Oxbridge Prep

Hidden Information

Hidden Action

Labor Market

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Linear Hotelling Model

- a town with unit length
- consumers are distributed evenly on the street, i.e. there are 0.25 consumers living between (0,0.25)
- two pizza shops located at 0 and 1
  - it is not hard to allow the two shops to choose where to locate
- a consumer living on x only buys one pizza,
  - the cost of travelling to shop 0 is x^2
  - the cost of travelling to shop 1 is $(1-x)^2$
- his utility from pizza is $u - p_1 - t(1-x)^2$ or $u - p_0 - t(x)^2$

Consumer x is indifferent if utility from both pizza shop is equal

example games: Hotelling Model

Equating the two utilities

$$u - p_1 - (1-x)^2 = u - p_0 - (x)^2 \tag{1}$$

$$\implies x = \frac{p_0 - p_1 + 1}{2} \tag{2}$$

this is consumer's demand curve

- consumers between $(0, x)$ will go to shop 0
- consumer between $(x, 1)$ will go to shop 1

Assuming symmetry, $p_0 = p_1$ and both firms capture half of the market

example games: Hotelling Model

Implications

- Medium Voter Theorem
  - it is people in the middle that decides the outcome of an election
- product differentiation
  - products may be similar, but people have different tastes towards different brands

Extensions

- Salop's circular city model
- product attribute competition
  - product positioning
  - logistic model
  - generalization: prospect theory

Games with Incomplete Information

Some aspects of the game are no longer common knowledge for our players

- Payoffs
- Who the other players are
- Possible Actions
- how outcomes depends on action
- What other players know, what other player knows I know
- etc.

Lemon Market: Asymmetric Information

A market for used cars: good cars and bad cars(lemon)

Lemon Car market

For the buyer:

- good car: worth \$2,000
- bad car: worth \$1,000

For the Seller:

- good car: \$worth 1,600
- bad car : \$worth 8,00

Buyers cannot tell the difference between a good car and a lemon,
but the buyer know there are 50% of the cars are bad. Sellers know the quality of the car

Lemon Market: Asymmetric Information

For the buyer:

- good car: worth \$2,000
- bad car: worth \$1,000

For the Seller:

- good car: worth \$1,600
- bad car : worth \$800

Observation: it is desirable for both parties to trade, i.e. the buyer is willing to pay \$2,000 to buy a good car and \$1,000 for a lemon

Question: How much should the buyer pay?

Lemon Market: Asymmetric Information

For the buyer:

- good car: worth \$2,000
- bad car: worth \$1,000

For the Seller:

- good car: worth \$1,600
- bad car : worth \$800

A natural answer is: $P = 0.5 * 2000 + 0.5 * 1000 = 1500$

1. being offered \$1,500, will the good car be sold?
2. knowing sellers' action, will the buyer regret offering \$1,500
3. how much should the buyer offer?
4. will there be any trade between buyers and sellers?

Lemon Market: Asymmetric Information

Result:

- only bad cars will be traded in the market
- unless the proportion of good cars is large enough

This result has very important implications

- regulations for used cars (additional warranties)
- "bad money drives out good money"
- adverse selection for the insurance market
  - the person who gets insurance are more likely be in a inferior condition
  - insurance premium increase with age, sometimes people with ill-health are denied insurance

Asymmetric Information: Job Market Signalling

Let's change the set-up a bit, consider two types of workers

- smart worker: has productivity of \$ 600,000
- low IQ worker: has productivity of \$400,000

If only 50% of the workers, paying \$500,000 will not attract any smart workers

we consider the following pay schedule

- the worker earns \$600,000 if he has more than Y^* years of college
- the worker earns \$400,000 if he has fewer than Y^* years of college

Asymmetric Information: Job Market Signalling

The cost of going to college, assume

- it costs \$40,000 per year for a smart person(scholarship, being smart etc.)
- it costs \$51,000 per year for a low IQ person

Finding a separating equilibrium

- low IQ workers don't go to college if
- earnings(no college) $>$ earnings(college) - cost(college)
- $400,000 > 600,000 - 51,000Y^*$
- $Y^* > 3.9$
- i.e. low IQ worker does not go to college if $Y^* > 3.9$

Asymmetric Information: Job Market Signalling

Finding a separating equilibrium: smart workers

- smart workers go to college if
- earnings(no college) $<$ earnings(college) - cost(college)
- $400,000 < 600,000 - 40,000Y^*$
- $Y^* < 5$
- i.e. smart worker go to college if $Y^* < 5$

In this setting ,

- going to college does not increase workers' productivity.
- People go to college just to show employers that they are really smart

Economists try very hard to understand why people go to school and whether better school are worth paying for

Asymmetric Information: Moral Hazard

Previously we discussed market failures due to economic agent's inability to differentiate the quality of goods

- Now we consider economic agents' inability to monitor effort

The principal-agent problem

The principal-agent problem is a conflict in priorities between a person or group and the representative authorized to act on their behalf. An agent may act in a way that is contrary to the best interests of the principal.

Asymmetric Information: Moral Hazard

The principal-agent problem

- **Principal**: delegates authority to the agent to carry out a task
  - managing a firm's daily operations
- **Agent**: makes decisions on behalf of the principle
- conflict of interest
  - Principal tries to maximize profit
  - Agent tries to maximize utility

What are the players' actions

- agent: work hard / slack
- principle: offer different contracts

Principle's problem How to make sure agent work hard

Asymmetric Information: Moral Hazard

The principal hires an agent to manage a firm, output depends on effort (High and low), and the economic environment. The agent is paid with wage $\boldsymbol{w}$. The Principle's utility function is

$$U_p(Q, w) = Q - w$$

The agent has reservation utility $\underline{U_a}$=10 , and his utility function is

$$U_a(w, c) = \sqrt{w} - c \qquad (c \in \{0, 1\})$$

- 400 Output with probability p
- 100 Output with probability 1-p

Output based on effort

- $p = \frac{2}{3}$ if agent works with high effort
- $p = \frac{1}{3}$ if agent works with low effort

Asymmetric Information: Moral Hazard

$$U_p(Q, w) = Q - w \qquad U_a(w, c) = \sqrt{w} - c$$

With observable effort, to get low effort principal pays

$$\sqrt{w} - 0 \geq 10 \implies w \geq 100 \qquad \text{(principal pays 100)}$$

With observable effort, to get high effort principal pays

$$\sqrt{w} - 1 \geq 10 \implies w \geq 121 \qquad \text{(principal pays 121)}$$

Principal Receives

- low effort: $U_p = \frac{1}{3} * 400 + \frac{2}{3} * 100 - 100 = 100$
- high effort: $U_p = \frac{2}{3} * 400 + \frac{1}{3} * 100 - 121 = 179$

Result: With perfect monitoring, principal pays 121 to the agent for working with high effort

Asymmetric Information: Moral Hazard

$$U_p(Q, w) = Q - w \qquad U_a(w, c) = \sqrt{w} - c$$

With unobservable effort, the principal will design a contract based on the level of output

- pay high wage if output is high
- pay low wage if output is low

With low effort, the worker is expected to receive

$$\frac{1}{3}\sqrt{w_H} + \frac{2}{3}\sqrt{w_L} \geq 10$$

the principal then chooses $\{w_L, w_H\}$ that minimizes wage cost

$$min \quad \frac{2}{3}w_L + \frac{1}{3}w_H$$

solving the minimization problem: we get $w_L = w_H = 100$

Asymmetric Information: Moral Hazard

$$U_p(Q, w) = Q - w \qquad U_a(w, c) = \sqrt{w} - c$$

With high effort, the worker is expected to receive

$$\frac{2}{3}(\sqrt{w_H} - 1) + \frac{1}{3}(\sqrt{w_L} - 1) \geq 10$$

the principal then chooses $\{w_L, w_H\}$ that minimizes wage cost

$$min \quad \frac{1}{3}w_L + \frac{2}{3}w_H$$

solving the minimization problem: we get $w_L = w_H = 121$

- we have the same result as with observable effort
- Do we really?

Asymmetric Information: Moral Hazard

Without monitoring, the agent will work with low effort for sure, because it is utility improving

- what can the principal do, to make sure the agent is working hard
- design the wage schedule so that it is not optimal for the agent to be working with low effort

Another constraint (worker who want to work with high effort is not willing to work with low effort)

$$\frac{1}{3}\sqrt{w_H} + \frac{2}{3}\sqrt{w_L} \leq 10$$

We have

$$
\begin{aligned}
min \quad & \frac{1}{3}w_L + \frac{2}{3}w_H \\
s.t. \quad & \frac{1}{3}\sqrt{w_H} + \frac{2}{3}\sqrt{w_L} \leq 10 \\
& \frac{2}{3}(\sqrt{w_H} - 1) + \frac{1}{3}(\sqrt{w_L} - 1) \geq 10
\end{aligned}
$$

Solving the problem we have

- wage with high effort is 144
- wage with low effort is 81

Principal receives $\frac{2}{3}(400 - 144) + \frac{1}{3}(100 - 81) = 177$ and the worker works with high effort

- Principal prefers this wage schedule to paying \$100 for low effort

Asymmetric Information: Moral Hazard

Moral Hazard Problem arises

- principal cannot directly observe the agent's effort
- agent's interest is not fully aligned with the principal's

Implications

- insurance industry
  - how to make sure drivers drive with responsibility after getting insurance
  - financial industry
    - financial managers manage money on the behalf of investors
    - reckless lending/investing
    - *The Big Short* is a great reference

Reading

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Lead Essay

Tabarrok and Cowen, The End of Asymmetric Information

Response Essays

Ely, Let's Hope Not

Labor Supply

Individuals value consumption and leisure

$$U = f(C, L)$$

Individuals are also constraint by time

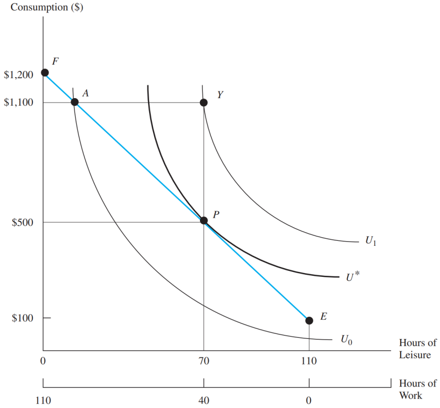
$$C = w * h + V$$

Where

- C is consumption
- w is wage rate
- h is hours worked
- V is nonlabor income

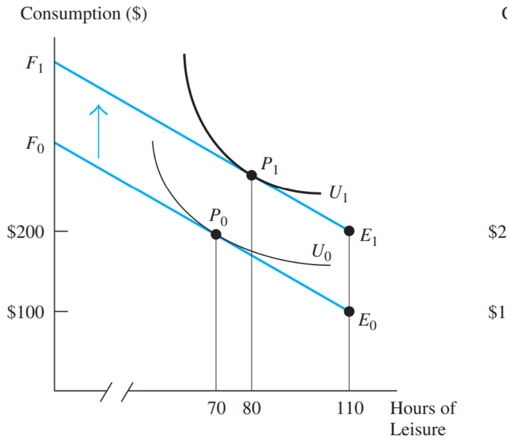
Labor Supply: Hours worked

labor supply is given by solving the utility maximization constraint subject to time constraint



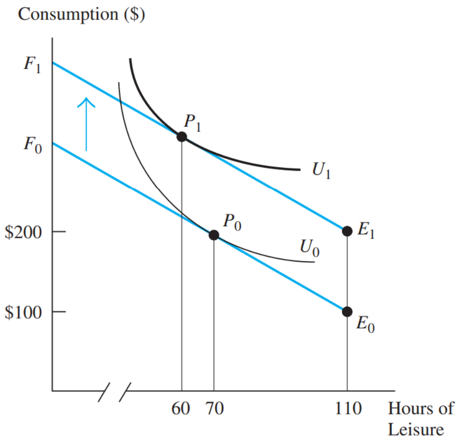
Labor Supply: income effect(normal leisure)

what happens if nonlabor income changes



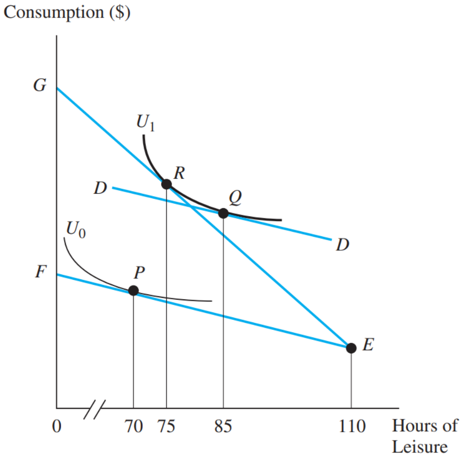
Labor Supply: income effect(inferior leisure)

what happens if nonlabor income changes



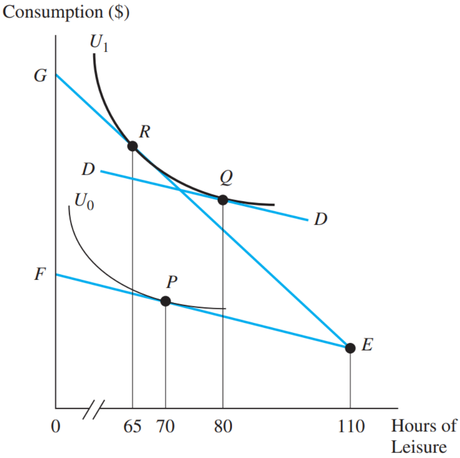
Labor Supply: substitution effect

what happens if wage rate changes: income effect dominates



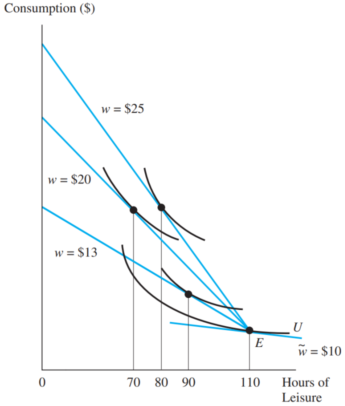
Labor Supply: substitution effect

what happens if wage rate changes: substitution effect dominates



Backward bending Labor Supply Curve

To obtain the labor supply, we change the wage rate



Backward bending Labor Supply Curve

To obtain the labor supply, we change the wage rate

- after wage rate reaches a certain point, substitution effect dominates