

Environmental Economics (AAE / ECON / Env. St. 343)

Exam #1. Suggested Solutions

1. In a famous legal case, *Miller v. Schonene* (287 U.S. 272), a property rights conflict arose. Red cedar trees, which are used for ornamental purposes, carried a disease that could destroy apple orchards within a radius of two miles. There was no known method of curing the disease except by destroying the cedar trees, or by ensuring that apple orchards were located at least two miles away from the cedar trees. Does it make any difference to the eventual outcome (cedar trees are destroyed or not) whether the cedar tree owners are legally entitled to retain trees, or the apple growers are entitled to be free of them? Explain your answer.

In the absence of significant transactions costs, the Coase Theorem states that the outcome of a dispute between two parties should be the same regardless of who holds the property rights, the cedar tree owners or the apple growers. However, if one group—the cedar tree owners or the apple growers—have significantly higher transactions costs of organizing than the other, the outcome may depend on the initial property rights. Also, if the property right is held by the cedar tree owners, there may be incentive for some apple growers to free-ride off of other apple growers' efforts to pay cedar tree owners to destroy their trees, also invalidating the Coase Theorem.

2. A recent essay in the *New York Times* discusses the fact that few people use reusable bags when shopping for groceries. The essay states the various environmental problems with the plastic bags used by grocery stores: “billions of plastic bags clogging landfills, killing aquatic creatures on the bottoms of oceans and lakes, and blowing in the wind”. It concedes that reusable grocery bags are only a small part of the environmental picture, but concludes with the lament, “But you think, if we can't change our behavior to deal with this one, we can't change our behavior to deal with anything”. For the sake of the questions below, assume paper bags cause the same environmental harm as plastic bags.

- a. Explain in economic terms why our current use of plastic shopping bags may be inefficient.

Since reusable bags are a more costly option to shoppers than plastic bags—costly in terms of their purchase and the inconvenience of carrying them around—then shoppers have no incentive to reduce their use of plastic bags because the costs of disposing the bags (e.g. “killing aquatic creatures”, etc.) are external to the shopper. Such negative externalities imply a property rights system that is not well-defined, and so the welfare theorem doesn't hold and the allocation of plastic bags will likely be inefficient.

- b. Suppose the use of plastic bags in Madison is an environmental hazard for Lake Mendota. To deal with the cost of removing plastic bags from the lake to keep it clean, the city charges every city household an annual “bag control” fee of \$60 per year. This fee is part of the property tax. Will this fee cause a reduction in the use of plastic grocery bags by city residents? Briefly explain your answer.

Despite the annual fee, the marginal cost of using plastic bags is still zero, and so there is no incentive for shoppers to reduce their use of plastic bags since plastic is still likely to be a cheaper option than reusable bags.

3. Consider the following statement from your book: “Marginal abatement cost (MAC) curves can vary enormously across firms for the same pollutant.” What significance does this statement have for command-and-control (CAC) policies which set uniform pollution standards across all polluters?

If there are different MAC curves for firms, then firms with lower MAC curves can reduce a given amount of pollution for less money than firms with higher MAC curves. Since CAC requires uniform pollution reduction, reallocating pollution reduction from high-cost firms (those with high MAC curves) to low-cost firms (those with low MAC curves) can achieve the same pollution reduction as CAC at lower total cost. So CAC is not a least-cost solution for reducing pollution when MAC curves vary across firms.

The following information applies to question 4. Consider a firm who initially releases 4 units of pollution into a river. Below are the costs to the firm for eliminating each unit of pollution (i.e. marginal abatement cost (MAC)) as well as the damages to a downstream resort from each unit of pollution (i.e. marginal pollution damages (MPD)).

Pollution Unit	Marginal abatement cost (MAC)	Marginal pollution damage (MPD)
4	\$2	\$10
3	\$5	\$7
2	\$8	\$4
1	\$11	\$1

4. What are the gains from negotiation to each party if the firm has the property right to pollute the river? What are the gains from negotiation to each party if the resort has the property right to a clean river? Show your work and state your assumptions.

Regardless of who owns the property right, the Coase Theorem states that in the absence of significant transaction costs there will be incentive for the two parties to negotiate until $MPD=MAC$ – which corresponds to two units of pollution control with the above data. If the mill has the property right, then the resort pays them to reduce units 4 and 3, while the mill pays the resort for the right to pollute units 1 and 2 if the resort holds the property right (assume the pollution price is \$6 in either case).

- *Mill holds property right:*
 - *Gains to mill = $(\$6-\$2)+(\$6-\$5)=\$5$.*
 - *Gains to resort = $(\$10-\$6)+(\$7-\$6)=\$5$.*
- *Resort holds property right:*
 - *Gains to mill = $(\$11-\$6)+(\$8-\$6)=\$7$.*
 - *Gains to resort = $(\$6-\$1)+(\$6-\$4)=\$7$.*

5. Two firms face the following marginal abatement costs (MAC) for a pollutant:

Pollution Unit	MAC Firm 1	MAC Firm 2
5	50	10
4	150	40
3	250	70
2	350	100
1	450	130

Suppose that the government sets a green tax of \$110 per unit of pollution.

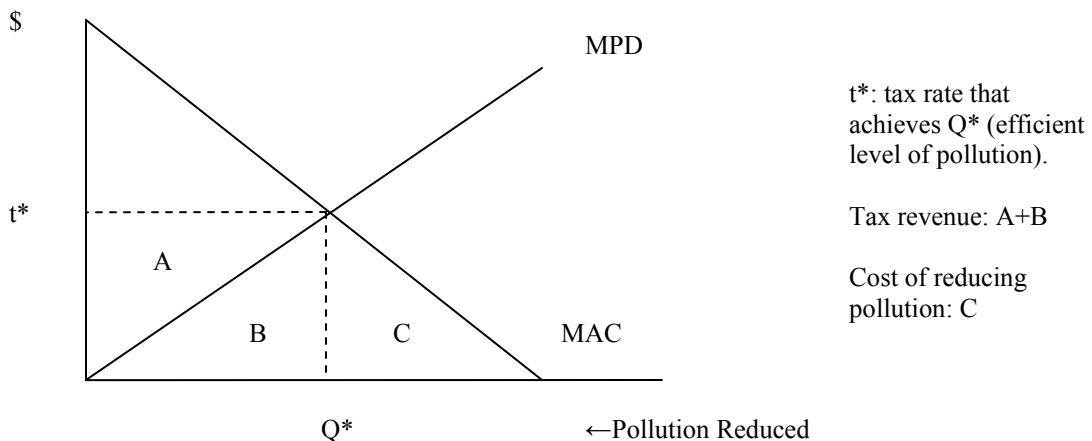
a. Given the above tax rate, what is the implied pollution goal in terms of total pollution units reduced? Is the implied pollution goal achieved at least cost? Explain.

Since each firm will pollute up to the point at which their MAC equals the tax, firm 1 will pollute 4 units and firm 2 will pollute 1 unit if a \$110 tax is imposed. Therefore, since 10 total units are emitted in the absence of the tax, the implied pollution goal is 5 units reduced. A property of a green tax is that it ensures that each firm reduces pollution until their marginal costs are equal to each other – the key condition for least-cost pollution control – and so the above tax achieves the pollution goal at least cost.

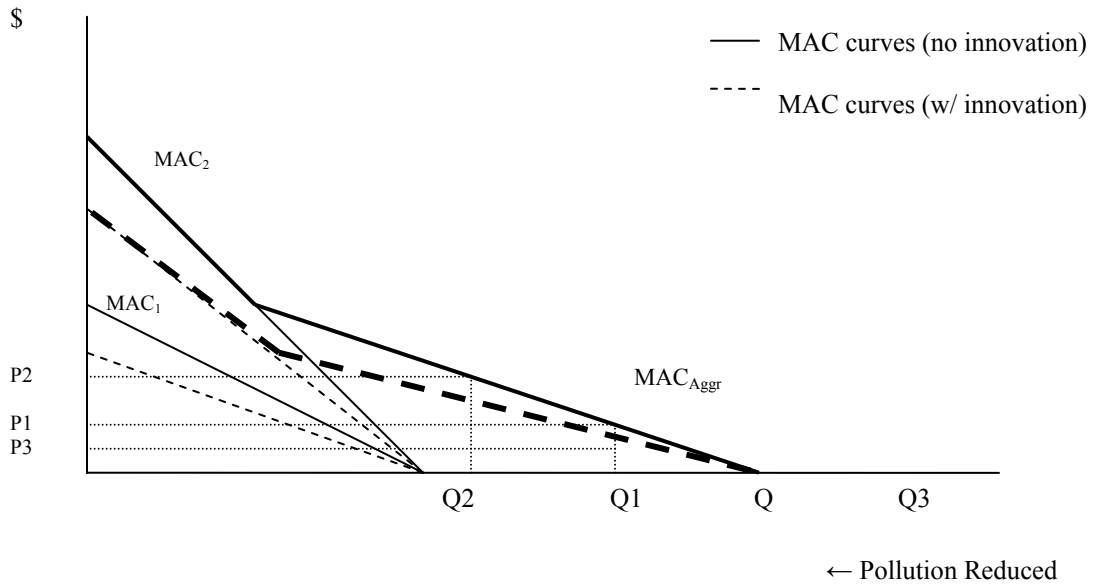
b. Is the implied pollution goal in part (a) the efficient level of pollution? Explain your answer.

Since there is no marginal pollution damage information given in this problem, there is no way to know if the implied pollution goal is the efficient level of pollution – the level of pollution at which MPD equals the aggregate MAC for reducing pollution.

6. Create the standard graph of the efficient level of pollution. On your graph, label all curves and axes, and show the following: a) the green tax rate that achieves the efficient level of pollution, b) the tax revenue collected by the government, c) the cost of reducing pollution under the tax.



7. It is well-known that permit prices for SO₂ have been declining in the last two years. Using a simple graph with different marginal abatement cost curves for two firms, illustrate how the following factors could lead to a decrease in pollution permit prices: i) the government's choice of a cap on pollution, and ii) the potential for firms to innovate new pollution abatement technologies.



As shown in the graph above, an increase in the pollution cap from Q₂ to Q₁ will reduce permit prices from P₂ to P₁. Also, if the firms innovate such that their MAC curves shift down (from solid to dashed lines in above graph), the permit price would fall from P₁ to P₃ if the government's cap is set at Q₁.