

14.41 Public Economics  
Section Handout #3

**I. Pigouvian Tax**

Rosen's explanation: "A Pigouvian tax is a tax levied on each unit of a polluter's output in an amount just equal to the marginal damage it inflicts *at the efficient level of output.*" In general, this is the kind of tax that a public economist thinks about.

Graphical presentation :

Mathematical example (from P.S. #1, question #2b) : driving cost and the number of axels

$$\begin{aligned} \text{cost of gas} &= (1/6)*A^2 \quad (\text{this is a private cost}) \\ \text{pollution} &= (1/6)*A^2 \\ \text{road damage} &= 20/A \end{aligned}$$

*Find social optimum:*

$$\text{Min } c(A) = \min ((20/A) + (1/3)*A^2 + (1/6)*A^2)$$

$$\text{F.O.C} = -20/(A^2) + (2/3)A + (1/3)A = 0$$

$$A^* = 20^{(1/3)} = 2.714$$

*Find Pigouvian Tax (in this case a subsidy):*

The tax will equal the marginal damage at the socially optimal output level,  $A^*$ .

$$\text{Tax} = -20/A^{*2} + (2/3)A^* = -(1/3) * 20^{(1/3)}$$

Driver's problem now that he/she faces the Pigouvian tax :

$$\text{Min } ((1/6)A^2 - (1/3)* 20^{(1/3)}*A)$$

F.O.C

$$(1/3)A - (1/3)* 20^{(1/3)} = 0$$

$$A = 20^{(1/3)} = A^*$$

The driver chooses the socially optimal level of A.

## II. Public Goods

### A. Definition

- Public goods are non-rival (my consuming it does not prevent you from consuming it) and non-excludable (I can't stop you from consuming it). Examples: national defense, lighthouse.
- Optimal level of provision of private goods: each person sets  $MRS = \text{ratio of prices}$ . Firms set  $MRT = \text{ratio of prices}$ . So  $MRS_a = MRS_b = MRT$  (a and b are two individuals). Market demand curve is horizontal sum of individual demand curves.
- Optimal level of provision of public goods: since both people are able to consume the good, its value is  $MRS_a + MRS_b$ . Set sum of  $MRS = MRT$ . Market demand curve is vertical sum of individual demand curves.

### B. Private provision of public goods

- Public goods problem: can be described as a free-rider problem (you prefer to let others pay since you still enjoy the benefits) or a positive externality (your provision benefits others, but this isn't in your utility function). The result is under provision by the private market.
- To find level of private provision, use Nash bargaining (what do I want to do, holding your actions constant). This gets us reaction curves (downward sloping).

### C. Public Provision

- If there is some private provision, what happens if government taxes you to provide some of the good? Crowdout: you reduce private provision to offset increase in public provision.
- Basic principle: if you start from an individual optimum and the environment changes, if you are able to undo this change to get back to the optimum, you will.
- Is there always 100% crowdout? Not if: 1) you get utility from your contributions as well as from the total (warm glow model); or 2) the government taxes some people more than they were contributing.
- How much of the good to produce? Can ask people what their MRS is, then charge them that amount: Lindahl equilibrium. Problems: 1) truthful preference revelation (free rider problem); 2) people may not know their valuation; 3) too costly to determine everyone's preferences.