Economic Efficiency and the Optimum Amount of Pollution Cleanup

Student Alert: **Does it make sound economic sense to clean up all pollution?**

The human and environmental damage caused by industrial pollution often arouses public attention. Although it might be nice to restore our environment to its pristine state, pollution cleanup is costly and dollars used for cleanup might be spent elsewhere. It seems, then, that some sort of balance must be struck between undesirable pollution and its costly cleanup. Let's apply marginal analysis to determine an optimal amount of pollution and environmental cleanup.

The marginal social benefit (MSB) of cleaning up pollution tends to decline as additional units of pollution are cleaned up. The marginal social cost (MSC) of cleaning up pollution tends to increase as additional units of pollution are cleaned up. If society has accurate information about the total social (public and private) benefits and costs of various amounts of cleanup, society should be able to get close to the most efficient, or optimum, level of cleanup (and/or pollution) where the marginal social benefits equal the marginal social costs (MSB = MSC).

Imagine a community in which two firms emit foul sludge into two local lakes (one for each firm). Natural processes gradually break down the sludge, rendering it harmless. But as long as emissions continue, a certain equilibrium level of harmful sludge remains in the lake. If emissions are lowered, this equilibrium level will be reduced. The opposite occurs if emissions are increased. Currently each firm emits five units of sludge each week.

Given the information in Tables 5-4.1 and 5-4.2, you should be able to determine the optimal level of emissions for this community. Fill in the blanks in the tables, and use this information to answer Questions 1 through 4. Assume that benefits obtained and costs incurred for cleanup at one lake have no impact on costs and benefits at the other lake.

Table 5-4.1
Firm 1

Reduction of foul sludge emissions	Total social benefit of cleanup	Marginal social benefit of cleanup	Total social cost of cleanup	Marginal social cost of cleanup
0	$0	—	$0	—
1	$350	$350	$160	$160
2	$650	***$300***	$370	***$210***
3	$900	***$250***	$630	***$260***
4	$1,100	***$200***	$940	***$310***
5	$1,250	***$150***	$1,300	***$360***

1. Using the data from Table 5-4.1, fill in the blanks or underline the correct words in parentheses.

   (A) The marginal social benefit (MSB) of reducing emissions by the first unit of foul sludge is ***$350***, and the marginal social cost (MSC) of reducing pollution emissions by the first unit is ***$160***. The MSB is (***greater than*** / *equal to* / *less than*) the MSC, so it (***would*** / *would not*) be economically efficient from society's perspective to require Firm 1 to reduce pollution emission by the first unit.

   (B) The MSB of eliminating the last (fifth) unit of foul sludge is ***$150***, and the MSC of reducing pollution emissions by the last (fifth) unit is ***$360***. The MSB is (*greater than* / *equal to* / ***less than***) the MSC, so it (*would* / ***would not***) be economically efficient from society's perspective to require Firm 1 to reduce pollution emission by the fifth unit.

Table 5-4.2
Firm 2

Reduction of foul sludge emissions	Total social benefit of cleanup	Marginal social benefit of cleanup	Total social cost of cleanup	Marginal social cost of cleanup
0	$0	—	$0	—
1	$350	$350	$130	$130
2	$650	***$300***	$280	***$150***
3	$900	***$250***	$450	***$170***
4	$1,100	***$200***	$640	***$190***
5	$1,250	***$150***	$850	***$210***

2. Using the data from Table 5-4.2, fill in the blanks or underline the correct words in parentheses.

   (A) The MSB of eliminating the fourth unit of foul sludge is ***$200***, and the MSC of reducing pollution emissions by this fourth unit is ***$190***. The MSB is (***greater than*** / *equal to* / *less than*) the MSC, so it (***would*** / *would not*) be economically efficient from society's perspective to require Firm 2 to reduce pollution emissions by four units.

   (B) The MSB of eliminating the fifth (last) unit of foul sludge is ***$150***, and the MSC of reducing pollution emissions by this fifth (last) unit is ***$210***. The MSB is (*greater than* / *equal to* / ***less than***) the MSC, so it (*would* / ***would not***) be economically efficient from society's perspective to require Firm 2 to reduce pollution emissions by five units.

3. If this community decides to adopt a pollution control ordinance aimed at maximizing economic efficiency, how should it evaluate each of the following three proposals, all of which are based on the data presented above? Write a brief economic evaluation in the space provided after each of the proposals. Be sure to use the concepts of marginal social benefit and marginal social cost in your analysis.

Proposal A. "Foul sludge emissions should be reduced (by five units) to zero for each firm because we should eliminate all pollution from our lakes regardless of the cost."

This proposal (*would* / ***would not***) maximize economic efficiency.

Economic efficiency considers marginal social costs and marginal social benefits:

MSB < MSC after Firm 1 reduces two units.
MSB < MSC after Firm 2 reduces four units.
For five units, MSC > MSB for both firms.

Therefore, it would not be economically efficient to make either firm reduce five units because the MSB would be less than the MSC.

Proposal B. "Firm 2 should be forced to reduce emissions from five units to zero because the total social benefit of cleanup ($1,250) exceeds the total social cost of cleaning up ($850). But Firm 1 should not be forced to clean up at all, because the total social benefit of cleanup ($1,250) is less than the total social cost of reducing emissions to zero ($1,300)."

This proposal (*would* / ***would not***) maximize economic efficiency.

It is marginal (not total) benefits and marginal (not total) costs that count in finding the optimum point of economic efficiency. If Firm 2 reduces five units and Firm 1 reduces zero units, the total net gain is $400 ($1,250 – $850) from Firm 2. However, if Firm 2 reduces only four units and Firm 1 reduces two units, the total net gain is $740:

Firm 1: $650 – $370 = $280
Firm 2: $1,100 – $640 = $460
$740

Proposal C. "In the interest of equal treatment for all, each firm should be forced to clean up (reduce emissions) by three units."

This proposal (*would* / ***would not***) maximize economic efficiency.

Making Firm 1 reduce a third unit would result in MSB < MSC. Stopping Firm 2 at three units would leave MSB > MSC. Efficiency would increase if Firm 1 cut back to reducing two units, and Firm 2 continued reducing to a fourth unit. With each firm reducing three units, the total net gain is $720:

Firm 1: $900 – $630 = $270
Firm 2: $900 – $450 = $450
$720

With Firm 1 reducing two units and Firm 2 reducing four units, the total net gain is $740:

Firm 1: $650 – $370 = $280
Firm 2: $1,100 – $640 = $460
$740

4. Using the data presented above, what do you think is the socially optimal level of emissions reduction for each firm? Explain why you chose these numbers.

   Firm 1: ___2___ units

   Firm 2: ___4___ units

   The optimal level of emissions is the output where MSB = MSC. For Firm 1, MSB > MSC up to a reduction of two units; beyond this point MSB < MSC. For Firm 2, MSB > MSC up to a reduction of four units; beyond this point MSB < MSC. No other combination yields a net gain greater than $740.

5. What would you say to someone who makes the following statement? "Society should do all it can to eliminate all pollution."
   I would say that the person is wrong. The optimal amount of pollution elimination is the amount at which the MSB = MSC of pollution reduction. Any units of pollution elimination that have MSB < MSC should not be provided.