

1 Conceptual Topics

1. Ricardian Equivalence
2. Externalities
3. Pigouvian Taxes
4. Government Spending and crowding out. Zero Lower Bound.

2 Problems

1. Tannery
2. Toxic Gas
3. Dust Bowl
4. Monopoly

2.1 Tannery

A tannery has a cost l^2 of tanning l tons of leather. Tanned leather can be sold at \$100 per ton. The tannery maximizes profits. The tanning process gives off unpleasant smells. Each ton of leather processed by the tannery has a social cost of \$10 (how much the neighborhood is willing to pay to avoid the smell).

a) Assuming the tannery ignores the effect of the smell, how much will it produce?

b) Consider a social planner who maximizes the tannery's profits plus the neighborhood's utility. How much will the social planner have the company produce?

c) Is it possible to achieve the social planner's preferred production level by imposing a tax on tanned leather? If not explain why not, if yes describe the tax and its level.

Answer:

a) The tannery solves

$$\max_l 100l - l^2.$$

Differentiate with respect to l and equate to zero to get $100 - 2l = 0$, whence $l = 50$.

b) The social planner solves

$$\max_l 100l - l^2 + (\underline{u} - 10l), \quad (1.1)$$

where \underline{u} represents the utility level of the neighborhood when the tannery produces nothing. Differentiating and equating to zero yields $l = 45$.

c) It is possible. Setting a tax of \$10 per ton of tanned leather completely internalizes the externality in the firm's profits. Indeed, in the presence of the tax the firm's problem are

$$\max_l 100l - l^2 - 10l,$$

which will lead to the same optimal quantity as the problem in (1.1).

2.2 Toxic Gas

The inverse demand function for a good is given by $P = 10 - Q$. The marginal cost per unit of the good to the producer is constant at 2. The toxic gas emanated during the production generates air pollution that amounts to 4 per unit.

- a) What is the socially optimal quantity?
- b) Suppose the industry is perfectly competitive and firms ignore pollution. What is the market equilibrium? That is, what is P and Q ? Is this outcome socially optimal?
- c) Now suppose the firms that acted in a perfectly competitive fashion in b) merge into one firm. What is the monopoly P and Q ? Is this outcome socially optimal? Explain.

Answer:

a) Social marginal cost is $SMC = 2 + 4 = 6$. Equate this to $P = 10 - Q$. From $10 - Q = 6$, $Q_s = 4$.

b) Set P equal to the private marginal cost 2. From $10 - Q = 2$, $Q_{pc} = 8$ and $P_{pc} = 2$. This is not socially optimal: $Q_{pc} > Q_s$. Since the firms are not taking into account the pollution, there occurs an overproduction.

c) Set $MR = 10 - 2Q$ to the private marginal cost 2. From $10 - 2Q = 2$, $Q_m = 4$ and $P_m = 6$. This is socially optimal. Usually, monopoly results in inefficiency because the monopolist tends to produce below the socially optimal level to maximize profit. In the presence of bad externality, however, this may be beneficial because it may help remedy the overproduction problem.

2.3 Dust Bowl

The Homestead Act of 1862 allocated farmland to farmers in units of 160 acres. While a farm of that size was efficient in New England, in the Great Plains that farm size was too small in the following sense. A farm of that small size needed to be cultivated intensively to be economically viable. Intense cultivation shakes loose the superficial particles in the soil, which are blown by the wind over neighboring farms. This dust reduces the fertility of neighboring farms, and makes neighboring farmers even more compelled to cultivate intensively. Thus, when all farmers cultivate intensively all farms become infertile; due to the presence of dust, farms are then less productive than they would be if all farms were not farmed intensively. Excessive cultivation gave rise to the Dust Bowl phenomenon in the 1930s.

a) Consider the following matrix representing the farmers' decision about the intensity of cultivation.

		Farmer 2	
		Not Intensely	Intensely
Farmer 1	Not Intensely	5,5	$a, 10$
	Intensely	$10, a$	b, b

Fill in numerical values for a and b that capture the Dust Bowl environment.

- b) What do you expect the outcome to be in this environment?
 c) What would R. Coase predict would happen in this environment?

Answer:

a) Since "This dust reduces the fertility of neighboring farms" we have $a < 5$. Since "This dust [...] makes neighboring farmers even more compelled to cultivate intensively" it must be $a < b$. Since "when all farmers cultivate intensively farms are then less productive than they would be if all farms were not farmed intensively" we have $b < 5$.

b) Since $b > a$, for both farmers cultivating "Intensely" is preferable to "Not Intensively." That is, each farmer maximizes utility by choosing to cultivate intensively. In so doing, a farmer imposes a negative externality on the other farmer.

c) Given the existing allocation of property rights, an inefficiency arises: excessive cultivation. R. Coase would predict that property rights would be traded among the farmers, which would result in one farmer (say farmer 1 in our example) buying out farmer 2. After the trade, the efficient intensity of cultivation is implemented (cultivating both farms not intensively if $a < 0$, and one farm not intensively if $a > 0$). The buyout price could be any price above b (which is what farmer 2 can guarantee himself if he does not sell). Assuming $a > 0$, the buyout price must be below $(10 + a) - b$ ($10 + a$ is the profit that farmer 1 would reap from the combined farm at the efficient intensity of cultivation, so if the price were to exceed $10 + a - b$ then farmer 1 would be better off not buying out farmer 2). When $a < 0$ the buyout price will not exceed $10 - b$.

2.4 Monopoly

A monopolist faces an inverse demand function $P(q) = 10 - q$, where q denotes the quantity produced by the monopolist. The monopolist chooses q to maximize profits. It costs the monopolist $2q$ to produce q units.

- a) How much will the monopolists produce?
- b) What is the socially efficient production level?
- c) Suppose the government gives the monopolist t units of money per unit sold. Can the monopolist be induced to produce at the socially efficient level by an appropriate choice of t ? If yes, determine the optimal t , if not explain why not.
- d) Suppose the government gives the monopolist T units of money independent of how many units are sold. Can the monopolist be induced to produce at the socially efficient level by an appropriate choice of T ? If yes, determine the optimal T , if not explain why not.

Answer:

a) The monopolist produces at the point at which marginal revenue equals marginal cost, i.e., where

$$10 - 2q = 2,$$

and solving for q we obtain the optimal quantity for the monopolist, $q^M = 4$.

b) The socially efficient level of production is the one for which the demand equals the marginal cost,

$$10 - q = 2,$$

and solving for q we obtain the socially optimal quantity, $q^S = 8$.

c) A per-unit subsidy of t is perceived by the monopolist as equivalent to lowering the marginal cost by t . Given such a subsidy the monopolist chooses the q that solves

$$10 - 2q = 2 - t.$$

If we want the monopolist to produce $q = 8$, t must equal 8.

d) The monopolist's optimal (i.e., profit-maximizing) quantity is not affected by the size of the lump-sum transfer T . Therefore, it is not possible to achieve the optimal production level by subsidizing the monopolist with a lump-sum transfer.