

## 10 Externalities

### PRINCIPLES OF ECONOMICS FOURTH EDITION

N. GREGORY MANKIW

Premium PowerPoint® Slides  
by Ron Cronovich

2008 update  
Modified by Joseph Tao-yi Wang

© 2008 South-Western, a part of Cengage Learning, all rights reserved

## First They Came...

- FIRST THEY CAME for the Communists, 起初他們(德國納粹黨)追殺共產主義者，
- And I didn't speak up because I wasn't a Communist. 我不是共產主義者，我不說話
- THEN THEY CAME for the Jews, 接著他們追殺猶太人，
- And I didn't speak up because I wasn't a Jew. 我不是猶太人，我不說話；

## First They Came...

- THEN THEY CAME for the trade unionists, 後來他們追殺工會成員，
- And I didn't speak up because I wasn't a trade unionist. 我不是工會成員，我繼續不說話；
- THEN THEY CAME for the Catholics, 此後他們追殺天主教徒，
- And I didn't speak up because I was a Protestant. 我不是天主教徒，我還是不說話

## First They Came...

- THEN THEY CAME for me, 最後，他們奔向我來，
- And by that time no one was left to speak up. 但已經沒有人能站起來為我說話了。

– by Pastor Martin Niemöller

### In this chapter, look for the answers to these questions:

- What is an externality?
- Why do externalities make market outcomes inefficient?
- How can people sometimes solve the problem of externalities on their own? Why do such private solutions not always work?
- What public policies aim to solve the problem of externalities?

### Introduction

- Recall one of the Ten Principles from Chap. 1: *Markets are usually a good way to organize economic activity.*
- Lesson from Chapter 7: In the absence of market failures, the competitive market outcome is efficient, maximizes total surplus.



## Introduction

- One type of market failure: externalities.
- **Externality:** the uncompensated impact of one person's actions on the well-being of a bystander
  - **Negative externality:** the effect on bystanders is adverse
  - **Positive externality:** the effect on bystanders is beneficial

## Introduction

- Self-interested buyers and sellers neglect the external effects of their actions, so the market outcome is not efficient.
- Another principle from Chapter 1: *Governments can sometimes improve market outcomes.*



## Pollution: A Negative Externality

- Example of negative externality: Air pollution from a factory.
  - The firm does not bear the full cost of its production, and so will produce more than the socially efficient quantity.
- How govt may improve the market outcome:
  - Impose a tax on the firm equal to the external cost of the pollution it generates



## Other Examples of Negative Externalities

- the neighbor's barking dog
- late-night stereo blasting from the dorm room next to yours
- noise pollution from construction projects
- talking on cell phone while driving makes the roads less safe for others
- health risk to others from second-hand smoke

## Positive Externalities from Education

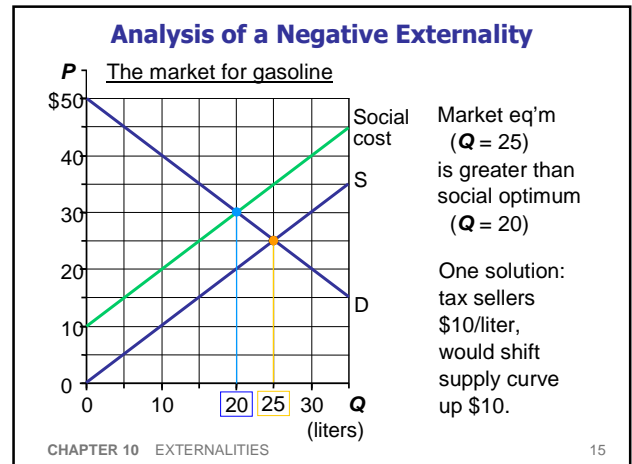
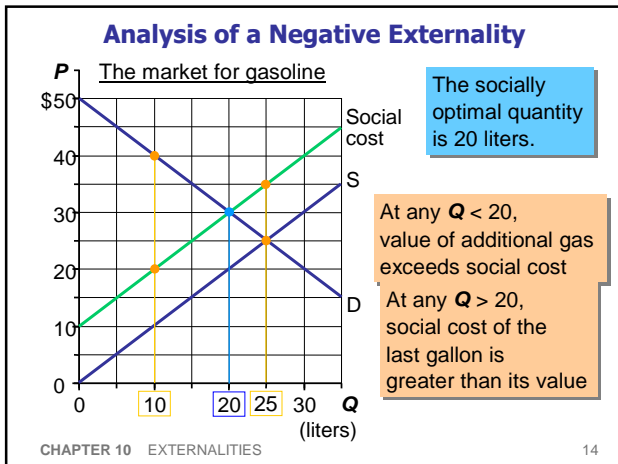
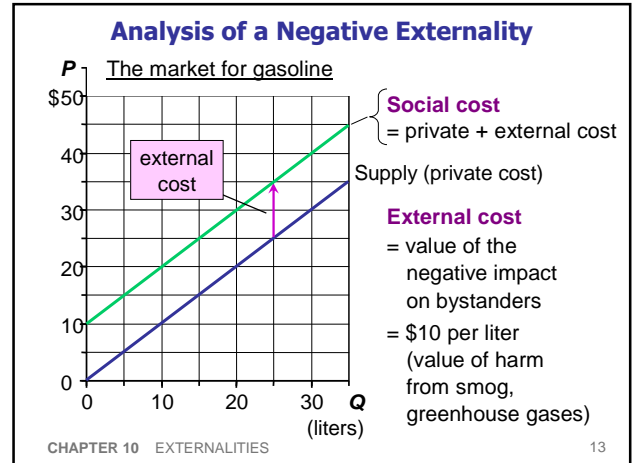
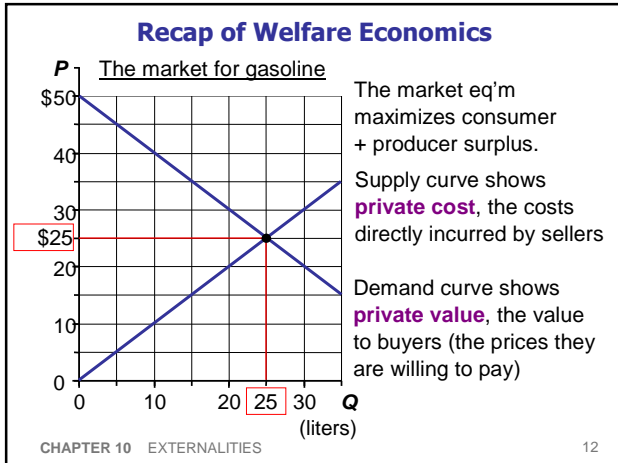
- A more educated population benefits society:
  - *lower crime rates:* educated people have more opportunities, are less likely to rob and steal
  - *better government:* educated people make better-informed voters
- People do not consider these external benefits when deciding how much education to "purchase"
- Result: market eq'm quantity of education too low
- How govt may improve the market outcome:
  - subsidize cost of education

## Other Examples of Positive Externalities

- Being vaccinated against contagious diseases protects not only you, but people who visit the salad bar or produce section after you.
- R&D creates knowledge others can use.
- Renovating your house increases neighboring property values.



*Thank you for not contaminating the fruit supply!*



### "Internalizing the Externality"

- **Internalizing the externality:** altering incentives so that people take account of the external effects of their actions
- In our example, the \$10/liter tax on sellers makes sellers' costs = social costs.
- When market participants must pay social costs, market eq'm = social optimum.

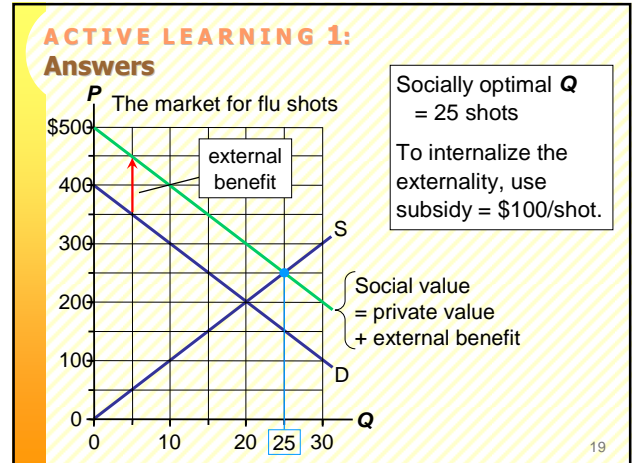
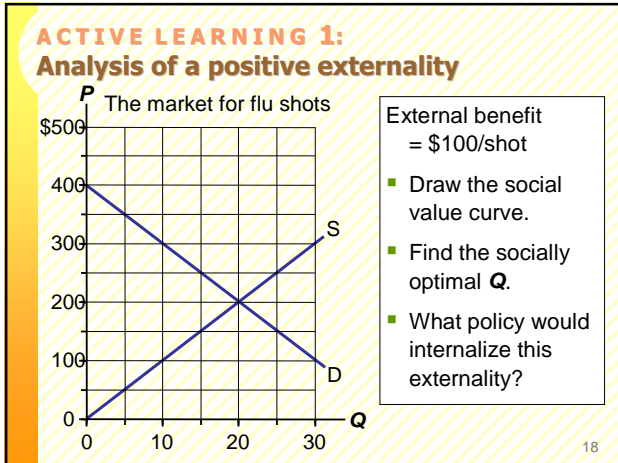
(Imposing the tax on buyers would achieve the same outcome; market  $Q$  would equal optimal  $Q$ .)

CHAPTER 10 EXTERNALITIES 16

### Positive Externalities

- In the presence of a positive externality, the **social value** of a good includes
  - **private value** – the direct value to buyers
  - **external benefit** – the value of the positive impact on bystanders
- The socially optimal  $Q$  maximizes welfare:
  - At any lower  $Q$ , the social value of additional units exceeds their cost.
  - At any higher  $Q$ , the cost of the last unit exceeds its social value.

CHAPTER 10 EXTERNALITIES 17



**Effects of Externalities: Summary**

If negative externality

- market quantity larger than socially desirable

If positive externality

- market quantity smaller than socially desirable

To remedy the problem, “internalize the externality”

- tax goods with negative externalities
- subsidize goods with positive externalities

CHAPTER 10 EXTERNALITIES 20

**Private Solutions to Externalities**

Types of private solutions:

- moral codes and social sanctions, e.g., the “Golden Rule”
- charities, e.g., the Sierra Club
- contracts between market participants and the affected bystanders

CHAPTER 10 EXTERNALITIES 21

**Private Solutions to Externalities**

- The Coase theorem:**  
If private parties can costlessly bargain over the allocation of resources, they can solve the externalities problem on their own.

CHAPTER 10 EXTERNALITIES 22


**The Coase Theorem: An Example**

Dick owns a dog named Spot.

Negative externality:  
Spot’s barking disturbs Jane, Dick’s neighbor.

The socially efficient outcome maximizes Dick’s + Jane’s well-being.

- If Dick values having Spot more than Jane values peace & quiet, the dog should stay.



See Spot bark.

*Coase theorem: The private market will reach the efficient outcome on its own...*

CHAPTER 10 EXTERNALITIES 23

### The Coase Theorem: An Example

- CASE 1:  
Dick has the right to keep Spot.  
Benefit to Dick of having Spot = \$500  
Cost to Jane of Spot's barking = \$800
- Socially efficient outcome:  
Spot goes bye-bye.
- Private outcome:  
Jane pays Dick \$600 to get rid of Spot,  
both Jane and Dick are better off.
- Private outcome = efficient outcome.

### The Coase Theorem: An Example

- CASE 2:  
Dick has the right to keep Spot.  
Benefit to Dick of having Spot = \$1000  
Cost to Jane of Spot's barking = \$800
- Socially efficient outcome:  
See Spot stay.
- Private outcome:  
Jane not willing to pay more than \$800,  
Dick not willing to accept less than \$1000,  
so Spot stays.
- Private outcome = efficient outcome.

### The Coase Theorem: An Example

- CASE 3:  
Jane has the legal right to peace & quiet.  
Benefit to Dick of having Spot = \$800  
Cost to Jane of Spot's barking = \$500
- Socially efficient outcome: Dick keeps Spot.
- Private outcome: Dick pays Jane \$600 to put up with Spot's barking.
- Private outcome = efficient outcome.

***The private market achieves the efficient outcome regardless of the initial distribution of rights.***

### ACTIVE LEARNING 2: Brainstorming

Collectively, the 1000 residents of Green Valley value swimming in Blue Lake at \$1,000,000.

A nearby factory pollutes the lake water, and would have to pay \$500,000 for non-polluting equipment.

- A. Describe a Coase-like private solution.
- B. Can you think of any reasons why this solution might not work in the real world?

### Why Private Solutions Do Not Always Work

1. **Transaction costs:**  
The costs parties incur in the process of agreeing to and following through on a bargain. These costs may make it impossible to reach a mutually beneficial agreement.
2. **Stubbornness:**  
Even if a beneficial agreement is possible, each party may hold out for a better deal.
3. **Coordination problems:**  
If # of parties is very large, coordinating them may be costly, difficult, or impossible.

### Public Policies Toward Externalities

Two approaches

- **Command-and-control policies**  
regulate behavior directly. Examples:
  - limits on quantity of pollution emitted
  - requirements that firms adopt a particular technology to reduce emissions
- **Market-based policies**  
provide incentives so that private decision-makers will choose to solve the problem on their own.

### Market-Based Policy #1: Corrective Taxes & Subsidies

- **Corrective tax:** a tax designed to induce private decision-makers to take account of the social costs that arise from a negative externality
- Also called **Pigouvian taxes** after Arthur Pigou (1877-1959).
- The ideal corrective tax = external cost
- For activities with positive externalities, ideal corrective subsidy = external benefit

### Market-Based Policy #1: Corrective Taxes & Subsidies

- Example:  
Acme, US Electric run coal-burning power plants. Each emits 40 tons of sulfur dioxide per month. SO<sub>2</sub> causes acid rain & other health issues.
- Policy goal: reducing SO<sub>2</sub> emissions 25%
- Policy options
  - regulation:  
require each plant to cut emissions by 25%
  - corrective tax:  
Make each plant pay a tax on each ton of SO<sub>2</sub> emissions. Set tax at level that achieves goal.

### Market-Based Policy #1: Corrective Taxes & Subsidies

- Suppose cost of reducing emissions is lower for Acme than for US Electric.
- Socially efficient outcome: Acme reduces emissions more than US Electric.
- The corrective tax is a price on the right to pollute.
- Like other prices, the tax allocates this “good” to the firms who value it most highly (US Electric).

### Market-Based Policy #1: Corrective Taxes & Subsidies

- Under regulation, firms have no incentive to reduce emissions beyond the 25% target.
- A tax on emissions gives firms incentive to continue reducing emissions as long as the cost of doing so is less than the tax.
- If a cleaner technology becomes available, the tax gives firms an incentive to adopt it.

### Market-Based Policy #1: Corrective Taxes & Subsidies

- Other taxes distort incentives and move economy away from the social optimum.
- But corrective taxes enhance efficiency by aligning private with social incentives.

### Example of a Corrective Tax: The Gas Tax

The gas tax targets three negative externalities:

- congestion  
the more you drive, the more you contribute to congestion
- accidents  
larger vehicles cause more damage in an accident
- pollution  
burning fossil fuels produces greenhouse gases

### ACTIVE LEARNING 3: Discussion question

Policy goal:

Reducing gasoline consumption

Two approaches:

- A. Enact regulations requiring automakers to produce more fuel-efficient vehicles
- B. Significantly raise the gas tax

Discuss the merits of each approach. Which do you think would achieve the goal at lower cost? Who do you think would support or oppose each approach?

36

### Market-Based Policy #2: Tradable Pollution Permits

- Recall: Acme, US Electric each emit 40 tons SO<sub>2</sub>, total of 80 tons.
- Goal: reduce emissions 25% (to 60 tons/month)
- Suppose cost of reducing emissions is \$100/ton for Acme, \$200/ton for US Electric.
- If regulation requires each firm to reduce 10 tons,  
cost to Acme: (10 tons) x (\$100/ton) = \$1,000  
cost to USE: (10 tons) x (\$200/ton) = \$2,000  
total cost of achieving goal = **\$3,000**

CHAPTER 10 EXTERNALITIES

37

### Market-Based Policy #2: Tradable Pollution Permits

- Alternative:
  - issue 60 permits, each allows its bearer one ton of SO<sub>2</sub> emissions (so total emissions = 60 tons)
  - give 30 permits to each firm
  - establish market for trading permits
- Each firm can choose among these options:
  - emit 30 tons of SO<sub>2</sub>, using all its permits
  - emit < 30 tons, sell unused permits
  - buy additional permits so it can emit > 30 tons

CHAPTER 10 EXTERNALITIES

38

### Market-Based Policy #2: Tradable Pollution Permits

Suppose market price of permit = \$150

One possible equilibrium:

Acme

- spends \$2,000 to cut emissions by 20 tons
- has 10 unused permits, sells them for \$1,500
- net cost to Acme: \$500

US Electric

- emissions remain at 40 tons
- buys 10 permits from Acme for \$1,500
- net cost to USE: \$1,500

Total cost of achieving goal: **\$2,000**

CHAPTER 10 EXTERNALITIES

39

### Market-Based Policy #2: Tradable Pollution Permits

- A system of tradable pollution permits achieves goal at lower cost than regulation.
  - Firms with low cost of reducing pollution sell whatever permits they can.
  - Firms with high cost of reducing pollution buy permits.
- Result: Pollution reduction is concentrated among those firms with lowest costs.

CHAPTER 10 EXTERNALITIES

40

### Tradable Pollution Permits in the Real World

- SO<sub>2</sub> permits traded in the U.S. since 1995.
- Nitrogen oxide permits traded in the northeastern U.S. since 1999.
- Carbon emissions permits traded in Europe since January 1, 2005.


CHAPTER 10 EXTERNALITIES

41

### Corrective Taxes vs. Tradable Pollution Permits

- Like most demand curves, firms' demand for the ability to pollute is a downward-sloping function of the "price" of polluting.
  - A corrective tax raises this price and thus reduces the quantity of pollution firms demand.
  - A tradable permits system restricts the supply of pollution rights, has the same effect as the tax.
- When policymakers do not know the position of this demand curve, the permits system achieves pollution reduction targets more precisely.

### Objections to the Economic Analysis of Pollution

- Some politicians, many environmentalists argue that no one should be able to "buy" the right to pollute, cannot put a price on the environment.
- However, *people face tradeoffs*. 
- The value of clean air & water must be compared to their cost.
- The market-based approach reduces the cost of environmental protection, so it should increase the public's demand for a clean environment.

### CHAPTER SUMMARY

- An externality occurs when a market transaction affects a third party. If the transaction yields negative externalities (e.g., pollution), the market quantity exceeds the socially optimal quantity. If the externality is positive (e.g., technology spillovers), the market quantity falls short of the social optimum.

### CHAPTER SUMMARY

- Sometimes, people can solve externalities on their own. The Coase theorem states that the private market can reach the socially optimal allocation of resources as long as people can bargain without cost. In practice, bargaining is often costly or difficult, and the Coase theorem does not apply.

### CHAPTER SUMMARY

- The government can attempt to remedy the problem. It can internalize the externality using corrective taxes. It can issue permits to polluters and establish a market where permits can be traded. Such policies often protect the environment at a lower cost to society than direct regulation.

## Externalities

- Social Cost/Benefit  $\neq$  Private Cost/Benefit
- Private Solutions: Coase Theorem
- Market-based Solutions:
  - Corrective Taxes
  - Tradable Pollution Permits
- Homework: Mankiw, Ch.10, pp. 221-222, Problem 4, 5, 6, 8, 12.