incumbent) =	100			
	Monopoly	Collude	Fight	
q1	0	25	101	
P1	$ -	$ 150.00	$ 99.00	
Profit 1	$ -	$3,200.00	$7,979.00	
q2	50	25	0	
P2	$ 150.00	$ 150.00	$ -	
Profit 2	$2,500.00	$1,250.00	$ -	

Next consider the case where Firm 2 can commit early to cooperating. Imagine this is an oil market outside the USA where firms can legally collude as they do through OPEC.

This gets us into Bayesian inference and Signalling Games