

14.41 Public Economics

Section Handout #2

Externalities

I. Review of Lifetime Utility Expression

The consumer's time t lifetime utility is the PDV (present discounted value) of lifetime consumption.

$$U_t = C_t + \sum_{i=t+1}^T C_i \delta^{(i-t)}$$

This is standard exponential discounting.

Hyperbolic discounting adds the parameter $\beta \in [0,1]$:

$$U_t = C_t + \beta \sum_{i=t+1}^T C_i \delta^{(i-t)}$$

If $\beta = 1$, we return to exponential discounting. β expresses the degree, or severity, of hyperbolic discounting.

II. Quantity Vs. Price Regulation under Uncertainty (Weitzman approach)

A. No uncertainty

- Equivalent to choose T or R_Q such that $MC=MD$.

B. Costs are certain, benefits are uncertain.

- $MB_1 =$ assumed MB, $MB_2 =$ actual MB
- What is outcome if we set T where $MB_1=MC$?
Optimum is B, we end up at C: too little abatement, $DWL = ABC$
- What is outcome if we set R_Q where $MB_1=MC$?
Optimum is B, we end up at C: too little abatement, $DWL = ABC$
- DWL is the same whether choose T or R_Q
Intuition: firms set $T=MC$; since MC is known, firms do what we expect

C. Costs are uncertain, benefits are certain.

- $MC_1 =$ assumed MC, $MC_2 =$ actual MC
- What is outcome if we set T where $MB=MC_1$?
Optimum is C, we end up at B: too little abatement, $DWL = ABC$
- What is outcome if we set R_Q where $MB=MC_1$?
Optimum is C, we end up at D: too much abatement, $DWL = CDE$
- What's different from previous example? Firm set $T=MC_2$, and since we were wrong about MC, this is different from quantity at which $T=MC_1$.
- Which is better? Depends on shape of curves (determines size of DWL).

D. Four cases:

1) Steep MB curve: choose R_Q

2) Flat MB curve: choose T

3) Steep MC curve: choose T

4) Flat MC curve: choose R_Q

III. Applications:

A. Polaroid/Hyatt Example

- Set-up: $MC_H = A_H$ (A=units of pollution abatement)
 $MC_P = 3A_P$
 $MD = 3$ (marginal damage is constant)
- Pigou Tax: Set $T = MD = 3$
What is equilibrium level of abatement, A? Each firm sets $MC = T$
Hyatt: $MC_H = T$, so $A_H = 3$
Polaroid: $MC_P = T$, so $3A_P = 3$, $A_P = 1$
 $A = A_H + A_P = 4$
What is the cost to the two firms?
To find total cost curves, integrate MC curves.
 $TC_H = 1/2 A_H^2 = 4.5$
 $TC_P = 3/2 A_P^2 = 1.5$
 $TC = TC_H + TC_P = 6$
This is an efficient solution: $MC = MD$
- Regulate: Require each firm to abate equally: $A_H = 2$ and $A_P = 2$
Cost? $TC_H = 2$, $TC_P = 6$, $TC = 8$
How can we tell this is not an efficient outcome?
1) lower SS (A is the same as under the tax, but TC is higher);
pareto improvement is possible.
2) MC_H not equal MC_P (violation of an efficiency condition; each firm sets $MC=P$, so MC of all firms are equal at the efficient solution.)
- Permits: Give each firm enough permits to produce their current level of emissions minus 2 units (so $A = 4$).
Hyatt sells one permit to Polaroid to get to optimum.
What is the price of the permit?
Maximum P will pay: $6 - 1.5 = 4.5$
Minimum H will accept: $4.5 - 2 = 2.5$
Range of possible prices: 2.5 - 4.5
Sale of one permit by H to P is a pareto improvement.
Would we ever want to restrict H to only selling 1/2 a permit?
No, because we would stop short of the efficient outcome.

This is just like the global warming example from class (US & Russia).

B. Road Wear and Tear

- Externality: driving on roads causes damage to roads. If you don't have to pay this cost, you ignore it when deciding whether to make trip, so you make too many trips.
- We have tolls on roads and gas taxes – do they fix the externality?
- Damage to road depends on weight/axle, not total weight.
- Most damage to roads is caused by trucks and buses.
- Tolls are higher if have more axles → tolls encourage more weight/axle.
- Get worse gas mileage if have more axles → gas tax encourages more weight/axle.
- Solution: restructure charges so increase with the weight/axle. Specifically, have trucks stop at weigh stations and pay a tax based on weight/axle and distance traveled.
- Problems: 1) cost of administering tax and cost to trucks of stopping moves us away from the optimum.
2) distortion: truckers may change routes to avoid weigh stations.

C. Congestion

- Externality: when you drive, you impose an externality on all the other drivers by slowing them down and increasing the time costs of their trip. Since you don't face this cost, you make too many trips.
- One solution: build more roads.
- Problem: Down's Law: as soon as you build roads, they fill to capacity, so adding capacity does not reduce congestion.
- Why? Cost of a trip = monetary costs (gas, parking) plus time costs. If add capacity, time costs drop, so people make more trips.
- Solution: congestion pricing. Charge driver different amount depending on the congestion of the road (by time of day gets it about right).
- How collect? Tolls? They increase congestion. Automated vehicle identification system measures road use as you drive by and sends you a bill later. But may be some costs from errors – need to include this when calculating efficiency gains.

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