SALOP'S CIRCULAR MODEL : GAME THEORETICAL APPROACH

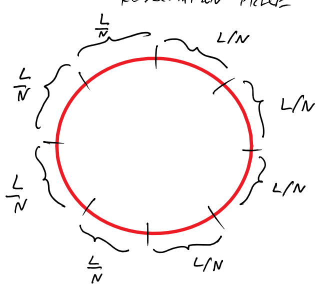
BASIC SETUP

- CONSUMERS LOCATE AROUND A CIRCLE
- THE FIRMS ALSO LOCATE AROUND THE POSSIBLE,
- CONSUMERS CAN ONLY TRAVEL AROUND THE CIRCLE.
- EACH CONSUMER PURCHASES A UNIT OF THE PRODUCT THAT IS IDENTICAL EXCEPT THE LOCATION OF THE FIRM.
- TRANSPORTATION COST IS LINEAR AND EQUAL TO t.
- MARGINAL COSTS ARE IDENTICAL FOR ALL FIRMS, $c_i = c$
- FIRMS INCUR A COST F TO ENTER THE MARKET
- FIRM i's PROFITS ARE $\begin{cases} (p-c)\,d_i - F & \text{IF FIRM } i \text{ ENTERS.} \\ 0 & \text{IF FIRM } i \text{ DOES NOT ENTER.} \end{cases}$

THE UTILITY THAT A CONSUMER i LOCATED IN X OBTAINS FROM BUYING THE GOOD FROM A FIRM j IS GIVEN BY

$$\boxed{u_{ij} = r - p_j - t\,x_{ij}}$$

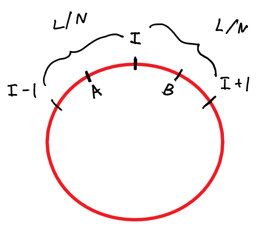
RESERVATION PRICE



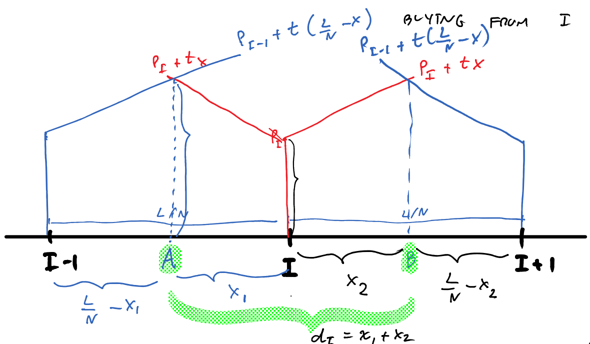
THE STRUCTURE OF THE GAME

- 2 - STAGE GAME → STAGE 1 : ENTER OR STAY OUT
  STAGE 2 : SELECT p SIMULTANEOUSLY GIVEN THESE LOCATIONS.
- ASSUMPTION : FREE ENTRY
  IMPLICATION ? ⇒ IN EQUILIBRIUM, PROFIT EACH EARNS = 0

- WE WANT TO FIND 2 THINGS :
  - PRICES IN EQUILIBRIUM = ?
  - NUMBER OF FIRMS DEPENDS ON ?



- I COMPETES W/ TWO NEAREST STORES, I-1 AND I+1
- A CONSUMER IS INDIFFERENT BET. BUYING FROM I OR I-1.
- B CONSUMER IS INDIFFERENT BET. BUYING FROM I OR I+1



$$A \rightarrow \quad P_I + t x_1 = P_{I-1} + t\left(\frac{L}{N} - x_1\right) \rightarrow x_1 = ?$$

$B \rightarrow \quad P_I + t x_2 = P_{I-1} + t\left(\frac{L}{N} - x_2\right) \rightarrow x_2 = ?$

$$d_I = x_1 + x_2 = \frac{(P_{I-1} - P_I) + (P_{I+1} - P_I)}{2t} + \frac{L}{N}.$$

WE SOLVE THIS GAME BY BACKWARD INDUCTION:

STEP 2 FIND N-E IN PRICES

STEP 1 FIND N^* (EQUILIBRIUM NUMBER OF FIRMS)

$\boxed{\text{STEP 2}}$ SOLVING FOR P^*:

$$\max_{P_i} \pi_i = d_i (P_i - c) - F = \left[\frac{(P_{I-1} - P_I) + (P_{I+1} - P_I)}{2t} + \frac{L}{N}\right](P_I - c) - F$$

FIRM I's REACTION FUNCTION $\rightarrow \quad P_I^*(P_{I+1}, P_{I-1}) = \frac{P_{I+1} + P_{I-1} + 2c}{4} + \frac{tL}{2N}$

AS WE HAVE EXOGENOUSLY IMPOSED SYMMETRIC LOCATIONS:

$$P_I = P \quad \underbrace{\forall i}_{\text{FOR ALL FIRM } i}$$

THE N-E IN PRICES FOR ANY N: $\boxed{P = \frac{tL}{N} + c}$. ***

① W/ PRODUCT DIFFERENTIATION, PRICE IS HIGHER THAN MARGINAL COST

② W/ $P - c = \frac{t \cdot L}{N}$

- GIVEN t, L, IF $N \uparrow$, $P - c \downarrow$
- GIVEN L AND N, IF $t \uparrow$, $(P-c) \uparrow$
- IN THE LIMIT, WHEN $t \rightarrow 0$, $P = c$.

STAGE 1: DETERMINATION OF THE EQUILIBRIUM NUMBER OF FIRMS

WE USE: ① EQUILIBRIUM PRICE FOR ANY N

② FREE-ENTRY EQUILIBRIUM $\rightarrow$ ZERO-PROFIT CONDITIONS

$\pi = 0$

$(P - c) d - F = 0$

$\frac{tL}{N} \cdot \frac{L}{N} - F = \frac{tL^2}{N^2} - F = 0 \quad \Rightarrow \quad \boxed{N^* = L\sqrt{\frac{t}{F}}}$

$\boxed{P^* = \sqrt{tF} + c}$

- REDUCTION OF F $\rightarrow$ INCREASE N $\rightarrow$ REDUCES $\frac{L}{N}$ $\rightarrow$ LESS PRODUCT DIFFERENTIATION $\rightarrow$ REDUCTION OF MARKET POWER

- WHEN $F \rightarrow 0$ $\rightarrow$, $N \rightarrow \infty$ AND $\frac{L}{N} \rightarrow 0$

NO PRODUCTION DIFFERENTIATION $\rightarrow$ PRICE COMPETITION W/ HOMOGENEOUS PRODUCT $\rightarrow$ $P = c$.

- $t \uparrow \rightarrow P \ldots\ldots \rightarrow (P - c) \ldots\ldots \rightarrow$