

Externalities

A *market externality* refers to a situation where some of the costs or benefits from an activity fall on someone other than the people directly involved in the activity. Externalities may be either positive (the activity provides a benefit to someone else) or negative (the activity places a cost on someone else). Costs that fall on someone else are called *external costs*, and benefits that fall on someone else are called *external benefits*. These external effects of an activity are also called *social spillover costs* and *social spillover benefits*, or *third-party costs* and *third-party benefits*.

The demand curve for a good or service shows the *marginal private benefit (MPB)* to those individuals who are consuming the product. It shows how many units will be demanded by consumers at different prices. The demand curve also shows the highest prices consumers will pay for different quantities of the product. The supply curve of a good or service shows the *marginal private cost (MPC)* to those individuals who are producing the product. It shows how many units will be supplied by producers at different prices. The supply curve also shows the lowest prices producers will accept for different quantities of the product.

If there are no positive externalities associated with the activity, then the marginal private benefit from an additional unit will be equal to the *marginal social benefit (MSB)*. The marginal social benefit shows the benefit to society from an extra unit of the activity. If no one other than the person associated with the activity receives any benefit from the extra unit, then $MPB = MSB$.

If there are no negative externalities associated with the activity, then the marginal private cost from an additional unit will be equal to the *marginal social cost (MSC)*. The marginal social cost shows the cost to society from an extra unit of the activity. If no one other than the person associated with the activity incurs any cost from the extra unit, then $MPC = MSC$.

Consumers of a product buy according to their marginal private benefits as shown by the demand curve, and producers of the item produce according to their marginal private costs as shown by the supply curve. The equilibrium quantity of the product in a perfectly competitive market will be the quantity where $MPB = MPC$. This is where the market demand curve intersects the market supply curve. *If there are no externalities, the competitive market output is the socially optimal (efficient) quantity because it is where $MSB = MSC$.* Society feels the market is producing exactly the right amount of the product. Given the marginal benefit society is receiving from the last unit, it feels the correct amount of its scarce resources is being allocated to the provision of that unit.

The competitive market results in *market failures*, however, if there are positive or negative externalities associated with the consumption or production of the good or service. These spillover benefits or costs, if not corrected, will result in the market producing either too much or too little of the activity from society's perspective. The externalities drive a wedge between the MSB and the MPB, or between the MSC and the MPC. Because the market will produce the output where $MPB = MPC$, these differences yield a quantity of the product at which MSB is not equal to MSC. We often turn to the government to attempt to correct these market failures.

To understand how externalities can result in market failures, it is important that you know these relationships:

- Marginal Social Benefit = Marginal Private Benefit + Marginal External Benefit

$$MSB = MPB + MEB$$

- Marginal Social Cost = Marginal Private Cost + Marginal External Cost

$$MSC = MPC + MEC$$

Summary of key points:

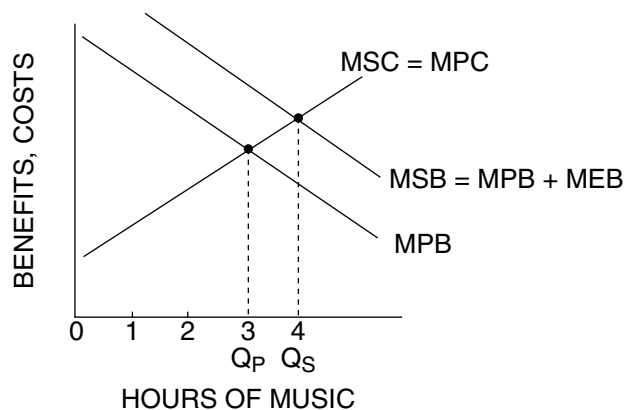
- Society wants a market to produce the quantity where $MSB = MSC$.
 - Private decision makers want to have the quantity where $MPB = MPC$.
 - As long as MEB and MEC are zero (no externalities), the market quantity will be the socially optimal (efficient) quantity.
 - If MEB or MEC is not zero, we will have a market failure.
- ! **Student Alert:** Some textbooks use slightly different approaches to the topic of externalities. While the end results with regard to the effects of externalities are the same, be sure you understand the approach and terminology that are being used.

Part A: How Much Music?



Figure 5-2.1

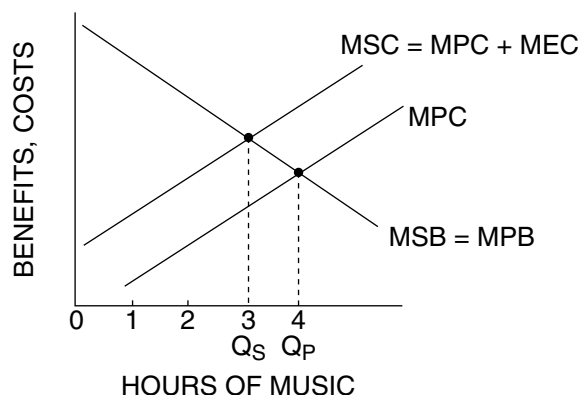
External Benefits



1. Margaret has Wendy as her roommate in a college residence hall. Wendy has brought an expensive stereo system to play in the room. Figure 5-2.1 shows Wendy's MPB and MPC curves for music played on the stereo system. Based on Figure 5-2.1, answer the following questions.
 - (A) If Wendy considers only the MPB and MPC from playing music, how many hours of music will be played? Label the number of hours in Figure 5-2.1 as Q_p to indicate the private market quantity.
Three hours, where $MPB = MPC$.
 - (B) Assume that Wendy plays music only at times that do not disturb Margaret and plays only music that Margaret also enjoys. The "MSB = MPB + MEB" curve in Figure 5-2.1 shows the MSB from the music, including the MEB to Margaret. If Wendy considers the MSB from playing music rather than only the MPB, what happens to the quantity of music played? Label the number of hours as Q_s in Figure 5-2.1 to indicate the socially optimal quantity.
It increases to 4 hours, where $MSB = MSC$. This is the socially optimal amount.
 - (C) In Figure 5-2.1, what does the vertical gap between the MSB and MPB curves represent?
The vertical gap represents the marginal external benefit (MEB) of the music. This is the social spillover benefit of the music to Margaret.
 - (D) Assuming there are no external costs from the music, when Wendy does not consider the MEB from playing music, the number of hours played is (*greater than / equal to / less than*) the socially efficient number of hours.



Figure 5-2.2
External Costs



2. Again, Wendy has a new stereo system and Margaret is her roommate.
 - (A) In Figure 5-2.2, assume Wendy only considers her MPB and MPC from music. How many hours of music will be played? Label the number of hours in Figure 5-2.2 as Q_p to indicate the private market quantity.
Four hours, where $MPB = MPC$.
 - (B) Now assume that Wendy plays music only at times that Margaret is trying to study and plays only music that Margaret hates. In Figure 5-2.2, the "MSC = MPC + MEC" curve shows the

MSC from the music, including the MEC to Margaret. If Wendy considers the MSC from playing music rather than only the MPC, what happens to the quantity of music played? Label the number of hours as Q_s in Figure 5-2.2 to indicate the socially optimal quantity.

It decreases to 3 hours, where $MSB = MSC$. This is the socially optimal amount.

(C) In Figure 5-2.2, what does the vertical gap between the MSC and MPC curves represent?

The vertical gap represents the marginal external cost (MEC) of the music. This is the social spillover cost of the music to Margaret.

(D) Assuming there are no external benefits from the music, when Wendy does not consider the MEC from playing music, the number of hours played is (***greater than*** / equal to / less than) the socially efficient number of hours.

3. How can government regulation (in this case, residence hall rules) assure the efficient quantity of music? Consider the circumstances under which prohibiting stereos or imposing daily “quiet hours” are efficient ways to regulate stereo use in the hall. Does economics suggest a more efficient approach to stereo regulation?

Prohibiting stereos or imposing quiet hours will not result in an efficient level since marginal external benefits and marginal external costs are not considered. A more efficient approach would be to issue “rights” to play stereos. You could issue property rights and negotiate how many hours the stereo could be played. For example, Wendy could pay Margaret if there is a negative externality, and Wendy could charge Margaret if there is a positive externality.

Part B: More Externalities Examples

4. For each of these activities, explain whether there is a positive or negative externality.

(A) Private high school education

Positive. The students become better citizens.

(B) Smog from an electric power plant

Negative. The pollution causes health problems for people living near the power plant.

(C) Your neighbor’s yappy dog

Negative. The dog’s barking keeps the neighbors awake at night.

(D) Pre-kindergarten measles vaccinations

Positive. There is less spread of disease.

Part C: Applying Your Knowledge of Externalities

The Women’s National Basketball Association (WNBA) is considering awarding a new franchise to the city of Metropolis, but only if the team has a new arena in which to play. Proponents of the franchise argue that the team will generate new businesses, provide jobs, increase tax revenue, and promote tourism in Metropolis. Opponents argue that most of the money spent on basketball games will come from Metropolis-area residents who will simply reduce their spending on other activities. The opponents claim there will be few new jobs, little increase in tax revenue, and few new tourists coming

to Metropolis. They also say the new arena will cause property values to fall in the area and create traffic congestion and noise pollution.

Voters have the following three proposals before them:

Proposal #1: No city money should be used to construct the arena. Team owners should pay the full cost of building the facility and include that cost in the price of game tickets.

Proposal #2: The city should place a tax on each ticket sold to pay the full cost of the arena.

Proposal #3: The city should build the arena and lease the right to play there to the basketball club at a subsidized rate.

For the analysis that follows, assume the output of the team is the number of tickets sold.

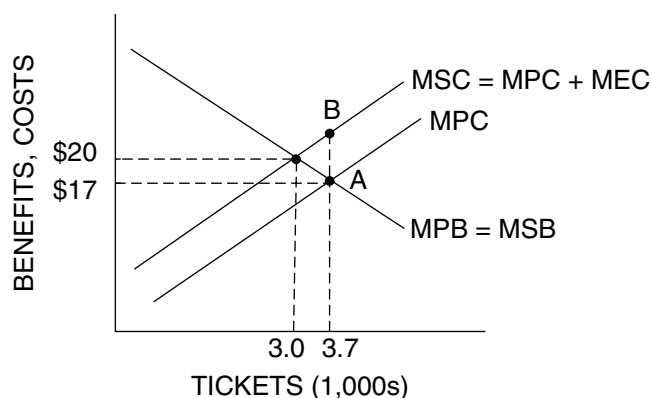
5. What assumption does Proposal #1 make about external costs and external benefits associated with the new franchise?

It assumes there are no positive or negative externalities. The benefits of the franchise go to the people who buy the tickets and there are no spillover benefits to others. It assumes the team incurs the cost of the franchise and arena and there are no spillover costs to others. Under these assumptions, $MPB = MSB$ and $MPC = MSC$. When the market produces the output where $MPB = MPC$, it also will be producing the socially optimal output where $MSB = MSC$.

Figure 5-2.3 can be used to illustrate the position of opponents to the franchise. Answer the following questions based on this graph.



Figure 5-2.3
Social Spillover Costs



6. What assumption is made about social spillover benefits from the franchise? Explain.

It assumes there are no spillover benefits because $MSB = MPB$.

7. What assumption is made about social spillover costs from the franchise? Explain.

It assumes there are spillover costs (such as traffic congestion). The MSC curve is above the MPC curve, with the difference between them being the marginal external cost (MEC).

8. How many tickets will be sold based on the MPB and MPC?

The market will result in 3,700 tickets per game because that is where $MPB = MPC$. The price of tickets will be \$17.

9. What is the socially optimal number of tickets?

The socially optimal number of tickets is 3,000 because that is where $MSB = MSC$. The price would be \$20.

10. What does the vertical gap “AB” represent?

This gap represents the marginal external cost of the franchise.

11. What can the Metropolis city government do to make the market output be equal to the socially efficient output? Explain, using the graph to illustrate your answer.

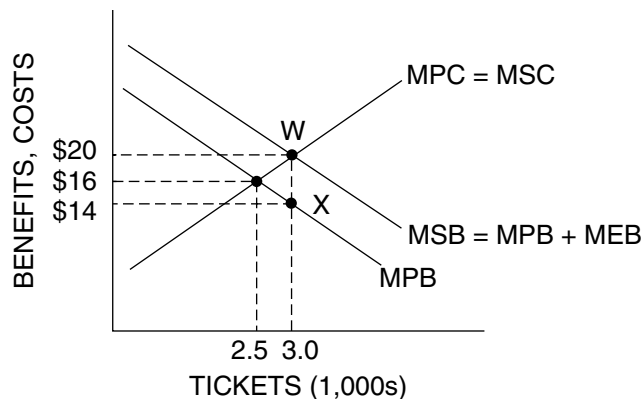
The government can place a tax on each ticket equal to the MEC (shown as “AB”). This will put the external cost on the team owners, thus making the MPC shift up to where the MSC curve is positioned. The team will sell 3,000 tickets at a price of \$20.

Figure 5-2.4 can be used to illustrate the position of supporters of the franchise. Answer the following questions based on this graph.



Figure 5-2.4

Social Spillover Benefits



12. What assumption is made about social spillover benefits from the franchise? Explain.

It assumes there are spillover benefits (such as more tax revenue to the city). The MSB curve is above the MPB curve, with the difference between them being the marginal external benefit (MEB).

13. What assumption is made about social spillover costs from the franchise? Explain.

It assumes there are no spillover costs because $MSC = MPC$.

14. How many tickets will be sold based on the MPB and MPC?

The market will result in 2,500 tickets per game because that is where $MPB = MPC$. The price of tickets will be \$16.

15. What is the socially optimal number of tickets?
The socially optimal number of tickets is 3,000 because that is where $MSB = MSC$. The price would be \$20.
16. What does the vertical gap “WX” represent?
This gap represents the marginal external benefit of the franchise.
17. What can the Metropolis city government do to make the market output be equal to the socially efficient output? Explain, using the graph to illustrate your answer.
The government can provide team owners with a \$6 subsidy for each ticket equal to the MEB (shown as “WX”). The purpose of this incentive is to encourage owners to provide more of the product. There are two ways this subsidy of \$6 can be demonstrated graphically.
- (1) *The subsidy can be viewed as a reduction of the MPC of the team owners, thus making the MPC shift down to an “MPC – subsidy” curve that intersects the MPB curve at 3,000 tickets. The team will sell these tickets at a price of \$14 and receive a subsidy of \$6 for each ticket.*
 - (2) *Or, the subsidy can be seen as an upward shift of the owner’s extra revenue per ticket by the amount of the subsidy so it is in the same position as the MSB curve. The result is that 3,000 tickets will be sold. Since fans will only pay a price of \$14 for 3,000 tickets (based on their MPB curve), that is the price received by owners. The owners will also receive a subsidy of \$6 for each ticket. This makes the revenue received from the last ticket equal to \$20, which is the same as the MPC of providing that unit.*

Part D: Per Unit or Lump Sum? Which Type of Tax or Subsidy to Use?

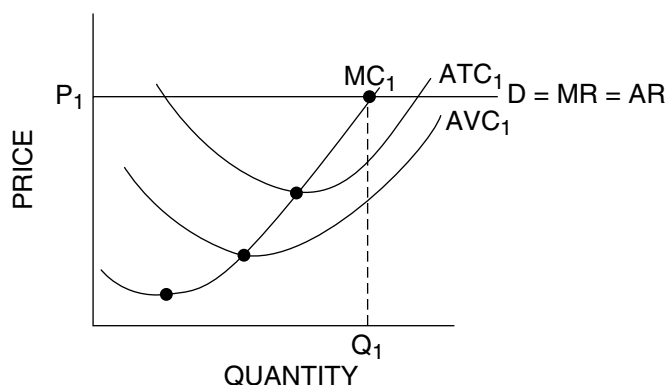
! Student Alert: Which form of a tax or subsidy should the government use to correct the effects of an externality? Should it apply a per-unit or a lump-sum adjustment?

Figure 5-2.5 shows the average total cost (ATC), average variable cost (AVC), marginal cost (MC), demand (D), marginal revenue (MR), and average revenue (AR) functions of a perfectly competitive firm. The firm is producing Q_1 units because that is where $MR = MC$. Assume there is a negative externality associated with the firm’s product and the government would like to have the firm reduce its output.



Figure 5-2.5

A Profit-Maximizing Perfectly Competitive Firm

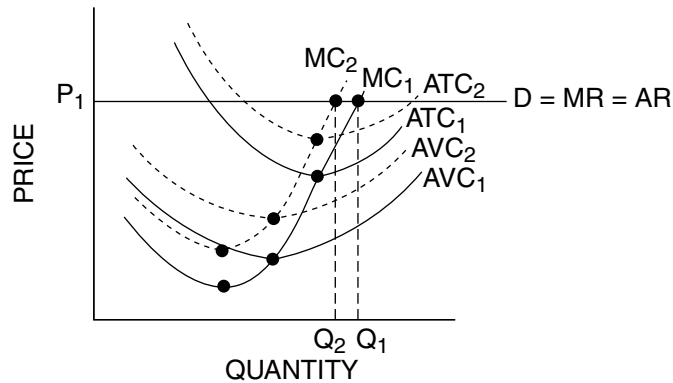


18. Suppose the government places a per-unit tax of “ t ” on the firm’s product. Which cost measures will be affected by this per-unit tax: ATC, AVC, average fixed cost (AFC), or MC? Show in Figure 5-2.6 how the cost curves will look after the tax is imposed. What happens to the output level the firm wants to produce? Was the per-unit tax successful in having the firm reduce its quantity?



Figure 5-2.6

The Government Levies a Per-Unit Tax of “ t ”



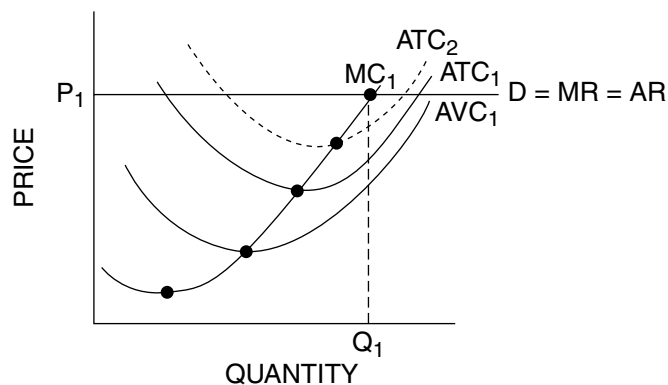
Because this is a per-unit tax, it will affect the firm’s MC and AVC curves, which means it also will affect the ATC curve. The AFC will not be affected because a per-unit tax does not change TFC. Each of the MC, AVC, and ATC curves shifts up vertically by the distance “ t ” at all output levels. The output levels where these three cost curves have their minimum points are the same as before. Because the firm’s MC curve has shifted up, the firm’s optimal output level where $MR = MC$ (shown as Q_2) will be less than the original level of Q_1 . The per-unit tax did result in a smaller quantity being produced by the firm. The demand facing the firm is not changed by the tax.

19. Suppose the government places a one-time, lump-sum tax of “ T ” on the firm’s product. Which of these cost measures will be affected by this lump-sum tax: ATC, AVC, AFC, or MC? Show in Figure 5-2.7 how the graph will look after the tax is imposed. What happens to the output level the firm wants to produce? Was the lump-sum tax successful in having the firm reduce its quantity?



Figure 5-2.7

The Government Levies a Lump-Sum Tax of “ T ”



Because this is a lump-sum tax and not dependent on how many units the firm produces, it amounts to an increase in the firm's TFC. This means the firm's AFC will increase as well. Because it is not a per-unit tax, the firm's MC and AVC curves are not affected. The ATC curve will increase because of the increase in AFC. The upward shift of the ATC curve gets smaller as quantity rises because as the lump-sum tax is spread over more output units, the increase in AFC is reduced. Because the firm's MC curve is unchanged, the firm's optimal output level where $MR = MC$ remains at Q_1 . The lump-sum tax reduced the firm's total profit but it did not result in a smaller quantity being produced by the firm. The demand facing the firm is not changed by the tax.

20. Assume a firm produces a product for which there is a positive externality. As an incentive to the firm to produce more of its product, should the government give the firm a per-unit subsidy or a lump-sum subsidy? Explain.

Using the same logic as for the per-unit tax and lump-sum tax, if the government wants the firm to increase its quantity, it should use a per-unit subsidy. A per-unit subsidy can be viewed as a decrease in the firm's MC of production, or as an increase in the firm's per-unit revenue. In either case, the output level where $MR = MC$ will be larger than before.

Part E: Summary

21. When positive externalities are involved, private markets produce (*more than / exactly / less than*) the socially optimal amount of the product.
22. When negative externalities are involved, private markets produce (*more than / exactly / less than*) the socially optimal amount of the product.
23. Why do economists say the presence of an externality results in a market failure?
Externalities make MPB different from MSB, or MPC different from MSC. Since the market output will be where $MPB = MPC$, the externality results in the market producing a quantity that is not the socially efficient level at which $MSB = MSC$. The result is either too many or too few of society's scarce resources being devoted by the market to the activity.
24. How can a tax be used to remedy a negative externality?
The tax raises the MPC of production and thus reduces the quantity.
25. How can a subsidy mitigate an inefficient output level in the presence of a positive externality?
The subsidy increases the quantity by providing an incentive to producers to provide a larger quantity. The subsidy can be viewed either as a reduction of the producers' MPC, or as an increase in the producers' marginal revenue from the last unit.

Private or Public? The Coase Theorem

When an activity results in a negative externality (external cost), the market outcome will not be efficient. In these cases, the government may choose to intervene in the market and impose some form of regulation, for example, a legal restriction or a tax. If the external cost the activity creates is borne by those who conduct the activity, the market outcome will be efficient.

For example, if a firm dumps its waste into a river, it pollutes the river and creates a negative externality (external cost) for those downstream. The government may intervene to restrict dumping in the river, or it may impose an effluent tax (a tax on each unit of pollution released into the river). If the firm is forced to pay for the pollution it releases into the river, it will dump less. A sufficiently high tax will lead to the optimal reduction in river pollution from the firm. Thus, the firm has internalized the externality.

However, in some situations, it may not be necessary to regulate a market to achieve an efficient outcome. It may be possible for the parties affected by an externality to negotiate an efficient outcome on their own. For example, if people who use the river downstream can negotiate with the polluting firm, they may be willing to pay the firm to stop polluting. This idea is embodied in the *Coase Theorem*, which states that if those who are affected by an externality can negotiate, they may arrive at an efficient solution to the externality problem.

Two firms are involved in a dispute. Grunge, Inc., a manufacturing firm, pollutes a nearby river. The pollution travels downstream past White Water Expeditions, a company that provides river rafting trips. Dumping its waste into the river cuts Grunge’s waste-disposal costs, while decreasing the number of people who want to raft on the river. The total profits of the two firms (both with and without waste dumping) are shown in Table 5-3.1.



Table 5-3.1
Total Profits per Month

	With dumping	Without dumping
Grunge, Inc.	\$2,300	\$2,000
White Water Expeditions	\$1,500	\$2,000

1. What are the total returns to both companies with and without dumping? Which situation (dumping or no dumping) is socially optimal—in other words, provides the highest combined returns?

The combined total profits with dumping: \$3,800

The combined total profits without dumping: \$4,000

The highest combined profits result when Grunge does not dump its waste into the river.

2. If there is no government intervention in the market, and the two companies do not communicate, will Grunge dump waste into the river? Why or why not?

Yes. Grunge has greater total profits if it dumps its waste and reduces its total costs.

3. What is the cost to Grunge not to dump waste into the river?
Since its total profits are \$300 lower if it does not dump its waste, the cost to Grunge of not polluting the river is \$300.
4. What is the cost of the pollution to White Water each month? How much would White Water be willing to pay Grunge to stop dumping waste into the river?
White Water's total profit is \$500 higher each month if the river is clean. That means White Water should be willing to pay Grunge up to \$500 each month not to dump its waste into the river.
5. If Grunge and White Water could negotiate, at no cost, could they come to an agreement that would eliminate the externality problem and result in the efficient outcome? If not, why not? If so, what would be the payment from White Water to Grunge?
If the two sides consider their potential increase in total profits, they have room to reach an agreement that will benefit both sides. If White Water will pay Grunge some amount between \$301 and \$499, each side will gain.
6. Does it matter who has the property right: Grunge to dump or White Water to have clean water? Explain.
No, it does not matter. If Grunge has the property right, White Water will pay Grunge not to dump. If White Water has the right, Grunge will clean up its waste at a cost of \$300.

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.

What Is a Fair Tax?

Almost everyone is concerned about how much we pay in taxes. The best way to determine how much tax you pay is to state your tax as an *effective tax rate*. An effective tax rate is the percentage of your income you pay in taxes. This differs from a *nominal tax rate* or *legal tax rate*. For example, a sales tax rate may be 5 percent (the nominal rate), but this does not mean that all people pay 5 percent of their income in sales taxes. Outlays for rent, insurance, and medical bills, among other things, may not be subject to sales taxes. Neither, of course, are savings.

Let's look at the effective tax rate of Joanne Walters. If she made \$30,000 a year and paid \$6,000 in taxes, her effective tax rate would be 20 percent. You can figure this by dividing \$6,000 by \$30,000:

$$\frac{\$6,000}{\$30,000} = 20\%.$$

There are three kinds of effective tax rates. If a tax is *progressive*, the effective tax rate increases as a person's income goes up. For example, a person who makes \$30,000 a year may have an effective tax rate of 10 percent, while a person who makes \$45,000 a year may have an effective rate of 18 percent.

If a tax is *proportional*, the effective tax rate stays the same regardless of income. In this case, a person making \$30,000 a year and a person making \$45,000 a year would both be taxed at an effective rate of, say, 10 percent. Of course, the person making \$45,000 a year would pay more total dollars in taxes. A proportional tax is sometimes called a *flat tax*.

If a tax is *regressive*, the effective tax rate decreases as income goes up. For example, a person making \$30,000 a year might pay an effective tax rate of 10 percent, while a person who makes \$45,000 a year might pay an effective tax rate of 8 percent.

Now answer these questions to see if you understand progressive, proportional, and regressive tax rates.

1. A tax that requires each person to pay 3 percent of income regardless of the level of income is a proportional tax.
2. A tax levied at 1 percent on the first \$1,000 of income, 2 percent on the next \$1,000, and so on is a progressive tax.
3. A tax levied at 15 percent on the first \$1,000 of income, 12 percent on the next \$1,000, and so on is a regressive tax.

4. If it is true that a person with an income of \$20,000 a year typically buys 10 gallons of gasoline per week and a person with an income of \$40,000 typically buys 15 gallons of gasoline per week, this suggests that an excise tax of 40 cents per gallon would be a regressive tax. Explain.
The richer person has double the income but buys only 50 percent more gasoline. Therefore, the poorer person pays a greater percentage of his or her income on the gasoline tax.
5. Rick Morales has an income of \$50,000 but spends only \$40,000 on taxable goods. Chet Burton has an income of \$25,000 and spends it all on taxable goods. Assuming an 8 percent sales tax, Mr. Morales will pay \$3,200 in sales taxes, which is 6.4 percent of his total income. On the other hand, Mr. Burton will pay \$2,000 in sales taxes, which is 8.0 percent of his total income. Therefore, we can conclude that the sales tax is (*progressive / proportional / regressive*).
6. Since the sales tax has the same nominal or legal rate based on sales, why is it regressive? What steps could be taken to make it less regressive?
The sales tax base is consumption, not income. Most states do not include services in their sales tax base. Since the rich purchase more services, taxing services would make the tax less regressive. It would also raise more revenue. Since the poor pay a greater percentage of their income on food, exempting food also makes the tax less regressive. Several states exempt food from sales taxes. The government could tax income, or exempt the first portion of expenditures, or eliminate the sales tax on necessities such as food.
7. Suppose that the government runs a pension fund to which all workers must contribute. The employee contribution rate is 6.2 percent on the first \$84,900 of income. All income in excess of \$84,900 is not taxed for pension purposes.
- (A) What is the effective pension tax rate for a person earning \$20,000 a year? 6.2%
- (B) What is the effective pension tax rate for a person earning \$84,900? 6.2%
- (C) What is the effective pension tax rate for a person earning \$169,800? 3.1%
The first \$84,900 is taxed at 6.2 percent = $(\$84,900)(0.062) = \$5,263.80$. The remaining income of \$84,900 is not taxed for this person. The effective tax rate is $\$5,263.80 / \$169,800 = 0.031 = 3.1$ percent.
- (D) Therefore, the pension tax is a (*progressive / proportional / regressive*) tax up to \$84,900 of income. For incomes above \$84,900, the tax is (*progressive / proportional / regressive*).
- (E) In addition to the pension tax, assume people must pay 1.45 percent of their income for medical benefits. There is no income limit on the medical care tax. Does this make the total tax for pension and medical care more or less regressive? Why?
Less regressive because high-income people must pay the medical care tax on their entire income, but they must pay the pension tax on their income up to only \$84,900.