Economics 101A
(Lecture 22)

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November 23, 2004

Outline

1. Dynamic Games

2. Oligopoly: Stackelberg

3. General Equilibrium: Introduction

4. Edgeworth Box: Pure Exchange

5. Barter

1 Dynamic Games

- Nicholson, Ch. 15, pp. 449–454.[OLD: Ch. 10, pp. 256–259]

- Dynamic games: one player plays after the other

- Decision trees
  - Decision nodes
  - Strategy is a plan of action at each decision node

- Example: battle of the sexes game

She \ He	Ballet	Football
Ballet	$2, 1$	$0, 0$
Football	$0, 0$	$1, 2$

- Dynamic version: she plays first

- **Subgame-perfect equilibrium.** At each node of the tree, the player chooses the strategy with the highest payoff, given the other players' strategy

- Backward induction. Find optimal action in last period and then work backward

- Solution

- Example 2: Entry Game

$1 \setminus 2$	Enter	Do not Enter
Enter	$-1, -1$	$10, 0$
Do not Enter	$0, 5$	$0, 0$

- Exercise. Dynamic version.

- Coordination games solved if one player plays first

- Can use this to study finitely repeated games

- Suppose we play the prisoner's dilemma game ten times.

$1 \setminus 2$	D	ND
D	$-4, -4$	$-1, -5$
ND	$-5, -1$	$-2, -2$

- What is the subgame perfect equilibrium?

- When does repetition lead to cooperation in Prisoner Dilemma?

- Need infinite repetition

- At every period probability p that game will be played again

- Strategy:
  - Cooperate (play ND)
  - If someone defected (played D) in past, defect (play D) thereafter

- See Econ 104 for more on this

2 Oligopoly: Stackelberg

- Setting as in problem set.

- 2 Firms

- Cost: $c(y) = cy$, with $c > 0$

- Demand: $p(Y) = a - bY$, with $a > c > 0$ and $b > 0$

- Difference: Firm 1 makes the quantity decision first

- Use subgame perfect equilibrium

- Solution:

- Solve first for Firm 2 decision as function of Firm 1 decision:

$$\max_{y_2} \left(a - by_2 - by_1^*\right) y_2 - cy_2$$

- F.o.c.:

$$a - 2by_2^* - by_1^* - c = 0$$

or

$$y_2^* = \frac{a-c}{2b} - \frac{y_1^*}{2}.$$

$$p_D^* = a - bY_D^* = a - b\left(2\frac{a-c}{3b}\right) = \frac{1}{3}a + \frac{2}{3}c.$$

- Firm 1 takes this response into account in the maximization:

$$\max_{y_1} \left(a - by_1 - by_2^*\left(y_1\right)\right) y_1 - cy_1$$

or

$$\max_{y_1} \left(a - by_1 - b\left(\frac{a-c}{2b} - \frac{y_1}{2}\right)\right) y_1 - cy_1$$

- F.o.c.:

$$a - 2by_1 - \frac{(a-c)}{2} + by_1 - c = 0$$

or

$$y_1^* = \frac{a-c}{2b}$$

and

$$y_2^* = \frac{a-c}{2b} - \frac{y_1^*}{2} = \frac{a-c}{2b} - \frac{a-c}{4b} = \frac{a-c}{4b}.$$

- Total production:

$$Y_D^* = y_1^* + y_2^* = 3\frac{a-c}{4b}$$

- Price equals

$$p^* = a - b\left(\frac{3}{4}\frac{a-c}{b}\right) = \frac{1}{4}a + \frac{3}{4}c$$

- Compare to monopoly:

$$y_M^* = \frac{a-c}{2b}$$

and

$$p_M^* = \frac{a+c}{2}.$$

- Compare to Cournot:

$$Y_D^* = y_1^* + y_2^* = 2\frac{a-c}{3b}$$

and

$$p_D^* = \frac{1}{3}a + \frac{2}{3}c.$$

- Figure

- Compare with Cournot outcome

3 General Equilibrium: Introduction

- So far, we looked at consumers
  - Demand for goods
  - Choice of leisure and work
  - Choice of risky activities

- We also looked at producers:
  - Production in perfectly competitive firm
  - Production in monopoly
  - Production in oligopoly

- We also combined consumers and producers:
  - Supply
  - Demand
  - Market equilibrium

- Partial equilibrium: one good at a time

- General equilibrium: Demand and supply for all goods!
  - supply of young worker$\uparrow$ $\Longrightarrow$ wage of experienced workers?
  - minimum wage$\uparrow$ $\Longrightarrow$ effect on higher earners?
  - steel tariff$\uparrow$ $\Longrightarrow$ effect on car price

4 Edgeworth Box: Pure Exchange

- Nicholson, Ch. 12, pp. 335–338, 369–370 [OLD: Ch. 16, pp. 422-425]

- 2 consumers in economy: $i = 1, 2$

- 2 goods, x_1, x_2

- Endowment of consumer i, good j: ω_j^i

- Total endowment: $(\omega_1, \omega_2) = (\omega_1^1 + \omega_1^2, \omega_2^1 + \omega_2^2)$

- Draw Edgeworth box

- Draw preferences of agent 1

- Draw preferences of agent 2

- Consumption of consumer i, good j: x_j^i

- Feasible consumption:

$$x_i^1 + x_i^2 \leq \omega_i \text{ for all } i$$

- If preferences monotonic, $x_i^1 + x_i^2 = \omega_i$ for all i

- Can map consumption levels into box

5 Barter

- Consumers can trade goods 1 and 2

- Allocation $\left((x_1^{1*}, x_2^{1*}), (x_1^{2*}, x_2^{2*})\right)$ can be outcome of barter if:

- **Individual rationality.**

$$u_i(x_1^{i*}, x_2^{i*}) \geq u_i(\omega_1^i, \omega_2^i) \text{ for all } i$$

- **Pareto Efficiency.** There is no allocation $\left((\hat{x}_1^1, \hat{x}_2^1), (\hat{x}_1^2, \hat{x}_2^2)\right)$ such that

$$u_i(\hat{x}_1^i, \hat{x}_2^i) \geq u_i(x_1^{i*}, x_2^{i*}) \text{ for all } i$$

with strict inequality for at least one agent.

- Barter outcomes in Edgeworth box

- Endowments (ω_1, ω_2)

- Area that satisfies individual rationality condition

- Points that satisfy pareto efficiency

- **Pareto set.** Set of points where indifference curves are tangent

- **Contract curve.** Subset of Pareto set inside the individually rational area.

- Contract curve = Set of barter equilibria

- Multiple equilibria. Depends on bargaining power.

- Bargaining is time- and information-intensive procedure

- What if there are prices instead?

6 Next lecture

- Example of General equilibrium

- General Equilibrium with Prices