PRINCIPLES OF MICROECONOMICS 2e

Chapter 12 Environmental Protection and Negative Externalities

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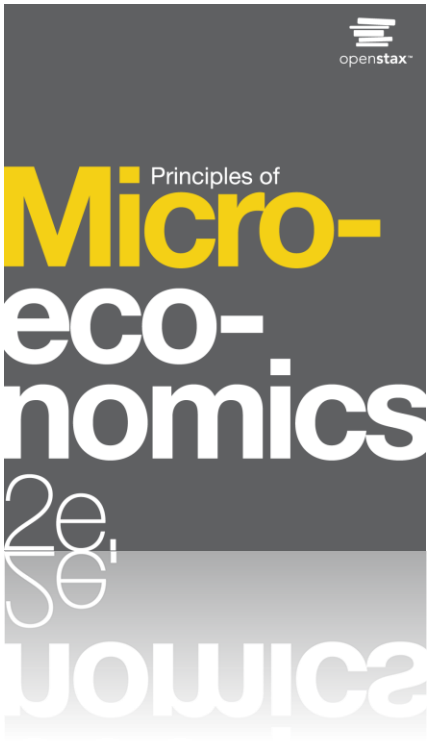

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Environmental Debate

Across the country, countless people have protested, even risking arrest, against the Keystone XL Pipeline.

(Credit: modification of image by “NoKXL”/Flickr Creative Commons)

12.1 The Economics of Pollution

- Since the 1970s the United States, using a variety of anti-pollution policies, has made genuine progress against a number of pollutants.

- Despite the gradual reduction in emissions from fossil fuels, many important environmental issues remain.

- Along with the still high levels of air and water pollution, other issues include:
  - hazardous waste disposal,
  - destruction of wetlands and other wildlife habitats,
  - and the impact on human health from pollution.

Externalities

- The effect of a market exchange on a third party who is outside or “external” to the exchange is called an **externality** or **spillover**.

- Externalities can be negative or positive.

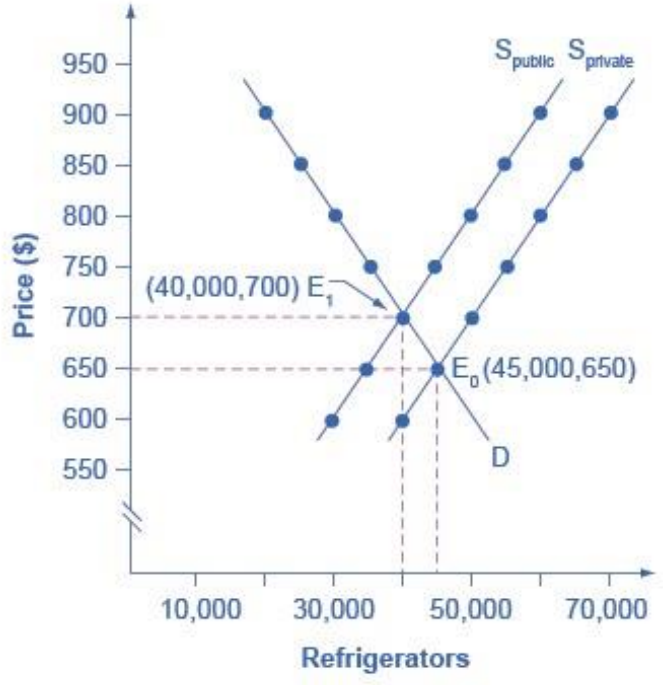
  - **Negative externality** - a situation where a third party, outside the transaction, suffers from a market transaction by others.

  - **Positive externality** - a situation where a third party, outside the transaction, benefits from a market transaction by others.

Pollution as a Negative Externality

- Pollution is a negative externality.
- **Additional external costs** - additional costs incurred by third parties outside the production process when a unit of output is produced.
- **Social costs** - costs that include both the private costs incurred by firms and also additional costs incurred by third parties outside the production process.

Taking Social Costs into Account: A Supply Shift



- If the firm takes only its own costs of production into account, then its supply curve will be $S_{private}$, and the market equilibrium will occur at E_0.
- Accounting for additional external costs of $100 for every unit produced, the firm's supply curve will be S_{social}. The new equilibrium will occur at E_1.

Market Failure

- **Market failure** - when the market, on its own, does not allocate resources efficiently in a way that balances social costs and benefits; externalities are one example of a market failure.

- If firms were required to pay the social costs of pollution, they would create less pollution but produce less of the product and charge a higher price.

12.2 Command-and-Control Regulation

- **Command-and-control regulation** - laws that specify allowable quantities of pollution and that also may detail which pollution-control technologies one must use.

- Requires that firms increase their costs by installing anti-pollution equipment.

- Thus, firms are required to account for the social costs of pollution in deciding how much *output* to produce.

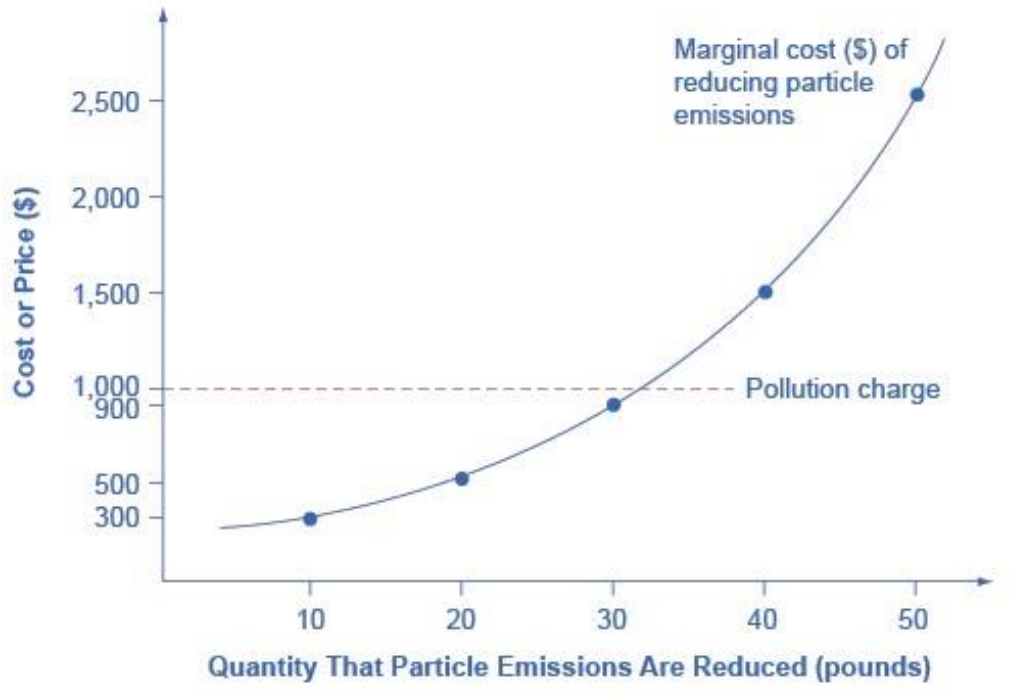
Difficulties with command-and-control environmental regulation

- 3 difficulties with command-and-control environmental regulation:
  - Regulation offers no incentive to improve the quality of the environment beyond the standard set by a particular law.
    - No incentive to do better.
  - Inflexible.
    - Requires the same standard for all polluters, and often the same pollution-control technology as well.
  - Subject to compromises in the political process.
    - Full of fine print, loopholes, and exceptions.

12.3 Market-Oriented Environmental Tools

- **Pollution charge** - tax imposed on the quantity of pollution that a firm emits.
  - Gives a profit-maximizing firm an incentive to determine the least expensive technologies for reducing pollution.
  - Firms that can reduce pollution cheaply and easily will do so to minimize their pollution taxes.

A Pollution Charge Example



- If a pollution charge is set equal to $1,000, then the firm will have an incentive to reduce pollution by 30 pounds,
- Because the $900 cost of these reductions would be less than the cost of paying the pollution charge.

Marketable Permits

- **Marketable permit program** (e.g. cap-and-trade) - a permit that allows a firm to emit a certain amount of pollution.

- Firms with more permits than pollution can sell the remaining permits to other firms

12.4 The Benefits and Costs of U.S. Environmental Laws

- Benefits of a cleaner environment:

  (1) people may stay healthier and live longer;

  (2) certain industries that rely on clean air and water, such as farming, fishing, and tourism, may benefit;

  (3) property values may be higher;

  (4) people may simply enjoy a cleaner environment in a way that does not need to involve a market transaction.

Marginal Benefits and Marginal Costs

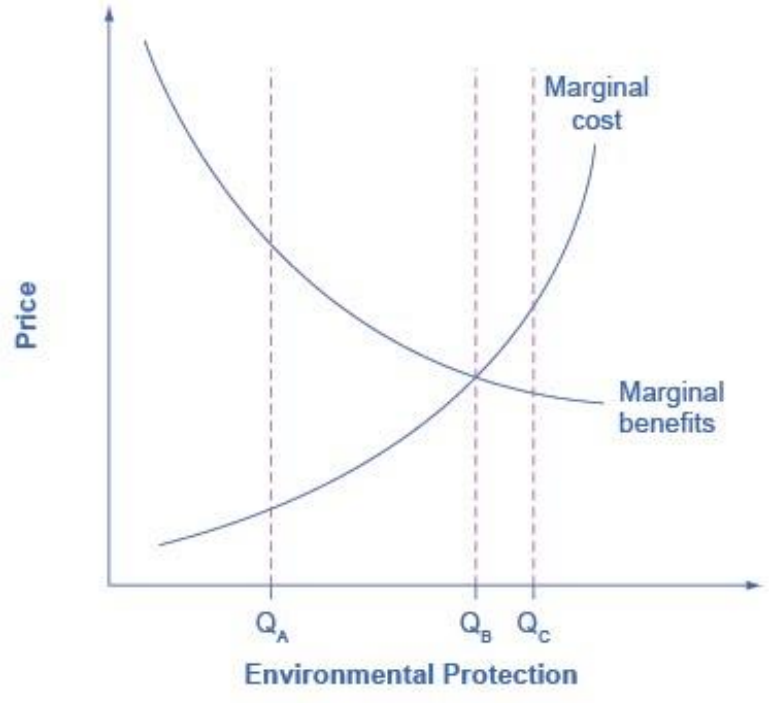
- Tools of marginal analysis can be used to illustrate the marginal costs and the marginal benefits of reducing pollution.

- Reducing pollution is costly - resources must be sacrificed.

- The marginal costs of reducing pollution are generally increasing,
  - The least expensive and easiest reductions can be made first, leaving the more expensive methods for later.

- The marginal benefits of reducing pollution are generally declining,
  - The steps that provide the greatest benefit can be taken first, and steps that provide less benefit can wait until later.

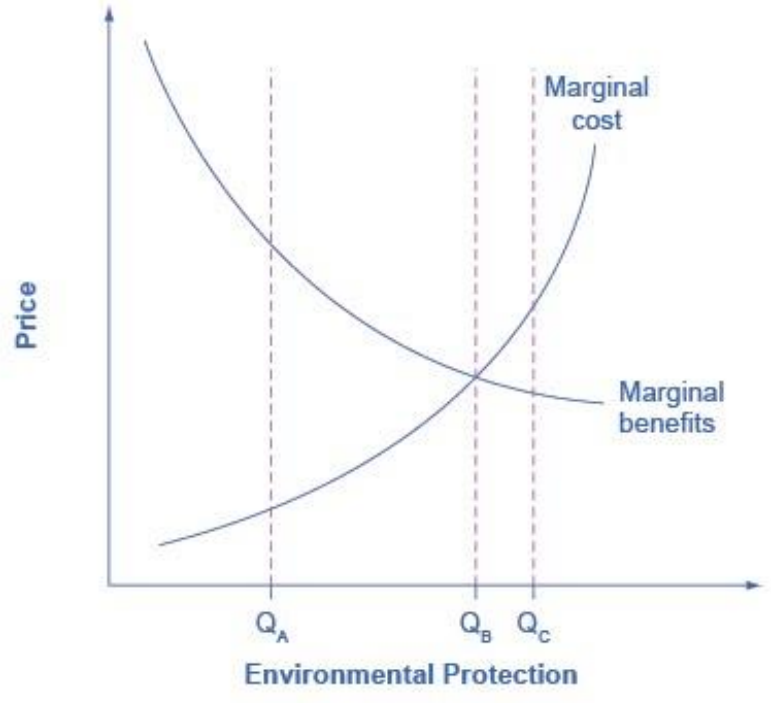
Marginal Costs and Marginal Benefits of Environmental Protection



- When the quantity of environmental protection is low:
  - Pollution is extensive (Q_A),
  - There are cheap and easy ways to reduce pollution.
  - So, the marginal benefits of doing so are quite high.

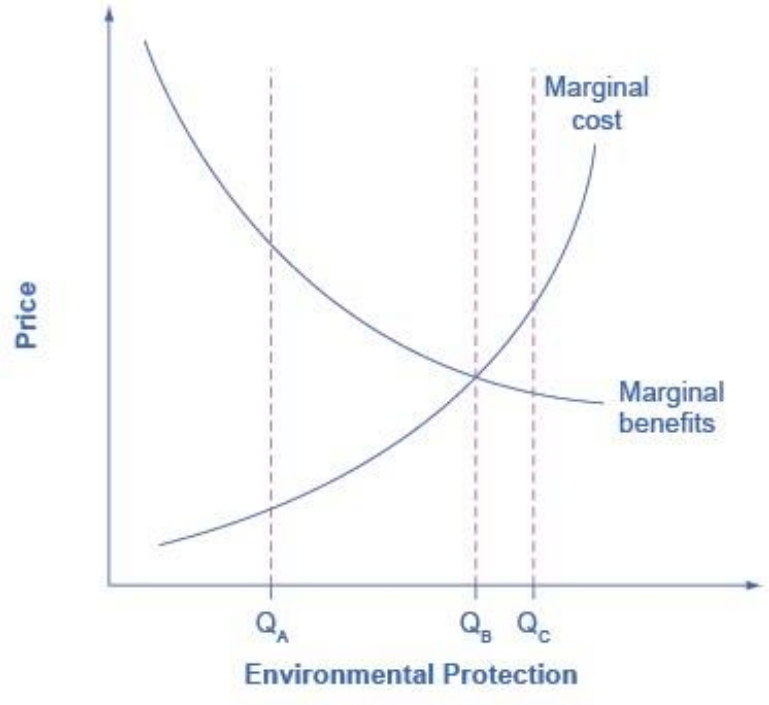
- At Q_A, it makes sense to allocate more resources to fight pollution.

Marginal Costs and Marginal Benefits of Environmental Protection, Continued



- As the environmental protection increases:
  - the cheap and easy ways of reducing pollution begin to decrease, and one must use more costly methods.
  - the marginal cost curve rises.
  - the largest marginal benefits happen first, followed by reduced marginal benefits.

Marginal Costs and Marginal Benefits of Environmental Protection, Continued



- As the quantity of environmental protection increases to Q_B, the gap between marginal benefits and marginal costs narrows.
- At point Q_C the marginal costs > marginal benefits.
- At this level of environmental protection, society is not allocating resources efficiently.
  - It may be forfeiting too many resources to reduce pollution.

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Chapter 13 Positive Externalities and Public Goods

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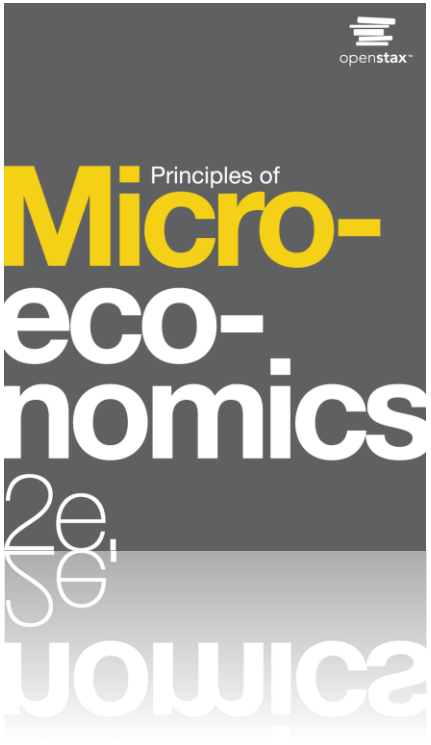

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CH.13 OUTLINE

13.1: Why the Private Sector Underinvests in Innovation

13.2: How Governments Can Encourage Innovation

13.3: Public Goods

View from Voyager

- Launched by NASA in 1977, Voyager 1's primary mission was to provide detailed images of Jupiter, Saturn, and their moons.
- In August of 2012, Voyager I entered interstellar space—the first human-made object to do so—and it is expected to send data and images back to earth until 2025.
- Such a technological feat has a lot to do with economic principles.

(Credit: modification of work by NASA/JPL)

13.1 Why the Private Sector Underinvests in Innovation

- Market competition can provide an incentive for discovering new technology, because a firm can earn higher profits:
  - by finding a way to produce products more cheaply
  - by creating products with characteristics consumers want.

- In some cases competition can discourage new technology, especially when other firms can quickly copy a new idea.

- Studies by economists have found that the original inventor receives 1/3 to 1/2 of the total economic benefits from innovations, while other businesses and new product users receive the rest.

The Positive Externalities of New Technology

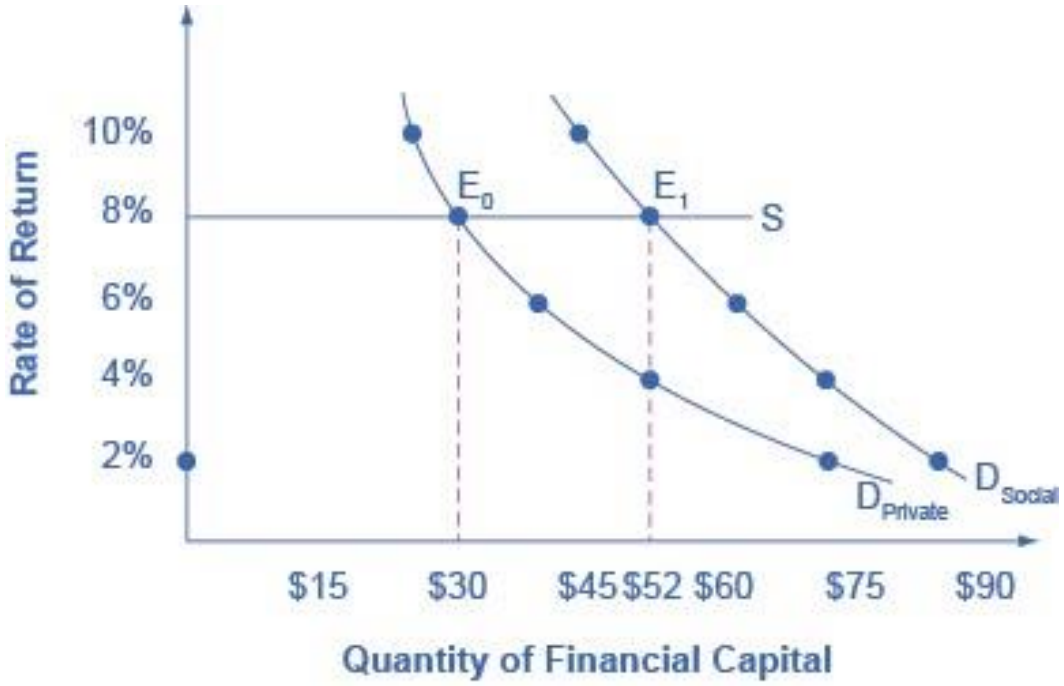
- **Private benefits** - the benefits a person who consumes a good or service receives, or a new product's benefits or process that a company invents that the company captures.

- **Social benefits** - the value of all the positive externalities of the new idea or product (whether enjoyed by other companies or society as a whole), as well as the private benefits the firm that developed the new technology receives.

= private benefits + external benefits

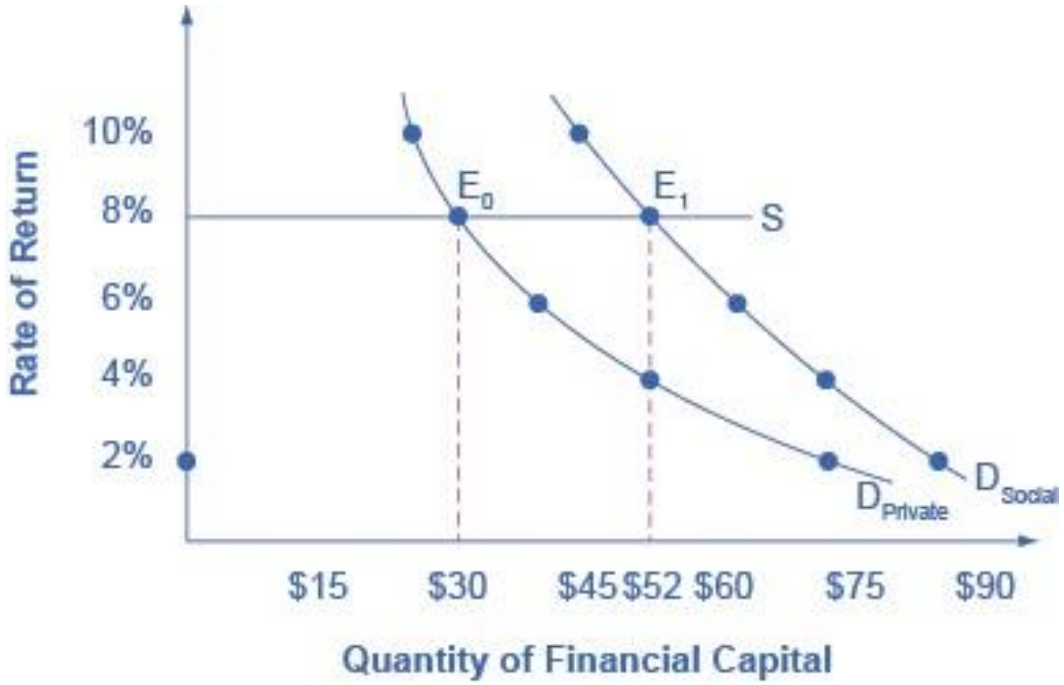
- **Positive externalities** or **benefits** - beneficial spillovers to a third party or parties.

Positive Externalities and Technology



- Big Drug faces a cost of borrowing of 8%.
- If the firm receives only the private benefits of investing in R&D, then we show its demand curve for financial capital by $D_{Private}$, and the equilibrium will occur at $30 million.
- Because there are spillover benefits, society would find it optimal to have $52 million of investment.

Positive Externalities and Technology, Continued



- If the firm could keep the social benefits of its investment for itself, its demand curve for financial capital would be D_{Social} and it would be willing to borrow $52 million. (The firm's private demand curve would be the same as society's demand curve.)

- But, unless there is a way for the company to fully enjoy the total benefits, then it will borrow less than the socially optimal level of $52 million.

Why Invest in Human Capital?

- The investment in education, or human capital, requires a certain upfront cost with an uncertain future benefit.
- The idea is that *higher* levels of educational attainment will eventually serve to *increase* the person's future productivity and subsequent ability to earn.
- Economists have found though several studies that the rate of return of a college education to that person, in the United States, is approximately 10-15%.
- **Private rates of return** - the estimated rates of return go primarily to an individual; for example, earning interest on a savings account.

Society Gains When People Learn

- Society also gains from investing in the education of another student.

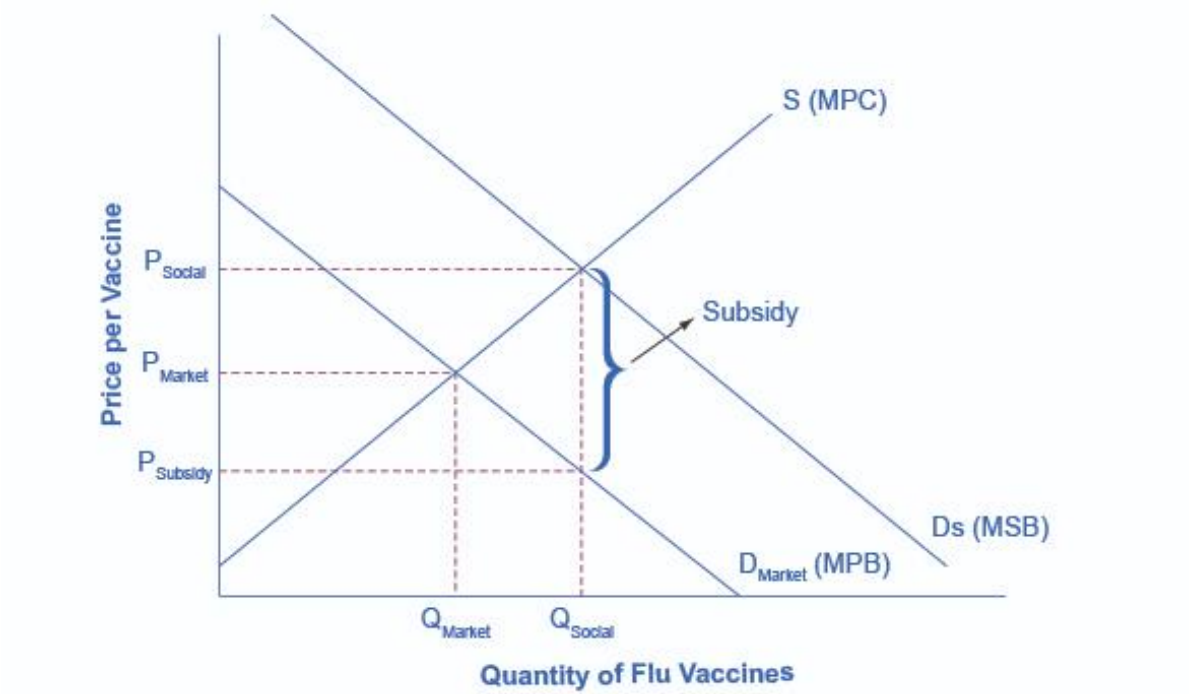
- The social rate of return on schooling is also positive:
  - better health outcomes for the population
  - lower levels of crime
  - a cleaner environment
  - a more stable, democratic government

- **Social rate of return** - when the estimated rates of return go primarily to society.

Positive Externalities Response

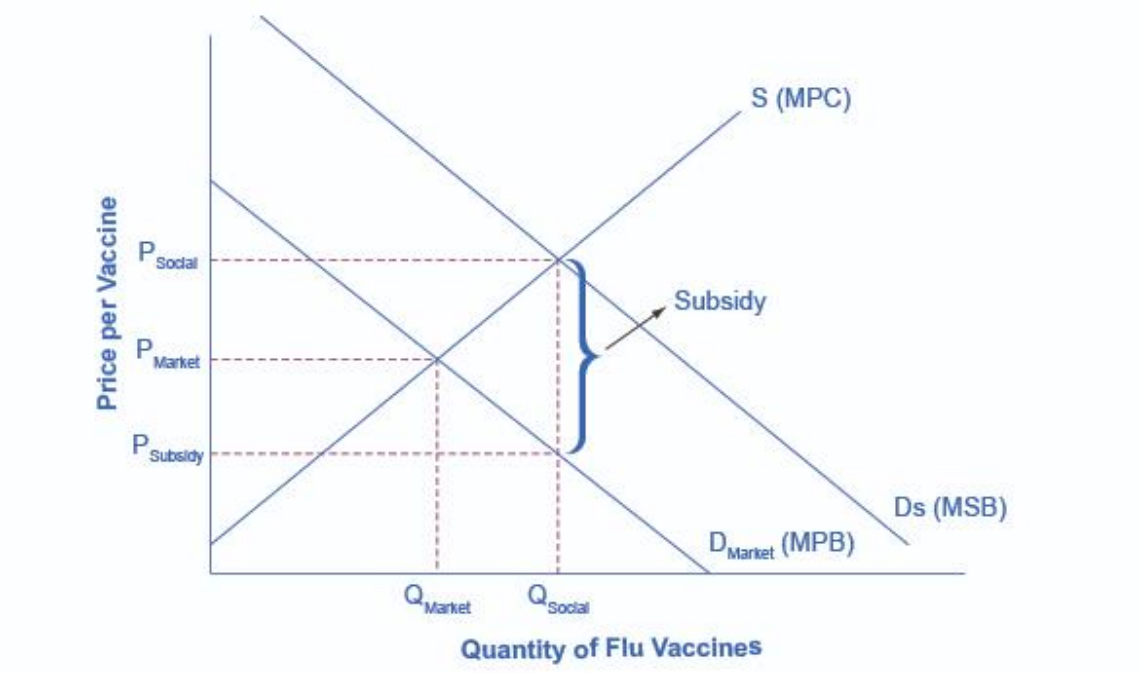
- The appropriate public policy response to a positive externality, like a new technology, is to help the party creating the positive externality receive a *greater share of the social benefits*.

The Market for Flu Shots with Spillover Benefits (A Positive Externality)



- The equilibrium quantity of flu shots produced in the market, where MPB = MPC, is Q_{Market} and the price of flu shots is P_{Market}.
- The market demand curve does not reflect the positive externality of flu vaccinations, so only Q_{Market} will be exchanged.
- This outcome is inefficient because the marginal social benefit *exceeds* the marginal social cost.

The Market for Flu Shots with Spillover Benefits (A Positive Externality), Cont.



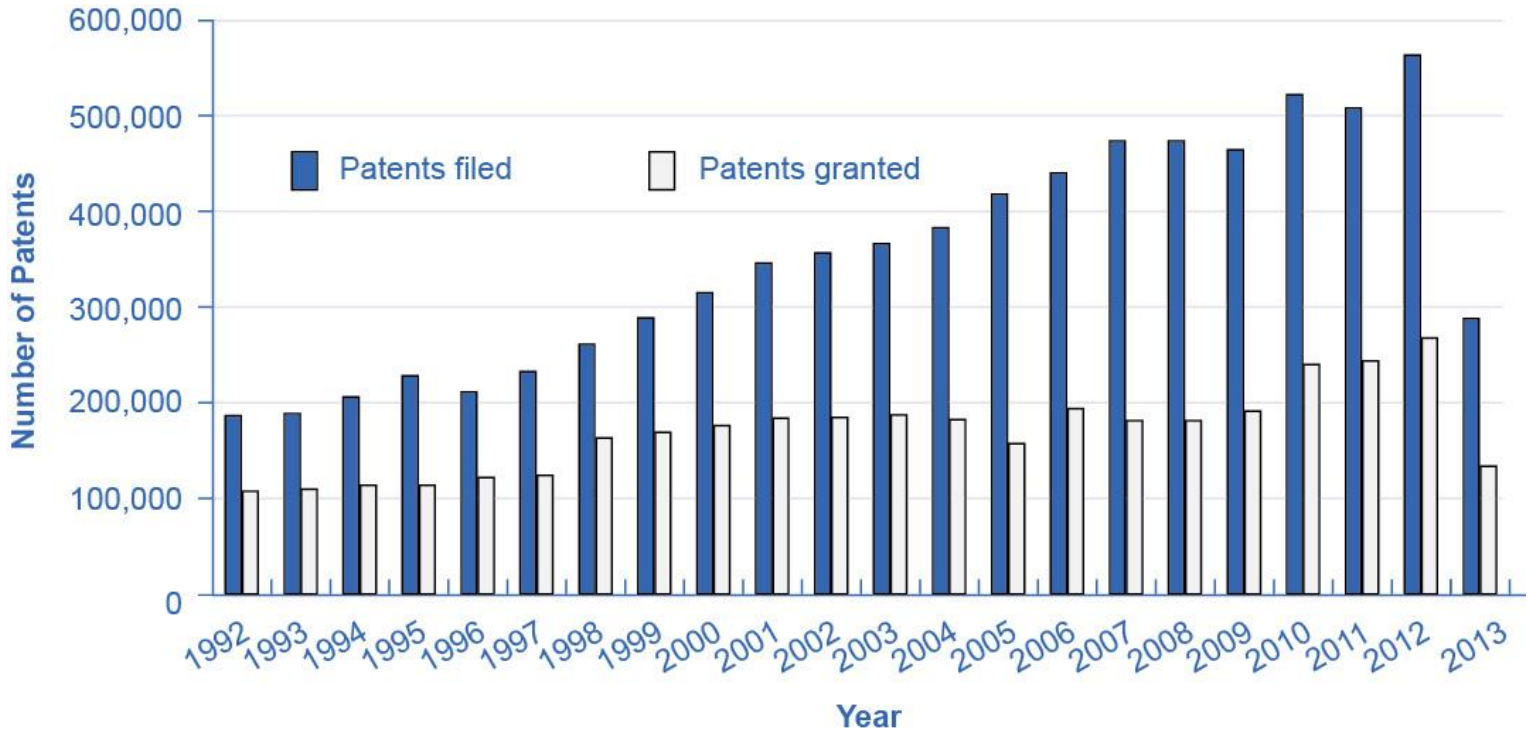
- If the government provides a subsidy to consumers of flu shots, equal to the MSB - MPB, the level of vaccinations can increase to the socially optimal quantity of Q_{Social}.

13.2 How Governments Can Encourage Innovation

- Different government policies can increase the incentives to innovate:
  - guaranteeing intellectual property rights
  - government assistance with the costs of research and development (R&D)
  - cooperative research ventures between universities and companies.

- **Intellectual property rights**: the body of law including patents, trademarks, copyrights, and trade secret law that protect the right of inventors to produce and sell their inventions.
  - Patents - give the inventor the exclusive legal right to make, use, or sell the invention for a limited time.
  - Copyright laws - give the author an exclusive legal right over works of literature, music, film/video, and pictures.

Patents Filed and Granted, 1981–2012



- The number of applications filed for patents increased substantially from the mid-1990s into the first years of the 2000s, due in part to the invention of the Internet, which has led to many other inventions and to the 1998 Copyright Term Extension Act.

(Source: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm)

Government Spending on Research and Development

- If the private sector does not have sufficient incentive to carry out R&D, one possibility is for the government to fund such work directly.

- Government spending can provide direct financial support for R&D conducted at:
  - colleges and universities
  - nonprofit research entities
  - sometimes by private firms
  - government-run laboratories

Tax Breaks for Research and Development

- A complementary approach is to give firms a *reduction in taxes* depending on how much R&D they do.
- The federal government refers to this policy as the research and experimentation (R&E) tax credit.
- Studies find that each dollar of foregone tax revenue through the R&E Tax Credit causes firms to invest at least a dollar or more in R&D.

Cooperative Research

- State and federal governments support research in a variety of ways, such as through partnerships and grants for innovative projects.
    - Examples: National Institutes of Health, National Academy of Scientists, and the Agriculture and Food Research Initiative.
- Cooperation between government-funded universities, academies, and the private sector can spur product innovation and create whole new industries.

13.3 Public Goods

- **Public good** - good that is nonexcludable and non-rival, and is difficult for market producers to sell to individual consumers.
    - **Nonexludable** - it is costly or impossible to exclude someone from using the good, and thus hard to charge for it.
    - **Non-rival** - even when one person uses the public good, another can also use it.

Examples: fire and police service and national defense

The Free Rider Problem of Public Goods

- **Free rider** - those who want others to pay for the public good and then plan to use the good themselves.
  - If many people act as free riders, the public good may never be provided.

- The free rider problem can be expressed in similar terms as the prisoner's dilemma game.

The Role of Government in Paying for Public Goods

- The key to paying for public goods is to assure that *everyone* will make a contribution and to prevent free riders.
  - This is done through government spending and taxes.

- In some cases, markets can produce public goods.
  - Creates an indirect way of "charging" for it.
  - Example: radio is a public good, but revenue is made by selling advertising, and "charging" listeners by taking up some of their time.

- Social pressures and personal appeals can also reduce the number of free riders and to collect resources for the public good.

Positive Externalities in Public Health Programs

- Advances in public health have all been closely linked to p*ositive externalities* and *public goods*.

- Rise in life expectancy seems to stem from three primary factors related to public health programs/goods:
  - Public sanitation systems - providing clean water and disposing of human waste help to prevent the transmission of many diseases.
  - Medical discoveries from government or university-funded research, such as:
    - Immunizations
    - Antibiotics
    - High blood pressure reducers
  - Changes in public behavior through government health campaigns. Examples:
    - Hand washing
    - Food storage and protection
    - Reducing tobacco smokers
    - Precautions against sexually transmitted diseases