

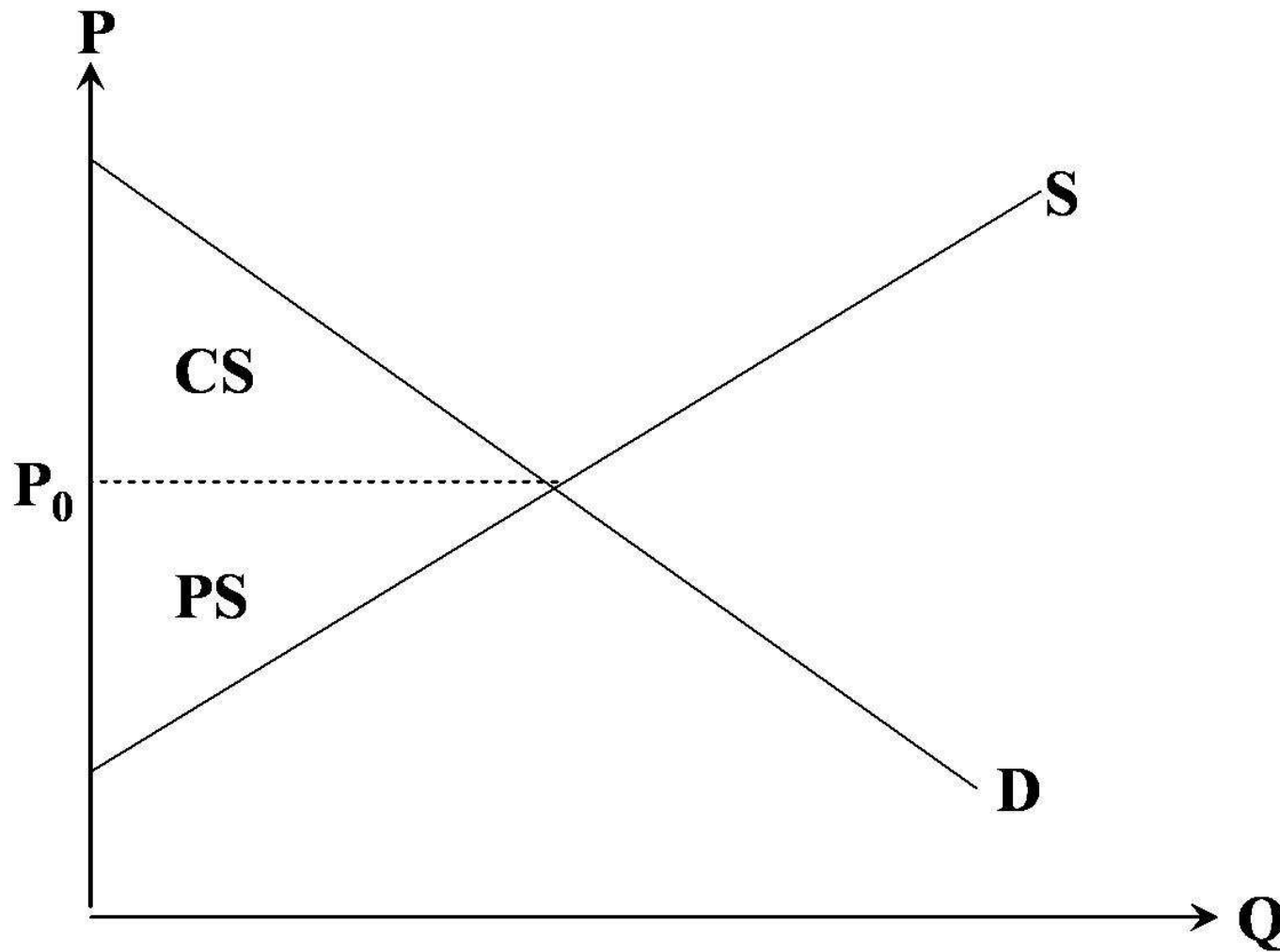
## Topic 3

- Welfare theorems
- Dead Weight Loss for externalities
- Dead Weight Loss for public goods
- Dead Weight Loss for tragedy of the commons
- Basic policy alternatives

# Welfare Theorems

- In a perfectly competitive market, the market equilibrium outcome is efficient
  - ▷ Pareto optimal – cannot make anyone better off without making someone worse off
  - ▷ Maximizes total social surplus (i.e. maximizes the sum of producer and consumer surplus)
- Known as the “First Theorem of Welfare Economics ”

# Consumer and Producer Surplus



Competitive equilibrium makes the sum of CS and PS as big as possible.

## Normative Implication

- When markets are perfectly competitive, the market mechanism allocates scarce resources as well as anything could.
- When there are perfectly competitive markets, pursuit of individual self interest is socially optimal.

# Market Failure

- Market Failure: When conditions of perfect competition do not exist
  - ▷ Market power
    - ◇ monopoly, oligopoly, monopsony, oligopsony
  - ▷ Asymmetric information
    - ◇ used cars, REPOs, collateralized debt obligations
  - ▷ Externalities
  - ▷ Public goods
  - ▷ Tragedy of the commons

# Market Failures in Environmental Economics

- Externalities
- Public goods
- Tragedy of the commons

## Definition of Externality

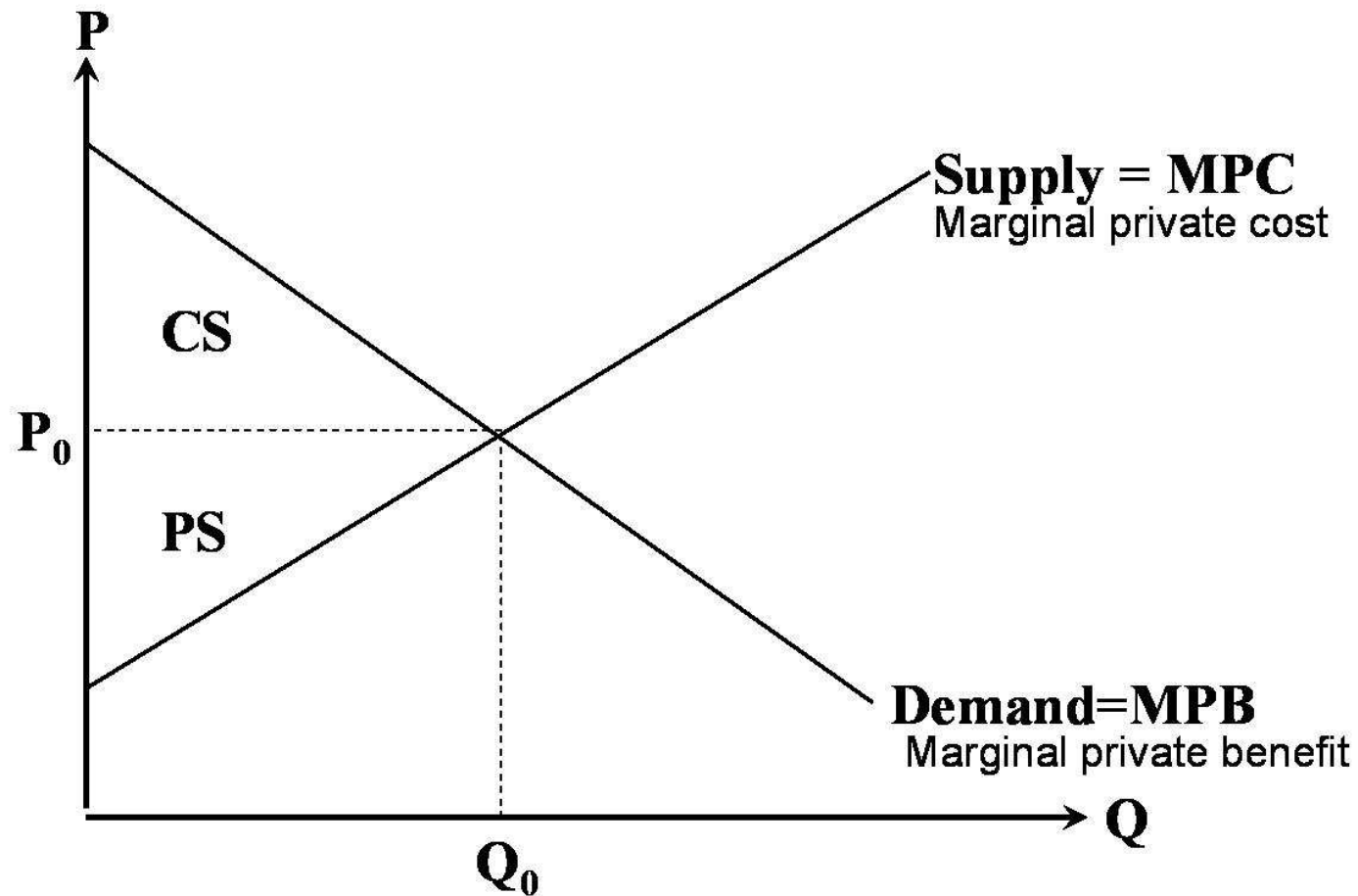
- “An externality results when the actions of one individual (or firm) have a direct, unintentional, and uncompensated effect on the well-being of other individuals or the profits of other firms.” (KO, p.66)
- Could be positive, e.g. your neighbor has a pretty garden
- Could be negative, e.g. your neighbor has smelly garbage

# Examples of Externalities

- Two students share a dormitory room – one smokes and the other has asthma
- A coal-fired power plant in Michigan produces sulfur dioxide, which in turn causes acid rain in Canada and damages Canadian wheat.
- A pulp mill dumps its effluent into a river. A manufacturing facility downstream from the pulp mill draws water from the river.



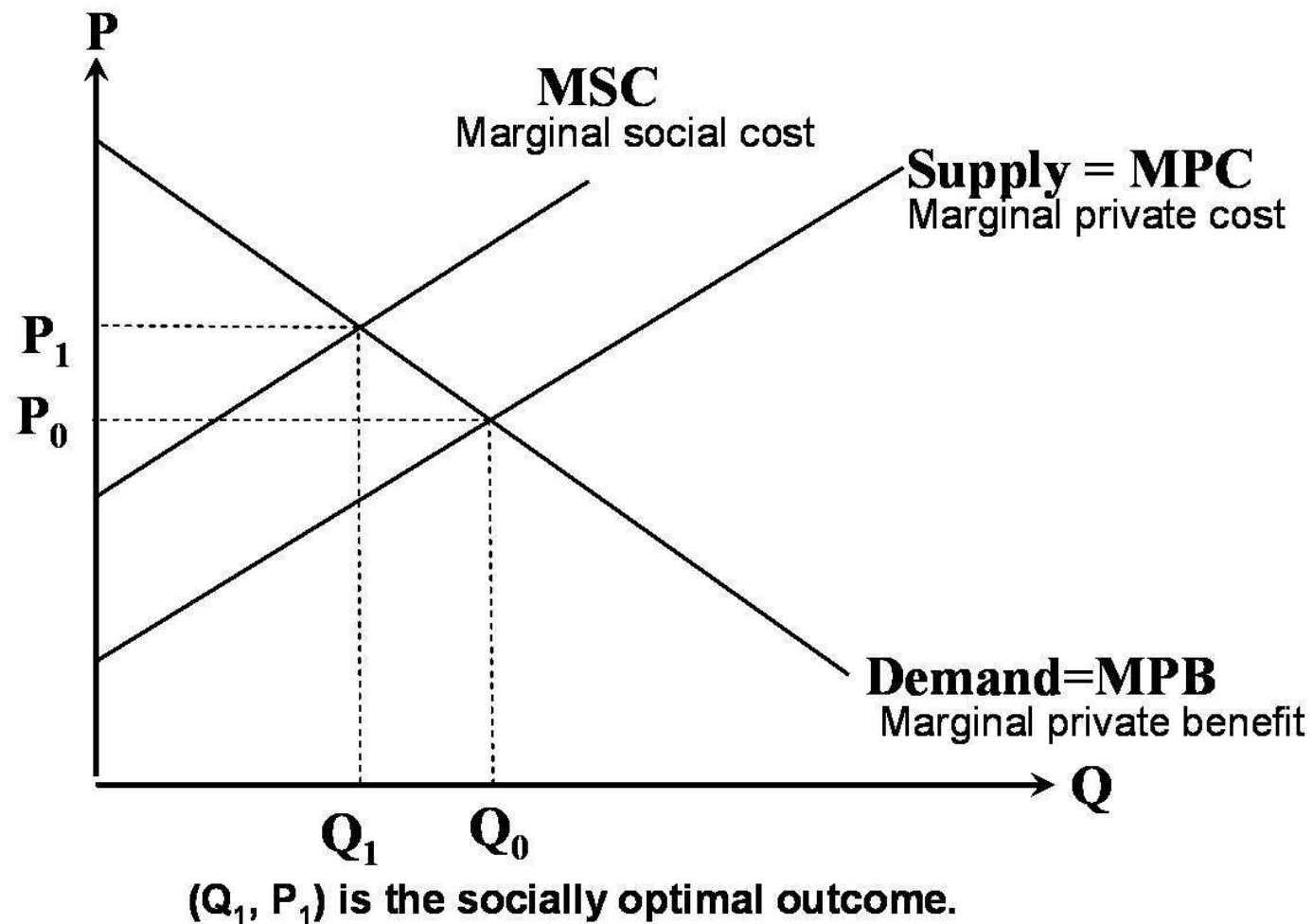
# Inefficiency Associated with Externalities – 1



Appears to be a “competitive” equilibrium

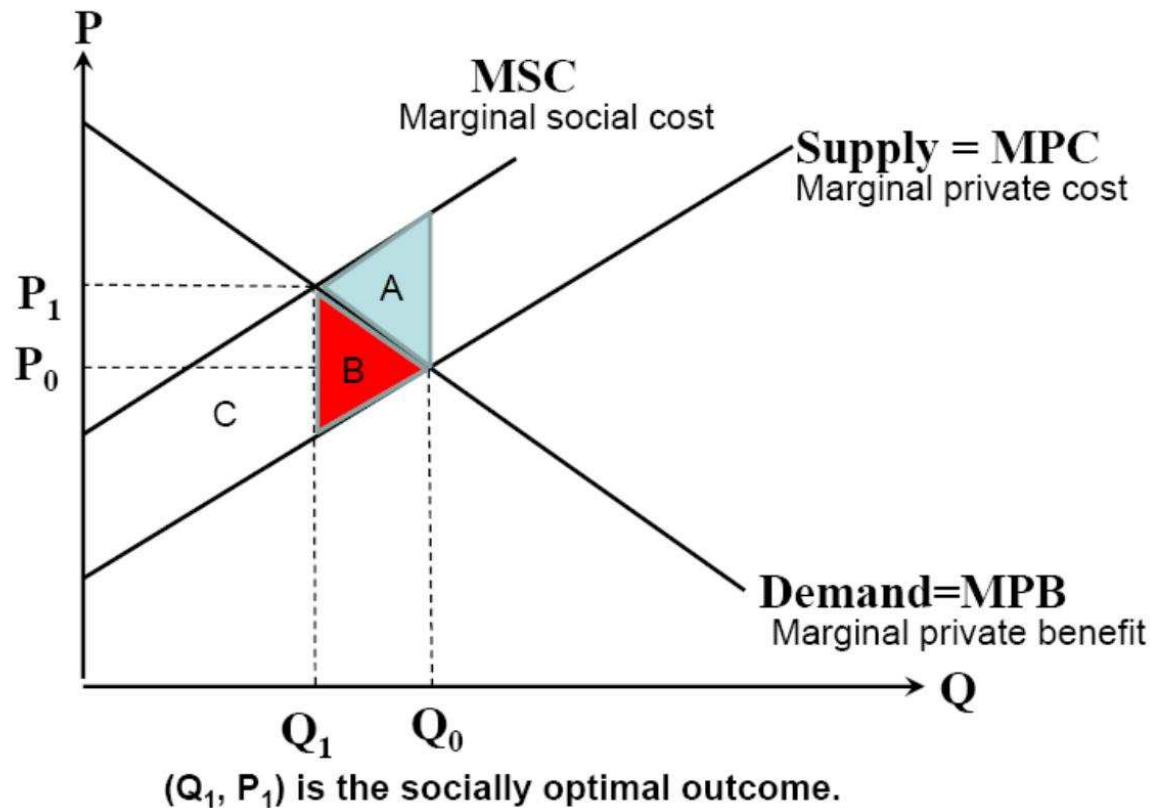
- Social costs are ignored

## Inefficiency Associated with Externalities – 2



- Marginal private cost vs. marginal social cost
- Difference is marginal external cost
- Unregulated market produces too much output and too much pollution

## Inefficiency Associated with Externalities – 3



- The sum of  $A$ ,  $B$ , and  $C$  is the social cost from the externality
- Producers and consumers expropriate  $B$  and  $C$  as surplus for themselves.
- $A$  is pure deadweight loss.
- At social optimum, producers and consumers lose  $B$ , society gains  $A$ .
- What happens to  $C$  depends on how it is done.
  - ◊ If a tax, society gets  $C$  and is compensated for damage.

## Inefficiency Associated with Externalities – 4

- Illustrate computation on board
- With externality (damage) proportional to output
- In which case deadweight loss exceeds lost consumer and producer surplus

## Marginal External Costs of Automobiles

Source of Cost	Cents/Gallon <sup>1</sup>	Cents/Mile <sup>1</sup>
Greenhouse gas emissions	6	0.3
Local air pollution	42	2.0
Congestion	105	5.0
Accidents	63	3.0
Oil dependency	12	0.6
Total	228	10.9

<sup>1</sup> Costs converted assuming fuel economy of 21 miles/gallon.

**Source:** Ian W. H. Parry, Margaret Walls, and Winston Harrington, "Automobile Externalities and Policies," *Journal of Economic Literature*, Vol. XLV, No. 2, June 2007, p. 384.

# Social Benefits of the Clean Air Act

BENEFIT CATEGORY	MONETIZED BENEFITS (MILLION 2006\$) BY TARGET YEAR			NOTES
	2000	2010	2020	
<b>Health Effects</b>				
PM Mortality	\$710,000	\$1,200,000	\$1,700,000	- PM mortality estimates based on Weibull distribution derived from Pope et. al (2002) and Laden et al., 2006. - Ozone mortality estimates based on pooled function
PM Morbidity	\$27,000	\$46,000	\$68,000	
Ozone Mortality	\$10,000	\$33,000	\$55,000	
Ozone Morbidity	\$420	\$1,300	\$2,100	
<b>Subtotal Health Effects</b>	\$750,000	\$1,300,000	\$1,900,000	
<b>Visibility</b>				
Recreational	\$4,100	\$9,000	\$18,000	Recreational visibility only includes benefits in the regions analyzed in Chestnut and Rowe, 1990 (i.e., California, the Southwest, and the Southeast).
Residential	\$13,000	\$27,000	\$49,000	
<b>Subtotal Visibility</b>	\$17,000	\$36,000	\$67,000	
<b>Agricultural and Forest Productivity</b>	\$1,000	\$5,500	\$11,000	
<b>Materials Damage</b>	\$58	\$93	\$110	
<b>Ecological</b>	\$6.9	\$7.5	\$8.2	Reduced lake acidification benefits to recreational fishing assuming effect threshold of 50 microequivalents per liter.
<b>Total: all categories</b>	\$770,000	\$1,300,000	\$2,000,000	
Note: See Chapters 5 and 6 of this report for detailed results summaries. Values presented are means from results reported as distributions. Estimates presented with two significant figures.				

Source: EPA, The Benefits and Costs of the Clean Air Act: 1990 to 2020. Estimated 2020 benefits are \$2 trillion and costs are \$65 billion.

# Taxonomy of Pollutants

- Cumulative vs. noncumulative
  - ▷ plastics vs. noise
- Local vs. regional vs. global
  - ▷ noise vs. acid rain vs. CFCs
- Point-source vs. non-point-source pollutants
  - ▷ wastewater vs. agricultural runoff
- Continuous vs. episodic emissions
  - ▷ electric power, waste treatment vs. oil or chemical spills
- Damage not related to emissions
  - ▷ conversion of land, logging, mining

## Conclusion with Externalities

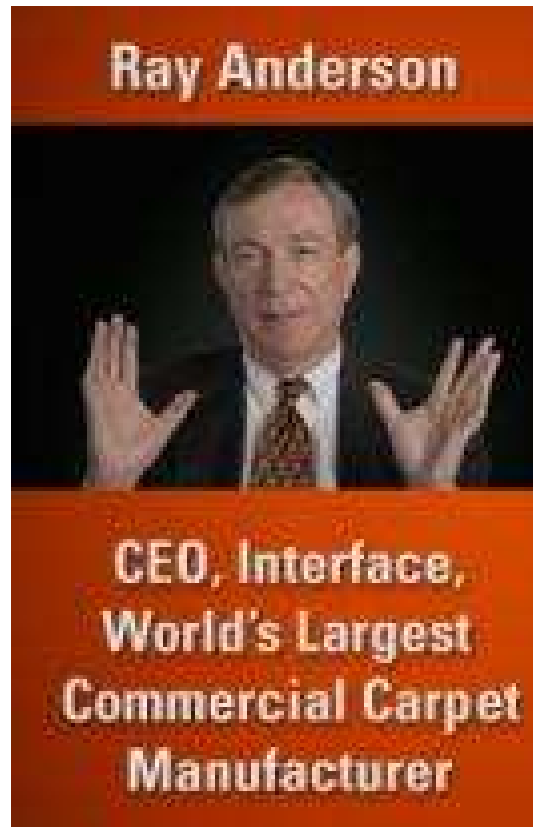
- Markets are not efficient when there are externalities
- There is overprovision of goods generating externalities in a competitive market
  - ▷ modified if market power or other countervailing effects



# Corrective Measures

- Command and control policies
  - ▷ Technology standards (catalytic converters)
  - ▷ Absolute source-based emission or effluent standards
    - ◇ input based
    - ◇ output based
- Policies based on economic incentives
  - ▷ Effluent fees (Pigouvian taxes)
  - ▷ Abatement subsidies
  - ▷ Tradable permits

# Viewpoint of “The Corporation”



- Clip from the interview of Ray Anderson
- <http://www.aronaldg.org/courses/econ428/RayAndersonTheCorporation.mp4>
- <https://www.youtube.com/watch?v=buqy32v7OV0>
- [www.interfaceflooring.com](http://www.interfaceflooring.com)

# Viewpoint of the Corporation – Clips

- “The Invisible Hand Is Blind”
  - ▷ Externalities
  - ▷ Role for government
  - ▷ Innovation incentives
- “Leading by Example”
  - ▷ Greenwash
- “As Bad As the Law Allows”
  - ▷ Corporate responsibility
- “Real World Strategies”
  - ▷ Property rights

# Definition of Public Goods

- A pure public good is a nonexcludable and nonrival good.
- Nonexcludability: It is not feasible to allow consumers to use the good selectively.
- Nonrivalry: Consumption of one individual does not reduce the amount of the good available to others.

# Examples of Public Goods

- Clean air outside
- Public TV
- Public parks
- Biodiversity
  - ▷ for its own sake
  - ▷ for development of new pharmaceuticals
- Avoiding climate change
- National defense

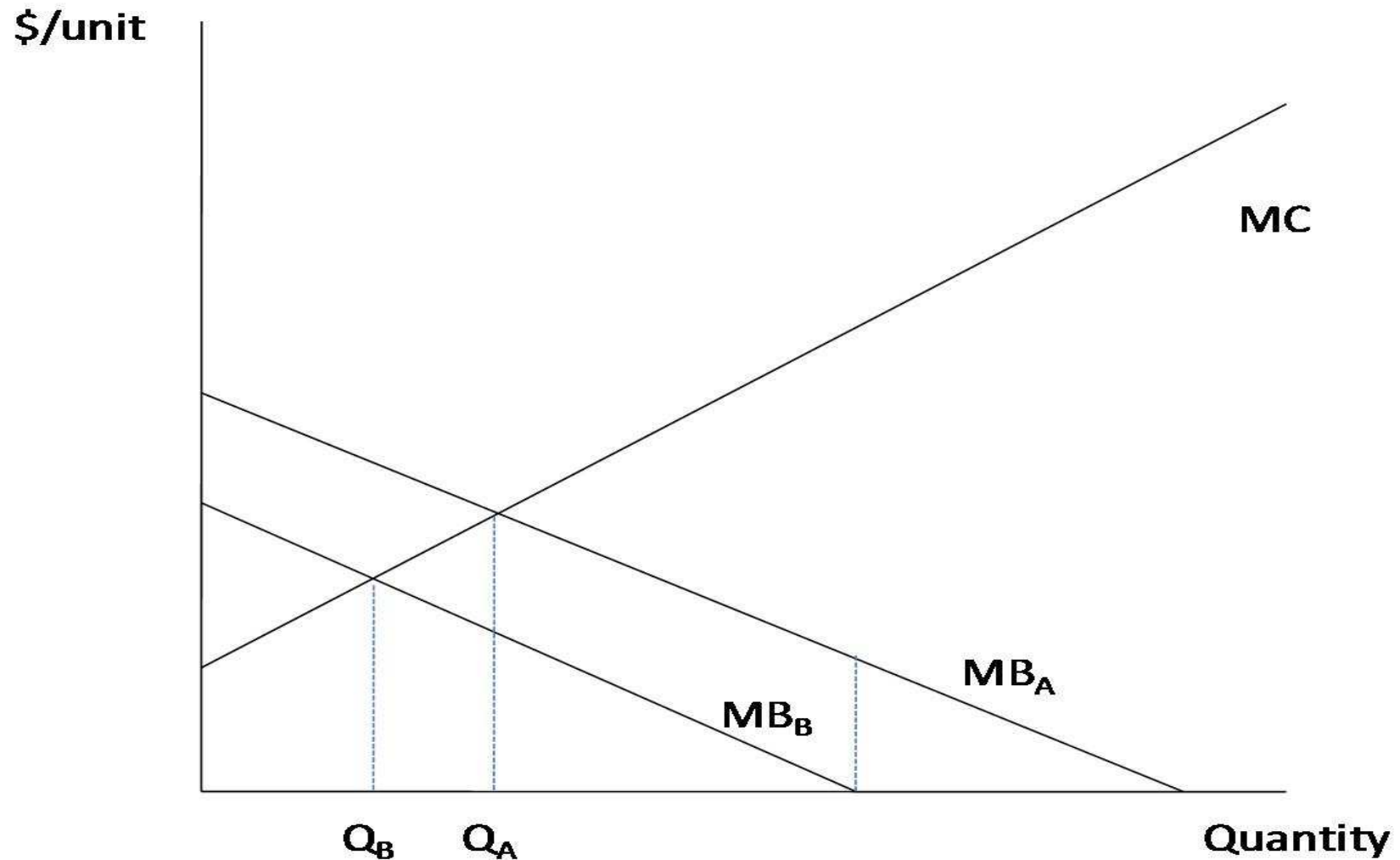
# The Public Goods Box

	Excludable	Non-Excludable
Rival	Pure Private Goods	Open Access (Common Property) Resources
Non-Rival	Club Goods	Pure Public Goods

# Demand Aggregation

- Blackboard illustration
- Rival goods  $\implies$  horizontal sum
- Non-rival goods  $\implies$  vertical sum

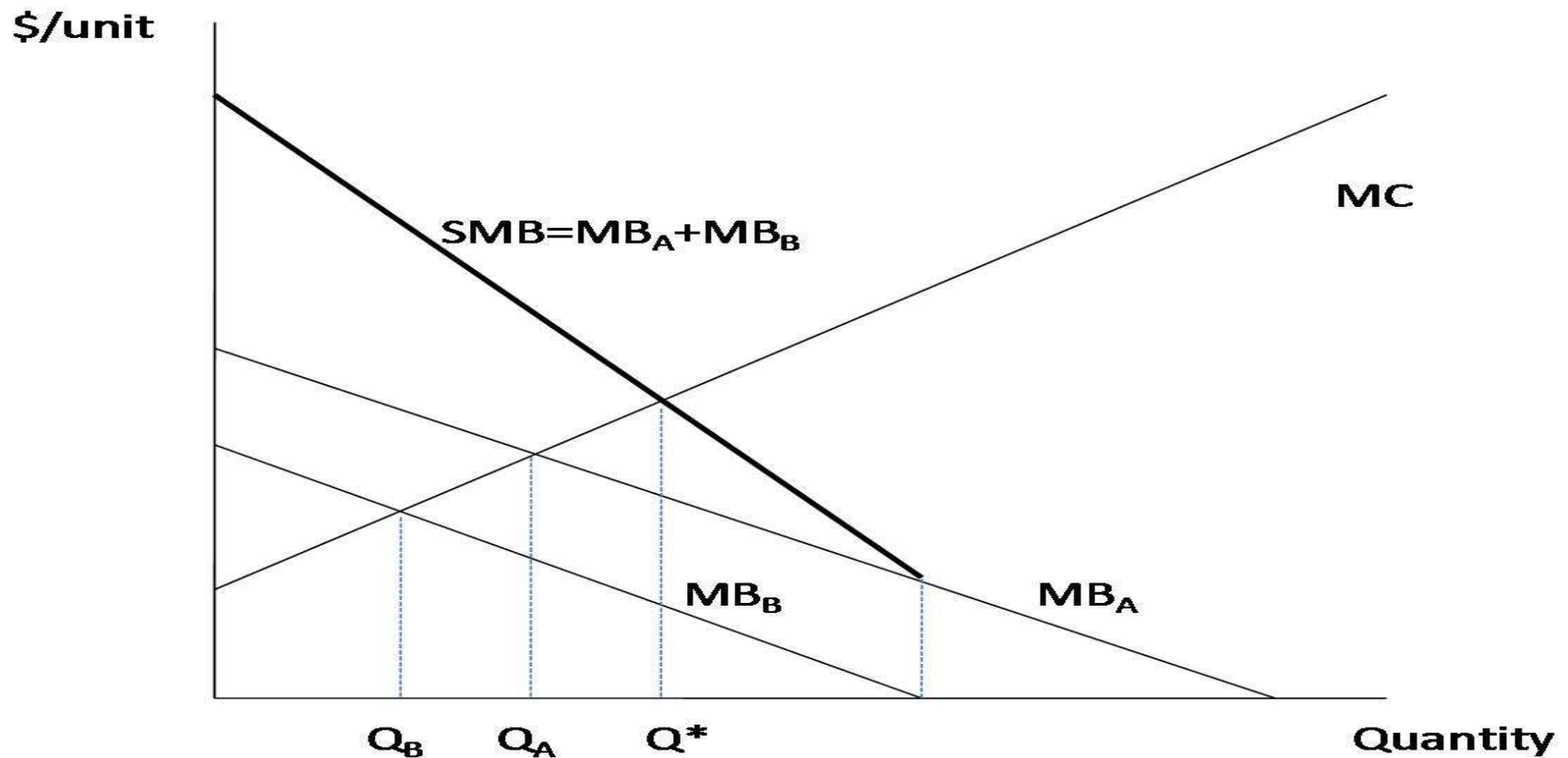
# Inefficiency Associated with Public Goods – 1



- Private provision of a public good by 2 firms  $A$  and  $B$
- Example:  $B$  produces  $Q_B$  and  $A$  produces  $Q_A - Q_B$



## Inefficiency Associated with Public Goods – 2



- At  $Q_A$  the combined marginal benefit from the public good exceeds the marginal cost
- What is the deadweight loss associated with  $Q_A$ ? Like monopoly, board presentation.

## Conclusion with Public Goods

- Markets for public goods are not efficient
- There is underprovision of public goods by the market

# Corrective Measures

- government provision
- voluntary contributions
- private action – homeowners' association
- moral pressure
- matching contributions (promise of future contributions, threat of shutting off future contributions)

# Missing Markets

- There is a missing market if some good that individuals value is not bought and sold in the marketplace.
  - ▷ Generation of air pollution uses clean air as an “input” in production, but there is no market for this clean air.
  - ▷ Access rights to groundwater
- “Green Goods” create some otherwise missing markets
  - ▷ Organic produce v. pesticides in the waterways
  - ▷ NC Green Power allows the purchase of electricity generated using renewable energy
- Government-created markets
  - ▷ FCC allocation of spectrum rights, access to “white spaces”

# Green Goods

- Competitive firms
  - ▷ View green and normal goods as close substitutes.
  - ▷ The demand curves will have large elasticities.
- Firms with market power
  - ▷ Review standard theory, blackboard
  - ▷ Point out the flaw in that approach for green goods with diapers, blackboard.
  - ▷ Illustrate willingness to pay approach with paint, website.

# Environmental Policy

- Website – Major U.S. legislation (Field and Field, 2009)
- Website – Summary of international treaties (Field and Field, 2009)