Industrial Organization

Recitation Nine

Topic One: Entry Costs

1) Takeaways of Simple Models

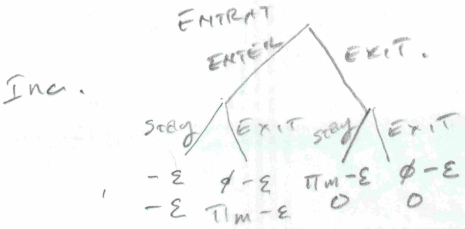
- With exogenous sunk costs and Bertrand competition, entry will not occur.
  - $\pi^{\text{ENRTRANT}}(\text{ENTER}) = 0 - \text{sunk costs}$
  - $\pi^{\text{ENTRANT}}(\text{Do not enter}) = 0$

- With exogenous sunk (/fixed) costs and Cournot competition, firms enter until

$$\frac{(A-c)^2}{(N+1)^2 B} - K < 0$$

$$\Rightarrow N^* = \left\lfloor \frac{A-C}{\sqrt{KB}} - 1 \right\rfloor$$

- With scrap values and <u>Bertrand</u>, if scrap values are large enough, entrant can push incumbent out
  - If entrant enters, all firms making 0 profit. Incumbent can make some profit by exiting and selling for scrap, so they do so.



2) ENDOGENOUS SUNK COSTS MODEL AND EXAMPLE

- IN THIS MODEL,

STAGE 1: FIRM 1 IS INCUMBANT. THEY SET THEIR CAPACITY.

STAGE 2: FIRM 2 DECIDES WHETHER TO ENTER AND PAY ENTRY COSTS

STAGE 3: FIRM 2 SETS THEIR CAPACITY

STAGE 4: EVERYONE PRODUCES THEIR CAPACITY AND GETS PROFIT.

TO MAKE IT A LITTLE DIFFERENT: $P = 4 - k_1 - k_2$ $c = 1$

AS USUAL, WE SOLVE BACKWARDS:

STAGE 3:

FIRM 2 TAKES $\bar{k}_1$ AND THE FACT THAT THEY HAVE ENTERED AS GIVEN.

$$\max_{k_2} \; k_2 P(\bar{k}_1, k_2) - k_2 - E$$

$$\max_{k_2} \; k_2 (4 - \bar{k}_1 - k_2) - k_2 - E$$

FOC wrt k_2: $4 - \bar{k}_1 - 2k_2 - 1 = 0$

$$k_2^* = \frac{3 - \bar{k}_1}{2}$$

STAGE 2: FIRM 2 KNOWS THEY WILL CHOOSE $k_2^* = \frac{k_1 - 3}{2}$ and TAKES $\bar{k}_1$ AS GIVEN. THEY ENTER IF $\pi(k_2^*(\bar{k}_1), \bar{k}_1) > 0$

$$\left(\frac{3 - \bar{k}_1}{2}\right)\left(4 - \bar{k}_1 - \frac{3 - \bar{k}_1}{2}\right) - \left(\frac{3 - \bar{k}_1}{2}\right) - E > 0$$

$$\left(\frac{3-\bar{k}_1}{2}\right)\left(\frac{3-\bar{k}_1}{2}\right) - E > 0$$

SOLVE FOR $\bar{k}_1$:

$$(3-\bar{k}_1)^2 > 4E$$
$$3-\bar{k}_1 > 2\sqrt{E}$$
$$\bar{k}_1 < 3-2\sqrt{E}$$

SO, FIRM 2 ENTERS IF $\bar{k}_1 \leq 3-2\sqrt{E}$

STAGE 1:

FIRM 1 TAKES FIRM 2'S ENTRY DECISION AND $k_2^*(\bar{k}_1)$ rule into account. THEIR PROFIT IS:

$$\pi(k_1, k_2) = \begin{cases} k_1 P(k_1, 0) - k_1 & \text{if } k_1 \geq 3-2\sqrt{E} \\ k_1 P(k_1, k_2(k_1)) - k_1 & \text{if } k_1 < 3-2\sqrt{E} \end{cases}$$

HOW DO WE FIND THE OPTIMAL k_1?

STEP 1: FIND NATURAL STAY OUT k_1 & π_1

$$\max_{k_1} \; k_1(4-k_1) - k_1$$

FOC: $4 - 2k_1 - 1 = 0 \implies k_1^{SO} = \frac{3}{2}$

$\pi_1^{SO} = 9/4$

ASK YOURSELF: IS $3/2 \geq 3-2\sqrt{E}$?

IF SO, THEN FIRM 2 IS BLOCKADED AND $3/2$ IS OPTIMAL. IF NOT, CONTINUE.

STEP 2: FIND THE DETERENCE PROFIT

i.e. set $k_1 = 3-2\sqrt{E}$

$$\pi_1^D = (3-2\sqrt{E})(3-(3-2\sqrt{E})) = 6\sqrt{E} + 4E$$

STEP 3: FIND THE NATURAL ENTRY k & π:

$$\max_{k_1} \; k_1\left(P(k_1, k_2(k_1))\right) - k_1$$

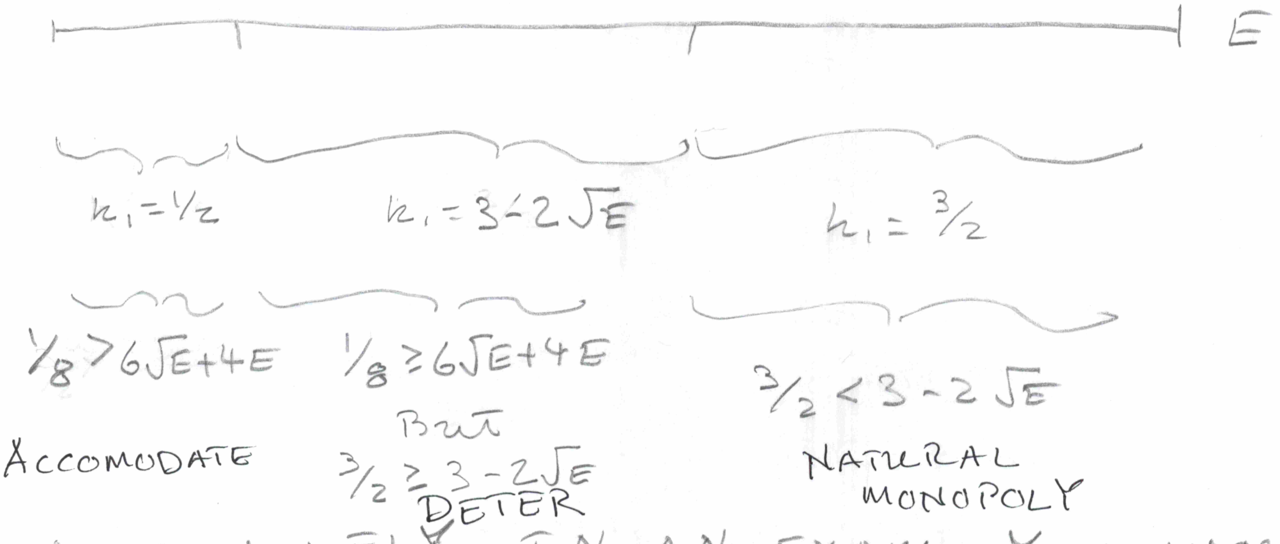
$$\max_{k_1} \; k_1\left(4 - k_1 - \frac{3-k_1}{2}\right) - k_1$$

$$\max_{k_1} \; k_1\left(\frac{3-k_1}{2}\right) - k_1$$

$$\text{FOC: } \frac{3}{2} - k_1 - 1 = 0 \Rightarrow k_1 = \tfrac{1}{2}$$

$$\pi^{NE} = \tfrac{1}{2}\left(\frac{3-\tfrac{1}{2}}{2} - 1\right) = \tfrac{1}{2}\left(\frac{6}{4} - \frac{1}{4} - \frac{4}{4}\right) = \tfrac{1}{8}$$

WHEN $\pi^{P} > \pi^{NE}$ (AND NATURAL BLOCKADING IS NOT OPITIMAL), DETER. OTHERWISE, ACCOMODATE.



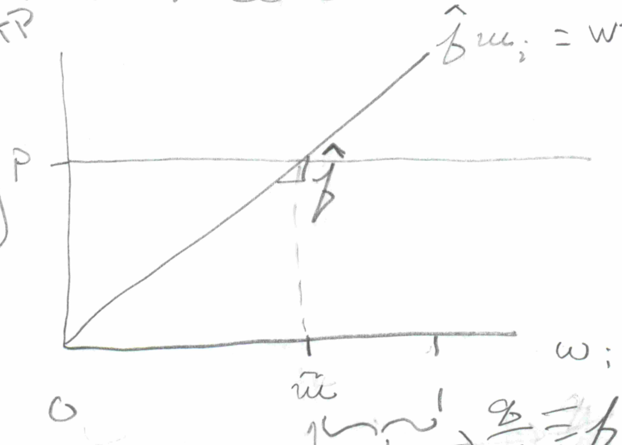
MOST LIKELY, IN AN EXAM, YOU WOULD BE GIVEN AN E (e.g. "SAY ENTRY COSTS =.5" AND ASKED WHAT THE EQUILIBRIUM WOULD LOOK LIKE.

TOPIC 2: NETWORK EFFECTS

- Two Types:
  - DIRECT → UTILITY DERIVED FROM THE ITEM COMES FROM USING IT IN INTERACTION WITH OTHERS WHO HAVE THE ITEM.
    - COMMUNICATION - PHONES, ETC.
    - REVIEW APPS - YELP, ETC.
    - PERSON TO PERSON SALES - EBAY, FLEA MARKET
  - IDIRECT → UTILITY DERIVED FROM COMPLEMENTARY PRODUCTS BEING INVENTED/PRODUCED.
    - VIDEO GAMES - XBOX
    - COMPUTER OPERATING SYSTEMS

- SIMPLE EQUILIBRIUM MODEL:
  - WTP for consumer i is $\hat{f}w_i$ where $\hat{f}$ is the expected fraction of consumers that will buy and w_i is distributed uniformly on $[0, 1]$. THERE ARE N CONSUMERS.

↓ NOTE: NOTES SAY [0,100] You can scale WTP depending on how valuable the good is.



$\frac{q}{N} = f$ (i.e. % of consumers with WTP > p)

marginal consumer ($\hat{f}\tilde{w} = p$)

true f (demand)

So, $f = 1 - \tilde{w} = 1 - \frac{p}{\hat{f}}$ → expected f

But, what is $\hat{f}$? If consumers are rational, $\hat{f} = f$ so, $f = 1 - \frac{p}{f} \Rightarrow f - f^2 = p$ THIS IS OUR <u>DEMAND CURVE</u>

WHATS THE IDEA HERE?

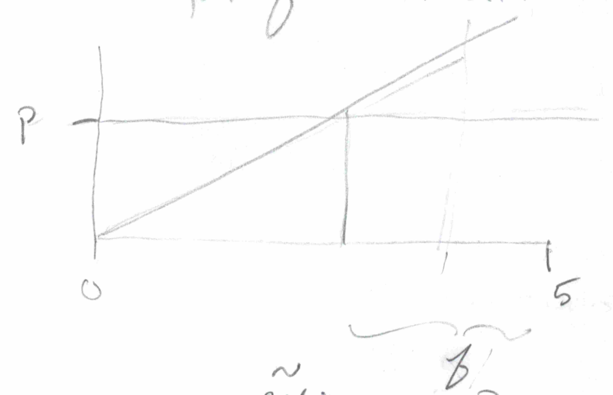
- FIRM SETS A PRICE → NOTE, WE ACTUALLY CHOOSE Q IN THE MODEL

- CONSUMERS SEE THAT PRICE AND THINK, "HM, I THINK EITHER Q_1 OR Q_2 people WILL BUY". IF THEY THINK Q_1 WILL BUY, THEN Q_1 BECOMES THE EQUILIBRIUM (IE Q_1 WILL ACTUALLY BUY). IF THEY THINK Q_2 WILL BUY THEN Q_2 .....

THERE ARE 2 POSSIBLE EQUILIBRIUM FOR EVERY PRICE. HOW DO WE DEAL WITH THIS? WE ASSUME THE HIGHER Q is the equilibrium.

EXAMPLE QUESTION:

"SAY 4,000 consumers have u_i uniformly between 0 and 5, and WTP = $f u_i$ where f is the fraction that they expect to buy. It cost 25¢ to produce the good. What is the profit maximizing Q?"



$$f = 1 - \frac{\tilde{u}_i}{5} = 1 - \frac{p}{5f}$$

$\Rightarrow 5f - 5f^2 = p \quad \Rightarrow$ Since $Q = 4000f$

$$\max_{f} \; pQ - cQ$$

$$\max_{f} 5(f - f^2)(4000f) - c\,4000f$$

FOC: $2(4000)5f - 3(4000)5f^2 - c(4000) = 0$

$$\Rightarrow 5f - \frac{15}{2}f^2 - \frac{1}{25} = 0$$

$$\Rightarrow f^* = .0544$$

$$= .6122$$

PLUG BOTH IN TO FIND WHICH PROVIDES A BETTER PROFIT.

$\pi(.0544) = .313$

$\pi(.6122) = 458.732$ ☆

so, the firm will sell to 61.22 % of the population at the price 1.19 \$ and will get 2294.65 \$ in profit.