Externalities

Problem 1 (APT'2001, P2)

Assume that product X is produced in a perfectly competitive industry and that product X yields costs to individuals who are neither consumers nor producers of product X.

(a) Using one correctly labeled graph, show the industry output and price under each of the following conditions.

    (i)   The industry ignores the externality.
    (ii)   The industry produces the socially optimum level of output.

Assume that the market is producing the level of output you identified in (i).

(b) Identify one policy the government might use to achieve the level of output you identified in (ii).

Sample answer:

(a) i) What we have here is the case of a negative externality, when the social costs of producing a good are greater than the private costs. The supply curve of an industry, which neglects the externality, will reflect only the costs incurred by the incumbent firms. It will therefore produce at point A where the demand curve intersects the marginal private cost curve and the marginal benefit from the last unit of X just equals the private cost of making it. At the optimum level of output, however, the benefit enjoyed by consumers from the last unit of a good must equal the social cost of producing this last unit. In our case, the costs to society of producing good X exceed the value of resources used up in its production (i.e. private costs) by the amount of damage imposed on third parties. Hence, the marginal social cost curve lies above the marginal private cost curve and to produce efficiently the industry must move to point B cutting its output to Q_B and raising the price to P_B.
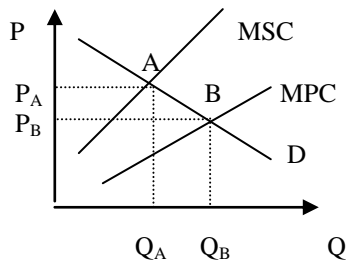
(b)   What the government needs to do is raise firms' private costs to the level of social
costs so as to make them aware of the damage they inflict on others. The obvious way to
achieve this is to levy a per-unit tax with the rate equal to the value of the marginal
external cost at the socially optimum output. As the following graph illustrates, the tax-
inclusive marginal cost curve will then intersect the demand curve at the same point as
the marginal social cost curve rendering an economically efficient outcome:

MSC
P
MPC+t
A
P_A B   MPC
P_B
D

Q_A Q_B Q

## Problem 2 (APT'95, P2)

Price / Supply / Demand / Good X
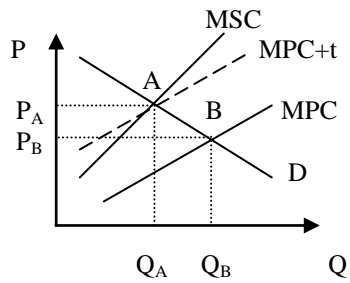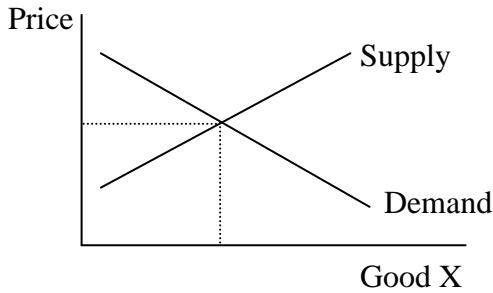
Production of good X imposes costs on people who are neither producers nor consumers of good X.

(a) A senator proposes a per unit sales tax on good X. Explain how this tax will affect each of the following.
- (i)   The price paid by consumers
- (ii)   The quantity of good X produced
- (iii)   The total after-tax revenues received by producers of good X

(b) Explain how imposing this tax might result in greater economic efficiency than would be achieved in an unregulated competitive market.

Sample answer:

(a) The imposition of a per unit tax will shift the entire supply curve up by the whole amount of the tax rate (see the graph below). As a result, the price paid by consumers will inevitably rise, while the quantity of good X produced will decrease.

The total revenue received by producers before the tax was levied is depicted by the area ABCD. The area KLMD represents the total net of tax revenues after the tax was imposed. Unless the demand curve is perfectly inelastic, the increase in price will be less than the tax rate. Consequently, the rectangle KLMD is all included in ABCD, which means that producers will suffer a reduction in the total after-tax revenues.
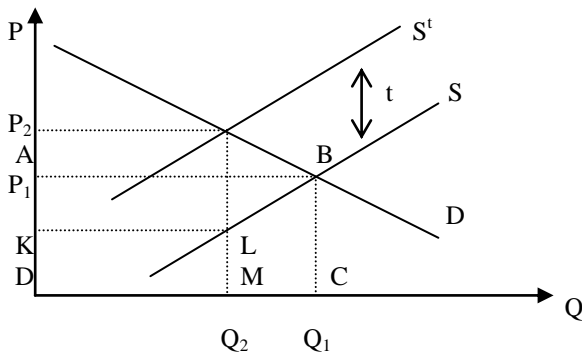
(b) If a product generates negative externalities imposing costs on people who are neither consumers, nor producers of the good, then social marginal costs of producing this good are greater than private marginal costs. As one can see from the diagram, without any regulation the industry would provide an outcome based on the considerations of private costs only, and, hence, there would be overproduction of good X. To bring the production of X down to the socially desired level (where P (price)=SMC (social marginal costs)) the government imposes a tax thus raising private marginal costs and reducing the gap between PMC (private marginal costs) and SMC (social marginal costs). By doing so, the tax increases the firms' awareness of the negative externality their activity generates making them take into account the costs the production of the good incurs on third parties. If the tax rate is chosen correctly, the industry can end up at the optimal point where SMC=MB (marginal benefit)=P or at least at a point close to it.

Problem 3 (APT'97, P3)

Marginal analysis is essential to microeconomics decision making. Discuss how marginal analysis is used in each of the following cases.

(a) To derive the supply curve for a perfectly competitive firm
(b) To identify the least-cost combination of capital and labor used to produce a given level of output
(c) To regulate an industry that produces a product that generates negative externalities

Sample answer:

a) The crucial assumption in explaining the behavior of a perfectly competitive firm is that of profit maximization. To decide how much to produce, a profit-maximizing firm applies marginal analysis by considering whether expanding output by one unit will increase or reduce total economic profits. Expansion of output remains profitable until marginal cost is equal to marginal revenue (i.e. MC=MR), so that the optimal level of production is the one where the two curves intersect. However, the firm will not produce at all if the price is less than AVC. In the case of perfect competition, the price is equal to the marginal revenue and, as a result, the supply curve for a competitive firm coincides with its marginal cost curve above the point where MC=AVC.

b) In choosing the least cost combination of labor and capital used to produce a given level of output, the firm compares the effectiveness of the last dollar spent on each input. Assume, for example, that the last dollar spent on labor produced an increase in output by MPL/w (where MPL denotes the marginal product of labor, and w – the wage rate), whereas the last dollar spend on capital entailed an increase in production by MPK/r (where, by analogy, MPK denotes marginal product of capital, and r – the rent). Then, depending on the relationship between these two quantities, the firm trying to minimize its costs might choose either to buy more labor and less capital, or vice versa. Thus, for instance, if MPL/w is greater than MPK/r, then by simply redistributing its expenses on the two inputs (i.e. taking away one dollar from capital and using it to buy additional labor) the firm could have increased its output while keeping the costs constant. In the same way it could have achieved the same level of production at a lower cost. Hence, the application of marginal analysis suggests that in order to minimize costs the firm must choose such a combination of labor and capital that MPL/w = MPK/r (otherwise it is always possible to change the inputs structure and cut the costs).

c) An industry which produces a product that generates negative externalities (say, pollution) operates at the point where marginal social costs are greater than marginal private costs. Regulators of the industry attempt to equate marginal social costs (MSC) to marginal private costs (MPC) by raising the marginal private costs (usually by taxation of the firms in the industry). In order to maximize total surplus, the government will put pressure on the firms to bring pollution down until the marginal social benefit of reducing pollution is equal to the marginal cost of reducing pollution for the society.