Economics 1
Principles of Economics

Externalities
(Chapter 10)

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Look for the Answers to These Questions:

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

I. Introduction 1 of 3

Recall from Chapter 1:

- One of the Ten Principles from Chapter 1:
  - Markets are usually a good way to organize economy activity.
  - In absence of market failures, the competitive market outcome is efficient, maximizes total surplus.
- One type of market failure is an externality.
- Def: Externality = The uncompensated impact of one person's actions on the well-being of a bystander.
- Externalities can be negative or positive, depending on whether the impact on a bystander is adverse or beneficial.

I. Introduction 2 of 3

Definitions

- Def: Private Cost = A cost paid by the consumer or producer.
- Def: External Cost = A cost paid by people other than the consumer or the producer trading in the market.
- Def: Social Cost = The cost to everyone, the private cost plus the external cost.
- Def: Social Surplus = Consumer surplus + producer surplus + everyone else's surplus.
- Def: Efficient Equilibrium = The price and quantity that maximize social surplus.
- Def: Efficient Quantity = The quantity that maximizes social surplus.

I. Introduction 3 of 3

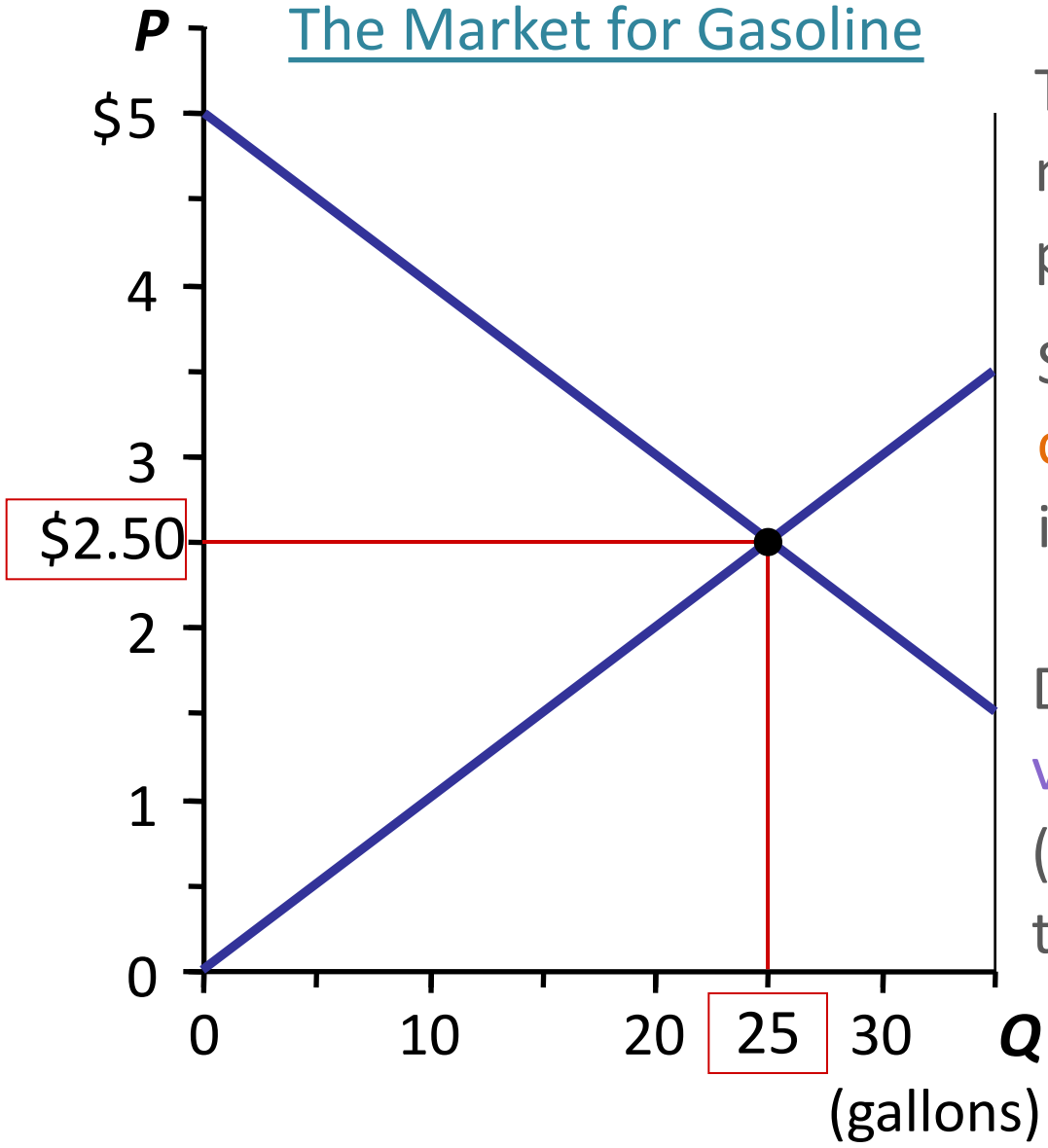
- Self-interested buyers and sellers neglect the external costs or benefits of their actions, so the market outcome is not efficient.
- Another principle from Chapter 1:
  - Governments can sometimes improve market outcomes.
- In presence of externalities, public policy can improve efficiency.

II. Negative Externality

Examples

- Air pollution from a factory.
- The neighbor's barking dog.
- Late-night stereo blasting from the dorm room next to yours.
- Noise pollution from construction projects.
- Health risk to others from second-hand smoke.
- Talking on cell phone while driving makes the roads less safe for others.

III. Negative Externality Example

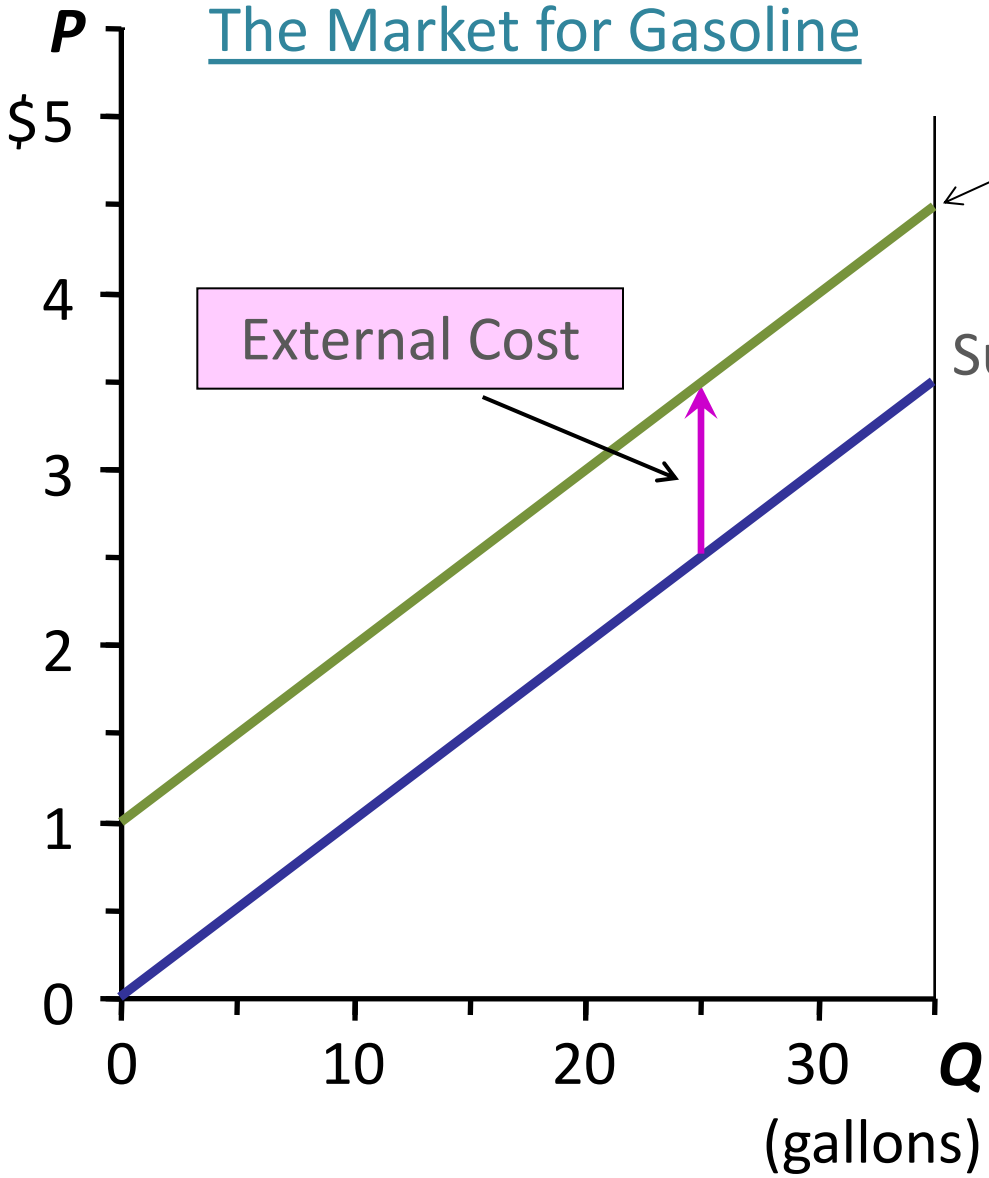


The market equilibrium maximizes consumer + producer surplus.

Supply curve shows private cost, the costs directly incurred by sellers.

Demand curve shows private value, the value to buyers (the prices they are willing to pay).

III. Negative Externality Example 2 of 8

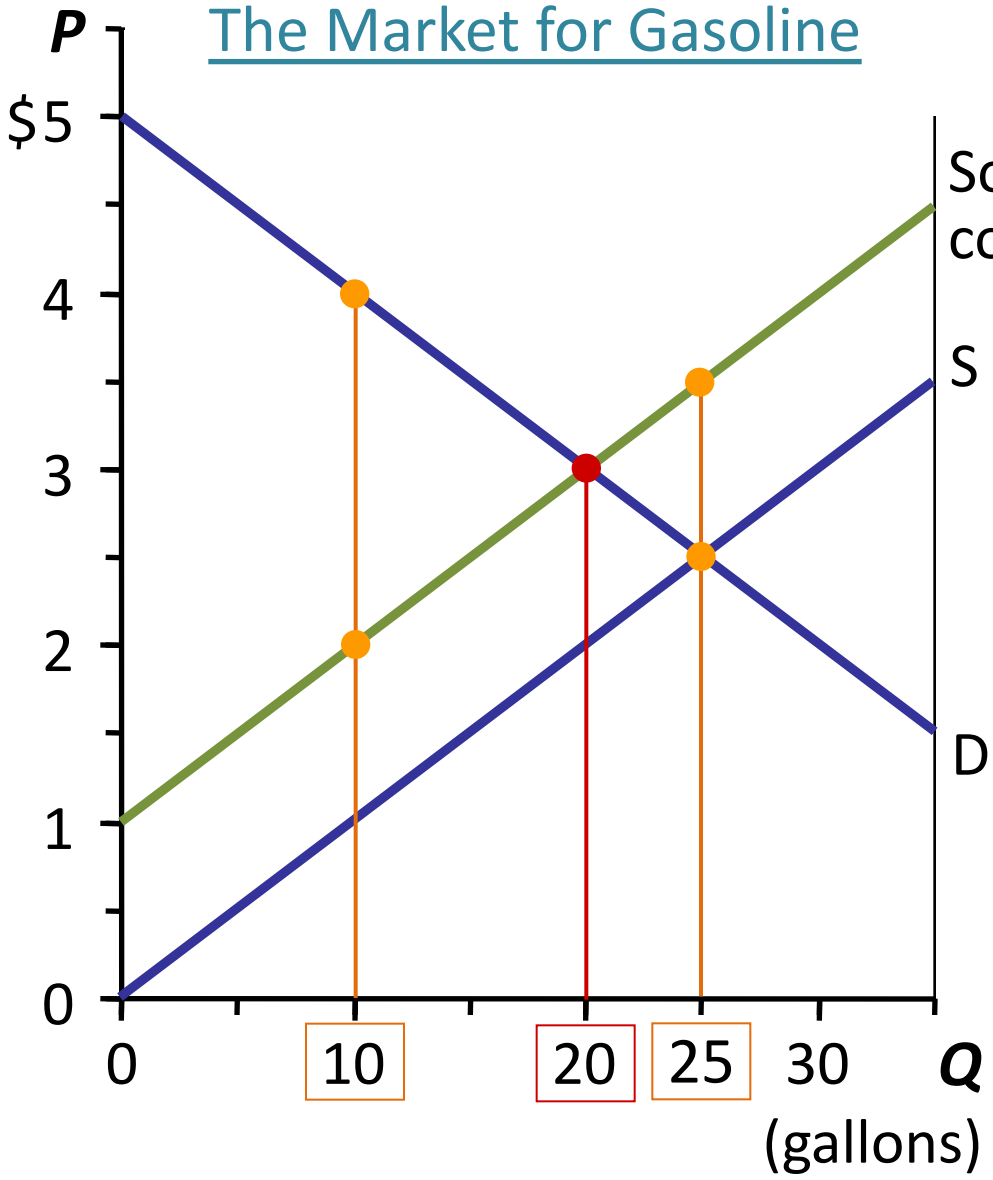


External cost

= value of the negative impact on bystanders.

= $1 per gallon (value of harm from smog greenhouse gases).

III. Negative Externality Example

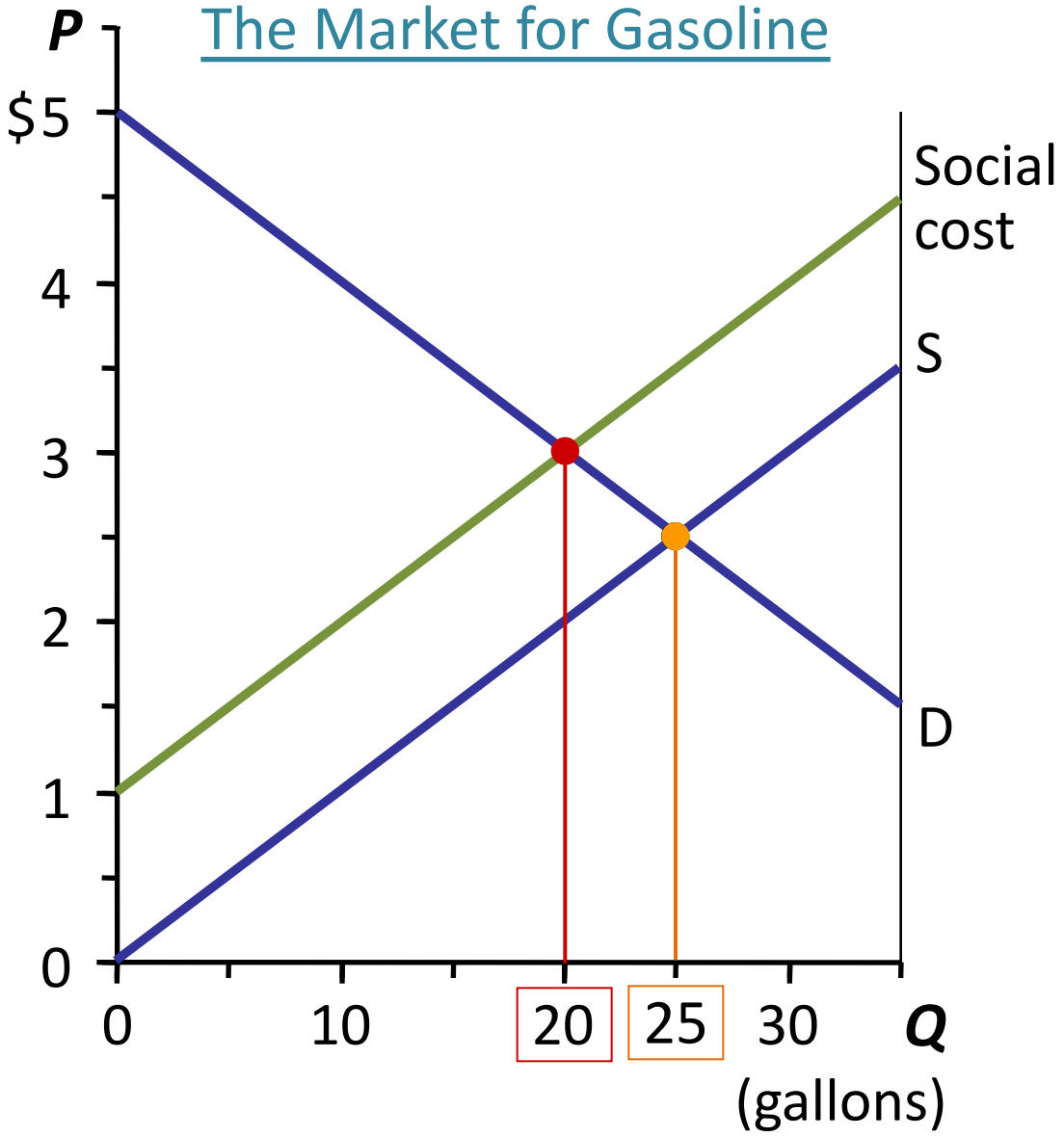


The socially optimal quantity is 20 gallons.

At any $Q < 20$, value of additional gas exceeds social cost.

At any $Q > 20$, social cost of the last gallon is greater than its value to society.

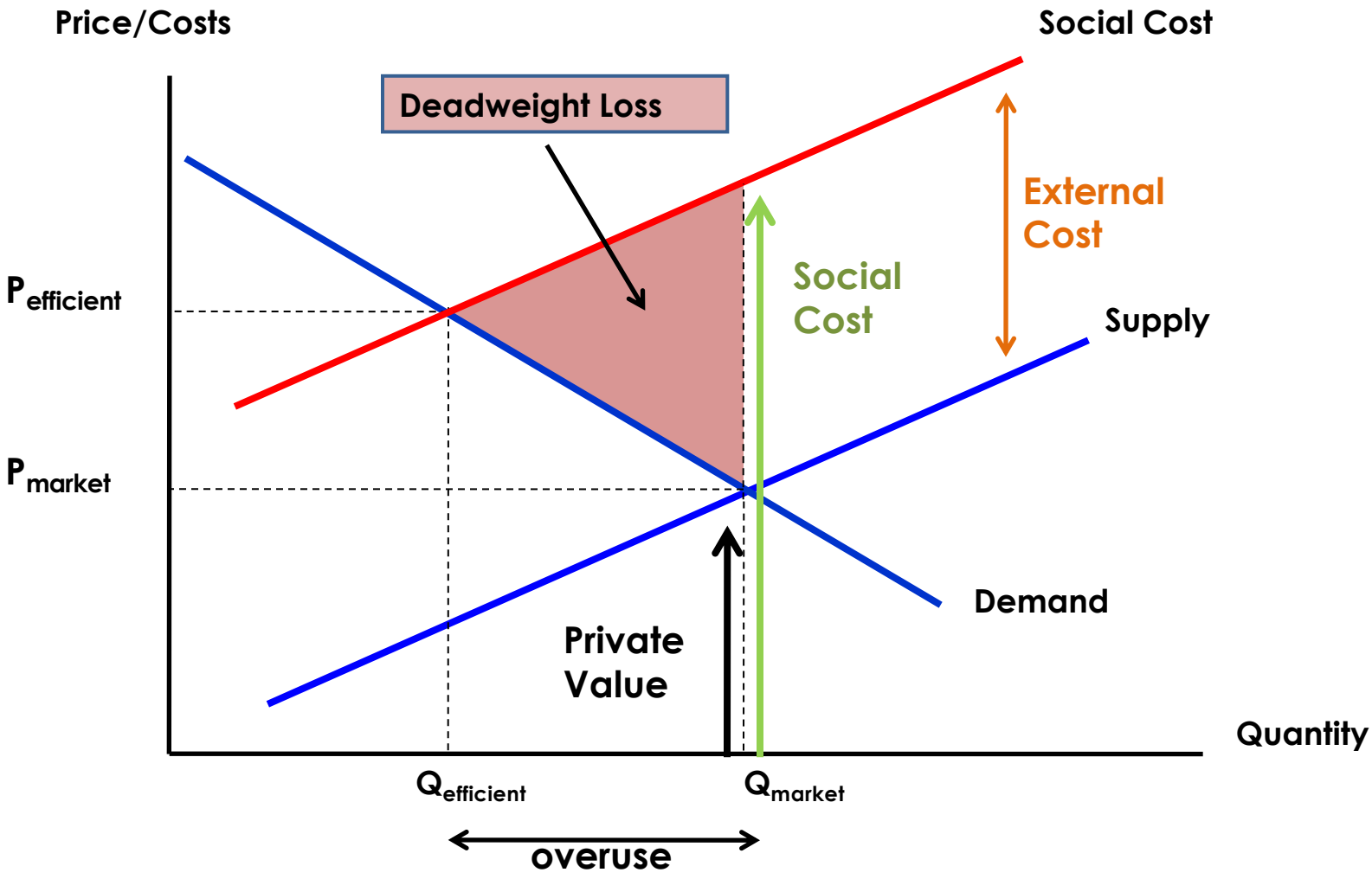
III. Negative Externality Example



Market equilibrium (***Q*** = 25) is greater than social optimum (***Q*** = 20).

One solution: tax sellers $1/gallon, would shift ***S*** curve up $1.

III. Negative Externality Example



III. Negative Externality Example

- When external costs are significant, output is too high.
  - Costs are underestimated: $Q_{Efficient} < Q_{Market}$.
  - At the higher market level of output, costs exceed the private benefits to buyers.
  - A deadweight loss emerges, reducing social surplus.

III. Negative Externality Example

- When external costs are ignored, the social surplus is reduced.
- In this case, reducing output below the market quantity increases social surplus.
- To maximize social surplus, output should be reduced to the socially efficient level.
  - For example, the government can tax sellers $1/gallon → shift the supply curve up by $1.

III. Negative Externality Example

- Def: Internalizing the Externality = Altering incentives so that people take account of the external effects of their actions.
- In our example, the $1/gallon tax on sellers makes sellers' costs = social costs.
- When market participants must pay social costs, market equilibrium = social optimum.
- Note: Imposing the tax on buyers would achieve the same outcome; market Q would equal optimal Q.

IV. Positive Externality 1 of 2

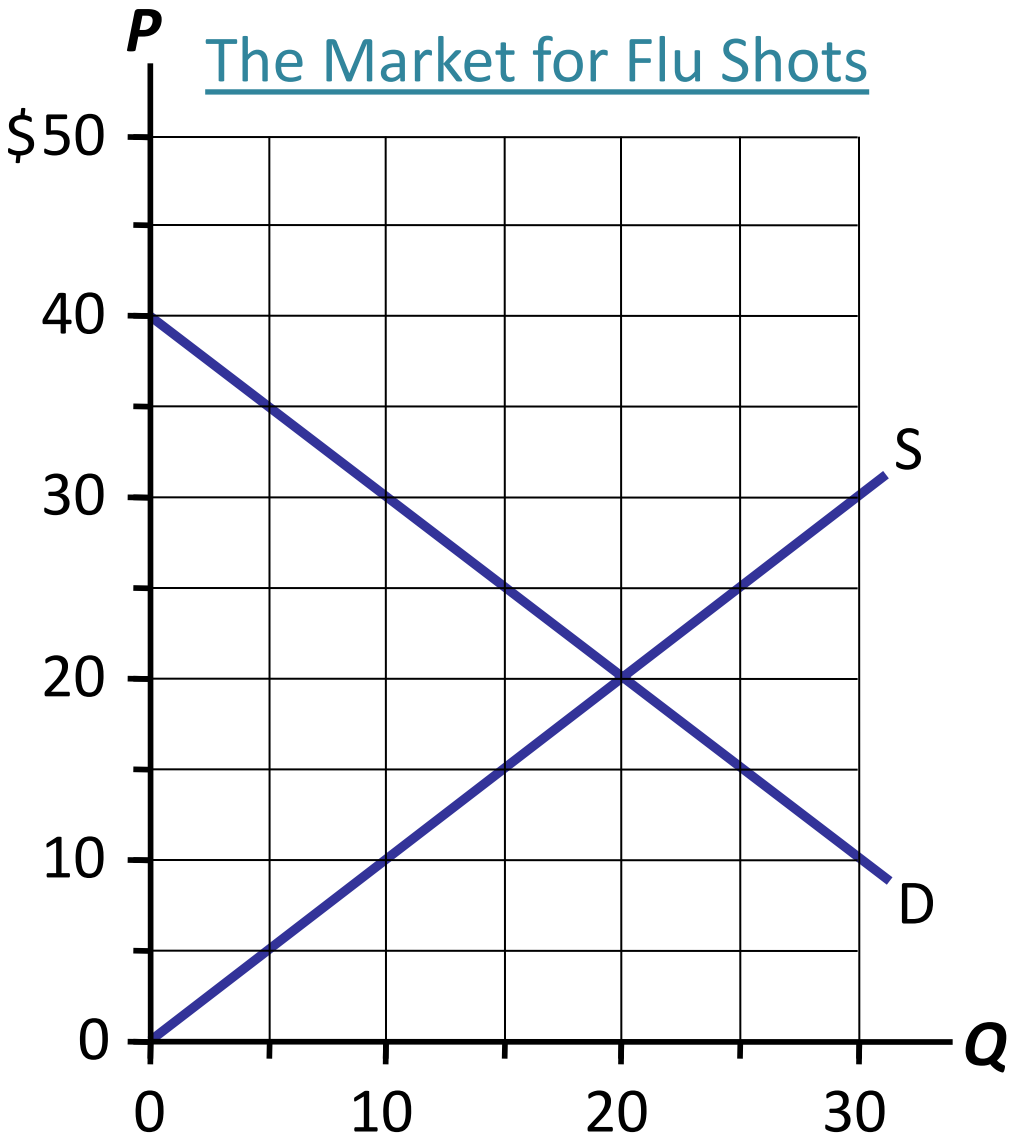
Examples

- 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.
- People going to college raise the population's education level, which reduces crime and improves government.

IV. Positive Externality 2 of 2

- 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.

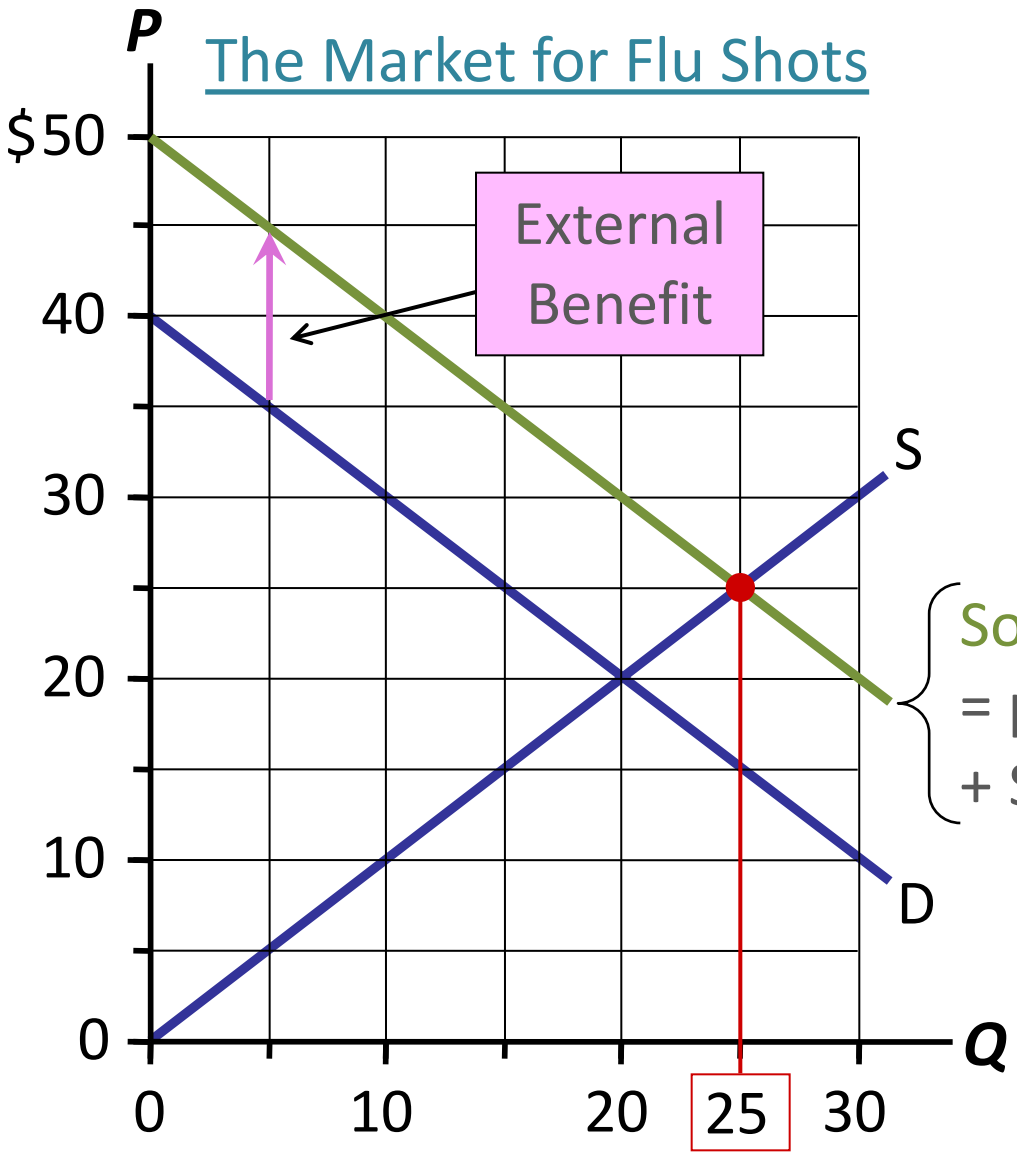
V. Positive Externality Example



External benefit
= $10/shot

- Draw the social value curve.
- Find the socially optimal *Q*.
- What policy would internalize this externality?

V. Positive Externality Example

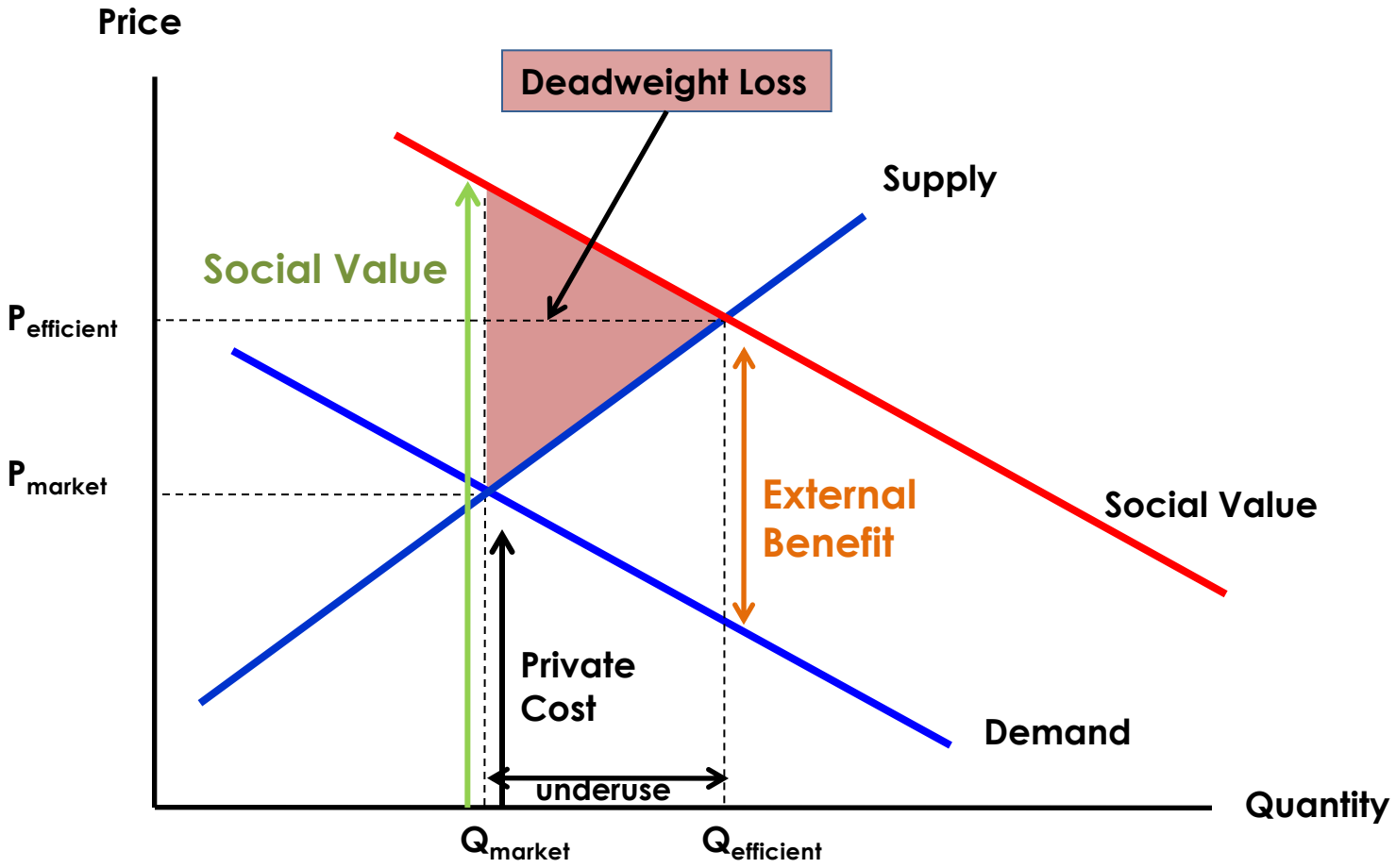


Socially optimal *Q* = 25 shots.

To internalize the externality, use subsidy = $10/shot.

Social value
= private value
+ $10 external benefit

V. Positive Externality Example 3 of 5



V. Positive Externality Example

- When external benefits are significant, output is too low.
  - Benefits are underestimated: $Q_{Efficient} > Q_{Market}$.
  - At the lower market level of output, total benefits exceed the private benefits to buyers.
  - A deadweight loss emerges, reducing social surplus.

V. Positive Externality Example

- When consumers and producers ignore external benefits, they base their decisions on private benefits only.
- In this case, increasing output above the market quantity increases social surplus.
- To maximize social surplus, output should be increased to the socially efficient level.
- In our example, the $10/shot subsidy for buyers

  → shift the demand curve up by $10.

VI. Effects of Externalities: Summary

- If it is a negative externality:
  - The market quantity is larger than socially desirable.
- If it is a positive externality:
  - The market quantity smaller than socially desirable.
- To remedy the problem, "internalize the externality".
  - Tax goods with negative externalities.
  - Subsidize goods with positive externalities.

VII. Corrective Taxes and Subsidies 1 of 2

Definitions

- Def: 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).
- Def: A Pigouvian Tax = a tax on a good with external costs (e.g., $1/gallon tax on gasoline).
  - The ideal corrective tax = external cost.
- Def: A Pigouvian Subsidy = a subsidy on a good with external benefits (e.g., $10/shot subsidy for flu shots).
  - For activities with positive externalities, ideal corrective subsidy = external benefit.

VII. Corrective Taxes and Subsidies 2 of 2

- Other taxes and subsidies distort incentives and move economy away from the social optimum.
- Corrective taxes & subsidies:
  - Align private incentives with society's interests
  - Make private decision-makers take into account the external costs and benefits of their actions
  - Move economy toward a more efficient allocation of resources

VIII. Corrective Taxes vs. Regulations 1 of 2

- Different firms have different costs of pollution abatement.
- Efficient outcome: Firms with the lowest abatement costs reduce pollution the most.
- A pollution tax is efficient:
  - Firms with low abatement costs will reduce pollution to reduce their tax burden.
  - Firms with high abatement costs have greater willingness to pay tax.
- In contrast, a regulation requiring all firms to reduce pollution by a specific amount is not efficient.

VIII. Corrective Taxes vs. Regulations

Corrective taxes are better for the environment:

- The corrective tax gives firms an incentive to continue reducing pollution 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.
- In contrast, firms have no incentive for further reduction beyond the level specified in a regulation.

IX. Solutions to Externality Problems

- When externalities are significant, the market equilibrium is no longer efficient.
- What can be done to resolve this problem?
  - Private Solutions
    1. The Coase Theorem
  - Government Solutions
    1. Taxes and Subsidies
    2. Command and Control
    3. Tradable Allowances

IX. Solutions to Externality Problems
Private Solutions 1 of 4

- In certain situations the private sector can resolve externalities.
- Solving problems requires time and effort.
- Def: Transaction Costs = All the costs necessary to reach an agreement.
- Types of Private Solutions:
  - Moral codes and social sanctions.
  - Charities.
  - Contracts between market participants and the affected bystanders.

IX. Solutions to Externality Problems

Private Solutions 2 of 4

The Coase Theorem

- If transaction costs are low and property rights are clearly defined, private bargains will ensure that the market equilibrium is efficient even when there are externalities.
- In other words: “if private parties can costlessly bargain over the allocation of resources, they can solve the externalities problem on their own.”

IX. Solutions to Externality Problems

Private Solutions 3 of 4

Example of The Coase Theorem

- Assume that collectively, the 1000 residents of Green Valley value swimming in Blue Lake at $100,000.
- A nearby factory pollutes the lake water, and would have to pay $50,000 for non-polluting equipment.
- Describe a Coase-like private solution.
- Solution: Each of the 1000 residents can pay $75, so the town can offer $75,000 to the factory to stop polluting.

IX. Solutions to Externality Problems

Private Solutions 4 of 4

Why Private Solutions Do Not Always Work

1. Transaction Costs:
   Transaction 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 the number of parties is very large, coordinating them may be costly, difficult, or impossible.

X. Solutions to Externality Problems
Government Solutions

1. Taxes and Subsidies

- Governments often use taxes and subsidies to resolve externalities.
  - If there are negative externalities, governments impose Pigouvian taxes to reduce the market quantity.
  - If there are positive externalities, governments offer Pigouvian subsidies to increase the market quantity.

X. Solutions to Externality Problems
Government Solutions

2. Command and Control

- The most direct approach for government to resolve externalities is to impose command and control regulation (regulate behavior directly).
  - If there are negative externalities, the government can mandate a lower quantity than the market level.
  - If there are positive externalities, the government can mandate a higher quantity than the market level.

X. Solutions to Externality Problems

Government Solutions

2. Command and Control

- Note: Command and control regulations do not always bring about an efficient solution…
  - Governments may not possess enough information for good policy.
  - Regulations do not provide buyers and sellers the flexibility to choose the least costly method of compliance.
- This approach makes sense for certain problems (like smallpox) but not all.

X. Solutions to Externality Problems
Government Solutions

3. Tradable Allowances (Market-based Policies)

- The government can address external costs by establishing a market for tradable allowances.
  - The government sets a maximum quantity and rations a portion of that level to players in the market.
  - Consumers and producers individually choose the best (least costly) approach to limit their quantity.
  - Example: Tradable pollution permits.

X. Solutions to Externality Problems

Government Solutions 5 of 14

Example: Tradable pollution permits.

- Acme and US Electric (USE) run coal-burning power plants. Each emits 40 tons of sulfur dioxide per month.
  Total emissions = 80 tons/month.
- Goal: Reduce SO_2 emissions 25%, to 60 tons/month
- Cost of reducing emissions:
  $100/ton for Acme, $200/ton for USE

X. Solutions to Externality Problems

Government Solutions

Example: Tradable pollution permits.

Policy Option 1 (Regulation):

- Every firm must cut its emissions 25% (10 tons).
- Compute the cost to each firm and total cost of achieving goal using this policy.
  - Cost to Acme: (10 tons) x ($100/ton) = $1000
  - Cost to USE: (10 tons) x ($200/ton) = $2000
  - Total cost of achieving goal = $3000

X. Solutions to Externality Problems

Government Solutions 7 of 14

Example: Tradable pollution permits.

Policy Option 2 (Tradable pollution permits):

- Issue 60 permits, each allows one ton of SO_2 emissions. Give 30 permits to each firm.
  - Establish market for trading permits.
- Each firm may use all its permits to emit 30 tons, may emit < 30 tons and sell leftover permits, or may purchase extra permits to emit > 30 tons.
- Compute the cost of achieving goal if Acme uses 20 permits and sells 10 to USE for $150 each.

X. Solutions to Externality Problems

Government Solutions 8 of 14

Example: Tradable pollution permits.

Policy Option 2 (Tradable pollution permits):

Acme:

- sells 10 permits to USE for $150 each, gets $1500
- uses 20 permits, emits 20 tons SO_2
- spends $2000 to reduce emissions by 20 tons
- net cost to Acme: $2000 – $1500 = $500

USE:

- buys 10 permits from Acme, spends $1500
- uses these 10 plus original 30 permits, emits 40 tons
- spends nothing on abatement
- net cost to USE = $1500

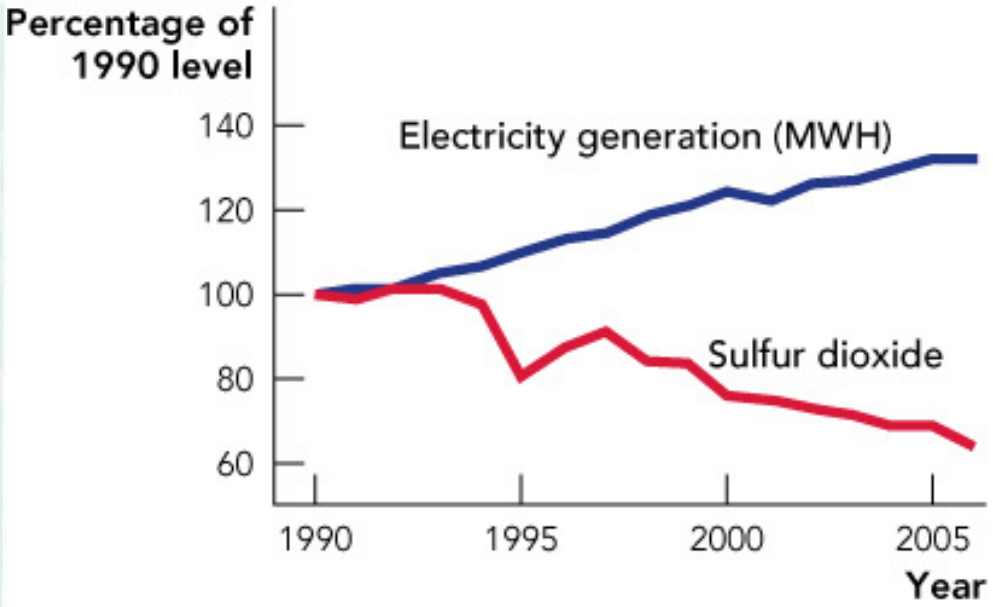
Total cost of achieving goal = $500 + $1500 = $2000

X. Solutions to Externality Problems

Government Solutions

Example: Tradable pollution permits.

Policy Option 2 (Tradable pollution permits):



Since the 1990 Clean Air Act, Electricity Generation has Increased and Sulfur Dioxide Emissions Have Decreased

X. Solutions to Externality Problems

Government Solutions 10 of 14

Example: Tradable pollution permits.

Policy Option 2 (Tradable pollution permits):

- Using tradable permits, the goal is achieved at lower total cost and lower cost to each firm than using regulation.
- Firms with low cost of reducing pollution do so and sell their unused permits.
- Firms with high cost of reducing pollution buy permits.
- Result: Pollution reduction is concentrated among those firms with lowest costs.

X. Solutions to Externality Problems
Government Solutions

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.

X. Solutions to Externality Problems

Government Solutions

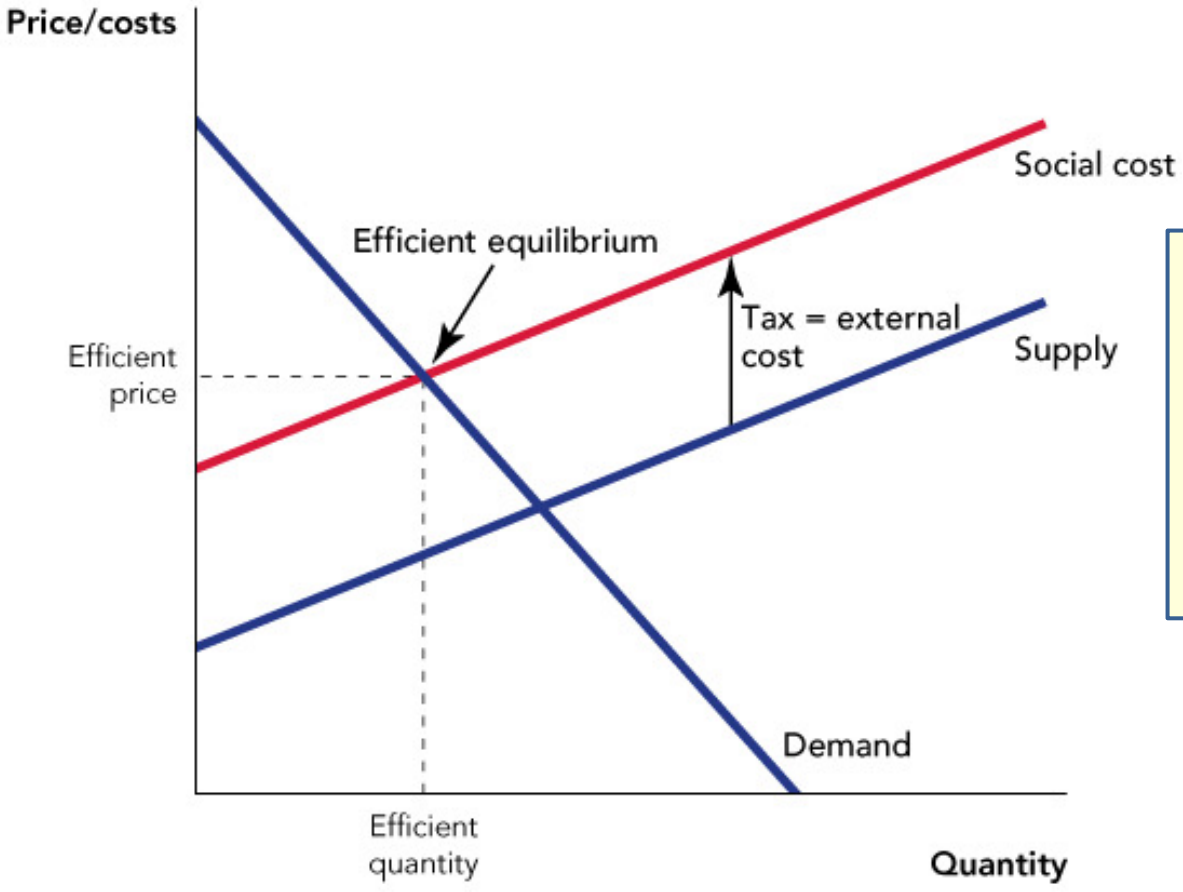
Corrective Taxes vs. Tradable Pollution Permits

- There is a close relationship between using taxes and tradable allowances to internalize externalities.
  - A tax set equal to the level of the external cost is equivalent to tradable allowances when the number of allowances is set equal to the efficient quantity.
- Buyers and sellers have much more flexibility about how to cut cost.
- There are strong incentives for buyers and sellers to reduce quantity since the allowances are tradable.

X. Solutions to Externality Problems

Government Solutions

Corrective Taxes vs. Tradable Pollution Permits



With perfect information, a Pigouvian tax would be identical to tradable allowances in effect.

X. Solutions to Externality Problems
Government Solutions

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 and 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.