Externalities and Public goods
Part 2

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Outline

Private Information

- In practice, the degree to which an agent is affected by an externality is often be known only to her. .
- The private (asymmetric) information can confound both centralized(quotas and taxes) and decentralized (bargaining)solutions to achieve the social optimum.

Private Information and Second-Best Solution: The formal model

- Consumer's derived utility function is $\phi(h, \eta)$, where h is externality and η stands for the type of consumer's preference
- Firm's derived profit function is $\pi(h, \theta)$, where h is externality and θ is its type.
- Actual value of the θ and η are privately observed
- Give values of θ and η, the $\pi(h, \theta)$ and $\phi(h, \eta)$ are strictly concave in h

Private Information and Second-Best Solution: The formal model

- Let assume that consumer has the right to and externality free environment.
- There is a Take-it-or-Leave-it bargaining processes offer to the firm.
- Two possible level of externality: 0 or $\bar{h} > 0$.
- Our focus is centered on the negative externality on the consumer
- Firm's benefit from externality is measured by $b(\theta) = \pi(\bar{h}, \theta) - \pi(0, \theta) > 0$
- Consumer's cost from externality level h is measured by $c(\eta) = \phi(0, \eta) - \phi(\bar{h}, \eta) > 0$

Private Information and Second-Best Solution: The formal model

- We denote the probability distribution function of $b(\theta)$ and $c(\eta)$, respectively by $G(b)$ and $F(c)$.
- Let assume that $\bar{h} > 0$ is the Pareto efficient level of externality for $b > c$.

Decenteralized Bargaining Solution Failure

- Consider T as the amount that the consumer will demand from the firm for the cost c in exchange for the permission of producing the externality related product.

- A simple lottery for the consumer:

b	$b(\theta) < T$	$b(\theta) \geqslant T$
p(b)	$p(b(\theta) < T)$	$p(b(\theta) \geqslant T)$
Consumer's payoff	$T - c$	$T - c$

$$p(b(\theta) \geqslant T) = 1 - G(T)$$

- The consumer knows that, the firm will never accept to pay $b(\theta) < T$.

Decenteralized Bargaining Solution Failure

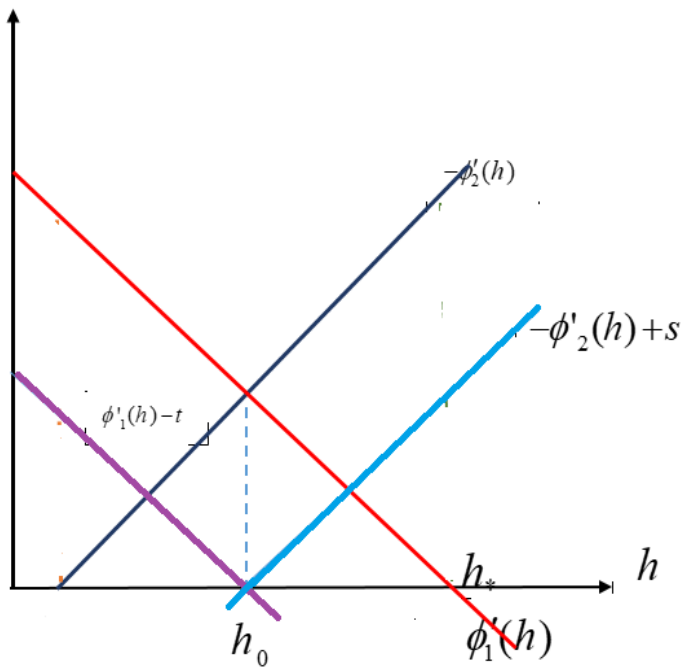
- The consumer's payoff from $b(\theta) < T$ is always zero (because $T = 0$ and $c = 0$, and $T - c$ is zero as well), therefore her expected payoff of the lottery is:

$$Max_T[1 - G(T)](T - c)$$

- She optimally chooses T to maximize the objective function. item The objective function is strictly positive for $T - c$ and equals zero for $T = c$
- Assume that $T_c^* = argmax[1 - G(T)](T - c)$, then, there is potential solution $T_c^* > b$.
- The solution implies a positive probability of inefficient outcome, namely $h = 0$ rather than $\bar{h}$

Centeralized Solution: Unobservability of the marginal values

- The problem of unobservable marginal values



Centeralized Solution: Unobservability of the marginal values

- A problem in centralized and decentralized solution for externality is the unbservibility of marginal values (benefits $b(\theta, h)$ and costs $c(\eta, h)$).
- The parties involved in the game may not have incentive to reveal them truthfully
  - The consumer has incentive to exaggerate her cost of h
  - The producer will have an incentive to under-report his benefits from h
- How to design mechanisms that control that control these incentives for misreporting?
- The question is studied in the Mechanism design scope.

Centeralized Solution: a model for revelation mechanism

- Can we design a scheme that achieves the optimal level of externality $\bar{h}$ generation for every realization of b and c? ***YES***

1. The firm and the consumer are asked to report their values of b and c and they report $\hat{b} = \pi(0,\theta) - \pi(\bar{h},\theta) = \Delta\pi$ and $\hat{c} = \phi(0,\eta) - \phi(\bar{h},\eta) = \Delta\phi$
2. For each pair of $(\hat{b},\hat{c})$, the government sets an allowed level of h as well as a **tax** $\hat{c}$ *or* **subsidy** $\hat{b}$ to maximize the aggregate surplus $\pi(\theta,h) + \phi(\eta,h)$
3. The allowed level of h is $\bar{h}$ if only if $(\hat{b} > \hat{c})$.
4. The tax rate on firm's activity is $\hat{c}$ and subsidy rate for consumer is $\hat{b}$.

Centeralized Solution: a model for revelation mechanism

- If the firm wants to generate the externality, it is required to pay the cost of that as declared by consumer
- If the consumer allows the firm to produce the externality, she will receive the payment which amounts to $(\hat{b})$ reported by the firm.

Under this plan both the firm and consumer will tell the truth
HOW?

Centeralized Solution: a model for revelation mechanism

- That setting of the game between the government, Firm and Consumer will guaranty the optimal level of $h = \bar{h}$ for every possible (b, c) pair.

1. Firm announces some $\hat{b} > c$
   - The consumer prefers to have the externality involved activity allowed, because she will do better $\hat{b} - c$.
   - Hence her optimal announcement satisfies $\hat{c} < \hat{b}$
   - Any such announcement will give her the same payoff, she has no incentive to be untruthful

2. Firm announces some $\hat{b} \leqslant c$
   - The consumer prefers to have externality level set to **ZERO**
   - Hence, she would like announce $\hat{c} \geqslant \hat{b}$
   - Again, any of these $\hat{c}$ announcements will give her the same payoff

Telling the truth is a weakly dominant strategy for the consumer