

Econ 496/598 Midterm Exam

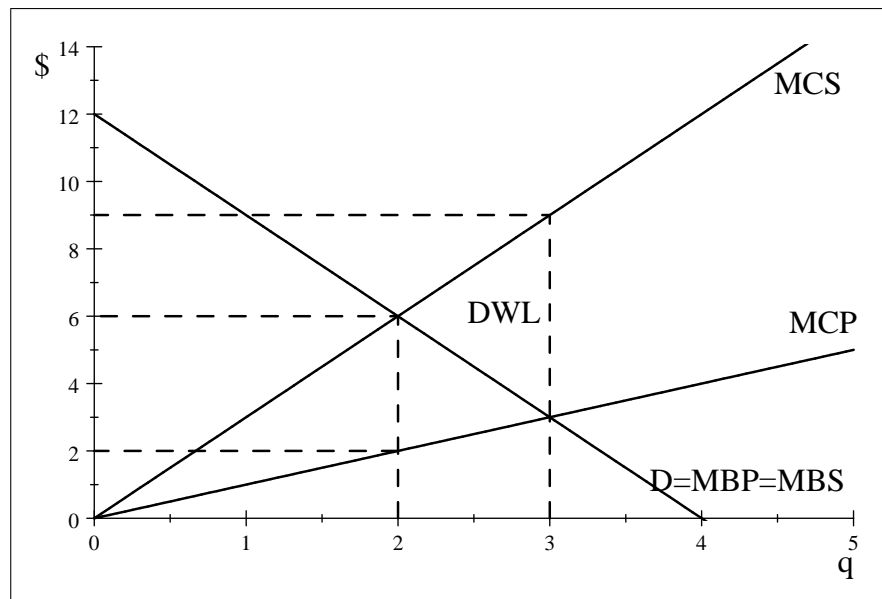
Suggested Answers

Part 1: Analytical Problems

Problem 1

(a) We know that $MC_S = MC_P + MC_E$. Since in this example the external marginal cost are double the private marginal cost and $MC_P = q$, we get $MC_E = 2MC_P \Rightarrow MC_E = 2q$. Therefore, $MC_S = MC_P + MC_E \Rightarrow MC_S = q + 2q \Rightarrow MC_S = 3q$.

(b) Graphically,



The market solution (q_M) is given by

$$MC_P = MB_P \Rightarrow q = 12 - 3q \Rightarrow 4q = 12 \Rightarrow q_M = 3 \text{ units.}$$

The social optimal solution (q^*) is

$$MC_S = MB_S \Rightarrow 3q = 12 - 3q \Rightarrow 6q = 12 \Rightarrow q^* = 2 \text{ units.}$$

(c) Under the market solution the total WTP is

$$\text{total } WTP_M = 0.5 \times [12 + MB_S(q_M)] \times q_M = 0.5 \times [12 + 3] \times 3 = \$22.5,$$

while the total cost is

$$\text{total Social Cost}_M = 0.5 \times MC_S(q_M) \times q_M = 0.5 \times 9 \times 3 = \$13.5.$$

Therefore, total surplus under the market solution is

$$Total\ Surplus_M = 22.5 - 13.5 = \$9.$$

Under the socially optimal solution the total WTP is

$$total\ WTP^* = 0.5 \times [12 + MB_S(q^*)] \times q^* = 0.5 \times [12 + 6] \times 2 = \$18,$$

while the total cost is

$$total\ Social\ Cost^* = 0.5 \times MC_S(q^*) \times q^* = 0.5 \times 6 \times 2 = \$6.$$

Therefore, total surplus under the market solution is

$$Total\ Surplus^* = 18 - 6 = \$12.$$

Given these results, the DWL is

$$DWL = Total\ Surplus^* - Total\ Surplus_M = 12 - 9 = \$3$$

Alternatively, the dead weight loss is equal to the area of triangle DWL in the graph above, *i.e.*,

$$DWL = 0.5 \times [MC_S(q^*) - MC_P(q^*)] \times [q_M - q^*] \Rightarrow$$

$$DWL = 0.5 \times [3(3) - 1(3)] \times [3 - 2] = \$3$$

- (d) Yes, with the proper policies. For example, if the government restricts the quantity *via* a quota equal to the socially optimal quantity. Or, by imposing a proper per-unit tax (Pigouvian tax) equal to the external marginal cost at the level of socially optimal quantity, *i.e.*,

$$MC_E(q^*) = 3(2) = \$6.$$

Problem 2

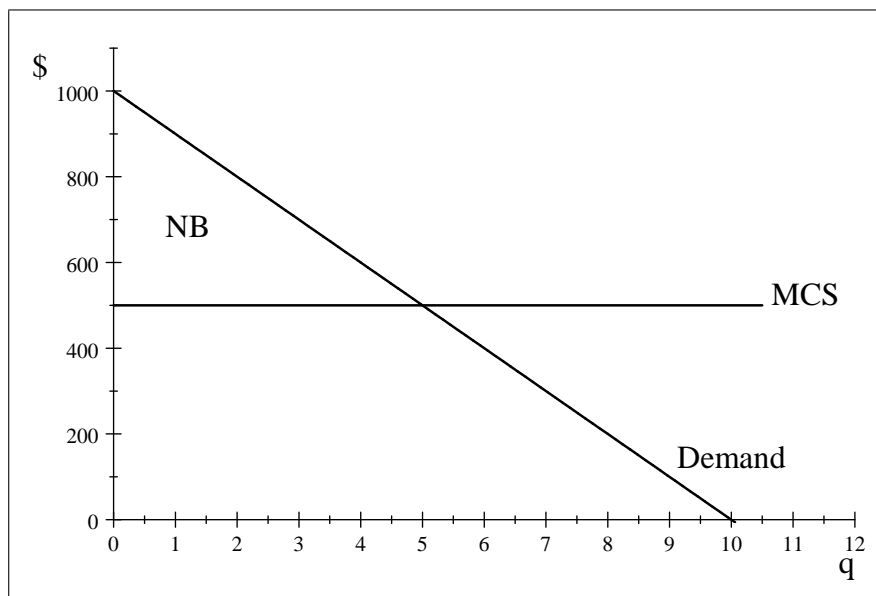
- (a) We know that since there are 100 people with identical demands, the total amount they are collectively willing to pay for a specific quantity of that public good (*i.e.*, the market demand) is

$$P_T = 100P \Rightarrow P_T = 100(10 - q) \Rightarrow P_T = 1000 - 100q.$$

- (b) Given our answer in part (a), the socially optimal amount (efficient allocation) is given by

$$MC_S = P_T \Rightarrow 500 = 1000 - 100q \Rightarrow q^* = 5\text{ miles.}$$

- (c) The net benefits will be equal to the difference between the total benefits and total costs.



Graphically, this is represented by the area between the demand and supply, i.e.,

$$\text{Net Benefits} = 0.5 \times (1000 - 500) \times 5 = \$1,250$$

- (d) Since this is an indivisible good, there will be incentive for free-riding (some consumers might not pay the amount they should pay in the hope that others will). Since this is a non-excludable good the private firms won't be able to exclude the free-riders from consuming it.

Problem 3

- (a) Considering each of the periods independently, the static efficiency requires

$$S = D \Rightarrow MC = P_i \Rightarrow 1 = 16 - 0.5q_i \Rightarrow q_i^* = 30 \text{ units.}$$

Therefore, the resource will be abundant for any stock of $2 \times 30 = 60$ or more. Since the available stock is 40, this resource is in scarcity.

- (b) Dynamic efficiency requires the equalization of net marginal benefits across time and exhaustion of the stock (when the resource is scarce). Therefore, we get the following system

$$\begin{cases} \frac{P_1 - MC}{(1+r)^{1-1}} = \frac{P_2 - MC}{(1+r)^{2-1}} \\ q_1 + q_2 = 40 \end{cases} \Rightarrow \begin{cases} \frac{16 - 0.5q_1 - 1}{(1+0.1)^{1-1}} = \frac{16 - 0.5q_2 - 1}{(1+0.1)^{2-1}} \\ q_1 + q_2 = 40 \end{cases} \Rightarrow \begin{cases} 15 - 0.5q_1 = \frac{15 - 0.5q_2}{1.1} \\ q_1 + q_2 = 40 \end{cases}$$

The solution of that system is $q_1^* = 20.476$ units, and $q_2^* = 19.524$ units.

(c) Given our answer in part (b) we get

$$P_1^* = 16 - 0.5q_1^* \Rightarrow P_1^* = 16 - 0.5(20.476) \Rightarrow P_1^* = \$5.762,$$

and

$$P_2^* = 16 - 0.5q_2^* \Rightarrow P_2^* = 16 - 0.5(19.524) \Rightarrow P_2^* = \$6.238.$$

(d) There are two ways to find the marginal usage cost. Using the langrangean multiplier and/or finding the difference between price and marginal extraction cost. Using the latter we get

$$MUC_1 = P_1 - MC \Rightarrow MUC_1 = 5.762 - 1 = \$4.762,$$

and

$$MUC_2 = P_2 - MC \Rightarrow MUC_2 = 6.238 - 1 = \$5.238.$$

Part 2. True or False. Choose 6 questions. Explain fully (answer with no explanation will get no marks).

1. True. When large populations are affected by the project we have the case of risk-pooling, that is the cost is dispersed among many different individuals and it becomes insignificant.
2. False. Static efficiency requires the maximization of total surplus, i.e., the sum of producer and consumer surplus.
3. True. If property rights are not transferable, resources do not in general end up in the hands of those who value them the most, thus under-maintenance will result.
4. False. The tragedy of the commons is a characteristic of open access resources, that is resources that are non-exclusive and divisible.
5. False. In the presence of negative externalities a competitive market (where Supply equals the Demand) will overproduce. A monopoly resulting in lower quantity might be socially beneficial.
6. True. Under rent-seeking resources are allocated to non-productive activities that aim to ensure the interests of specific groups.
7. False. Dynamic efficiency in general does not satisfy sustainability as the present periods (or present generations) can always benefit. However, through proper re-allocation mechanisms (such as intergenerational transfers) sustainability might be achieved.
8. False. CVMs have usually problems with (i) strategic bias, (ii) information bias, (iii) starting point bias, (iv) hypothetical bias, and (v) WTP versus WTA bias.
9. False. The concept of strong sustainability requires the stock of environmental resources (natural capital) not to decrease over time, while Hartwick's Rule requires the stock of total capital (*i.e.*, the sum of physical and natural capital) not to decrease over time
10. True. Coase's theorem is limited by (i) incentives of the polluters to over-pollute and enter the negotiations under preferable terms (when the polluters have the property rights), and (ii) high transaction and negotiations costs.