

Water Board Training Academy

Introduction to Environmental Economics

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What will we be doing today

This morning, we will

- look at basic principles in microeconomics
- apply these principles to natural resources

This afternoon, we will

- discuss cost benefit analysis, and then
- analyze a few water quality-related problems
 - nutrient standards
 - NPS pollution
 - groundwater contamination

So what is microeconomics all about?

Providing an explanation for why people do what they do

Predicting how people will react to change

Microeconomics is the study of individual choice, and how that choice is influenced by economic, technological, environmental, political, and social forces.

Why do we have to make choices?

***Scarcity* exists because individuals want more than can be produced.**

- The degree of scarcity is constantly changing.
- The quantity of goods, services, and usable resources depends on technology and human action.

Economic reasoning suggests we make decisions by comparing costs and benefits.

Marginal Costs and Marginal Benefits

- Marginal = expected *incremental*, or additional

If $MB \geq MC$ We Do It

If $MB < MC$ We Do Not

- ***Marginal cost*** – the additional cost to you over and above the costs you have already incurred.
 - This means not counting ***sunk costs*** – costs that have already been incurred and cannot be recovered.
- ***Marginal benefit*** – the additional benefit above and beyond what you've already accrued.

**Trout
Catch**

**Total
Benefit**

**Marginal
benefit**

Economic reasoning is based on the premise that everything has a cost.

Opportunity Cost

The benefit foregone of the next-best alternative to the activity you have chosen.

The opportunity cost of state revenue spent on wetlands restoration is less spending on other priorities.

**Trout
Restoration**

**Total
Cost**

**Marginal
Cost**

Economics and Market Forces

When goods are scarce, they must be rationed.

- That means a mechanism must be chosen to determine who gets what.
- Markets ration by changing prices.
 - When there is a shortage, the price goes up.
 - When there is a surplus, the price goes down.

Market reality, however, is controlled by three forces:

- Economic forces.
- Social and cultural forces.
- Political and legal forces.

**Demand
for
Goods and Services**

Demand

Who demands?

- Buyers of goods and service who are willing and able to pay.
- Prices limit willingness and ability to pay

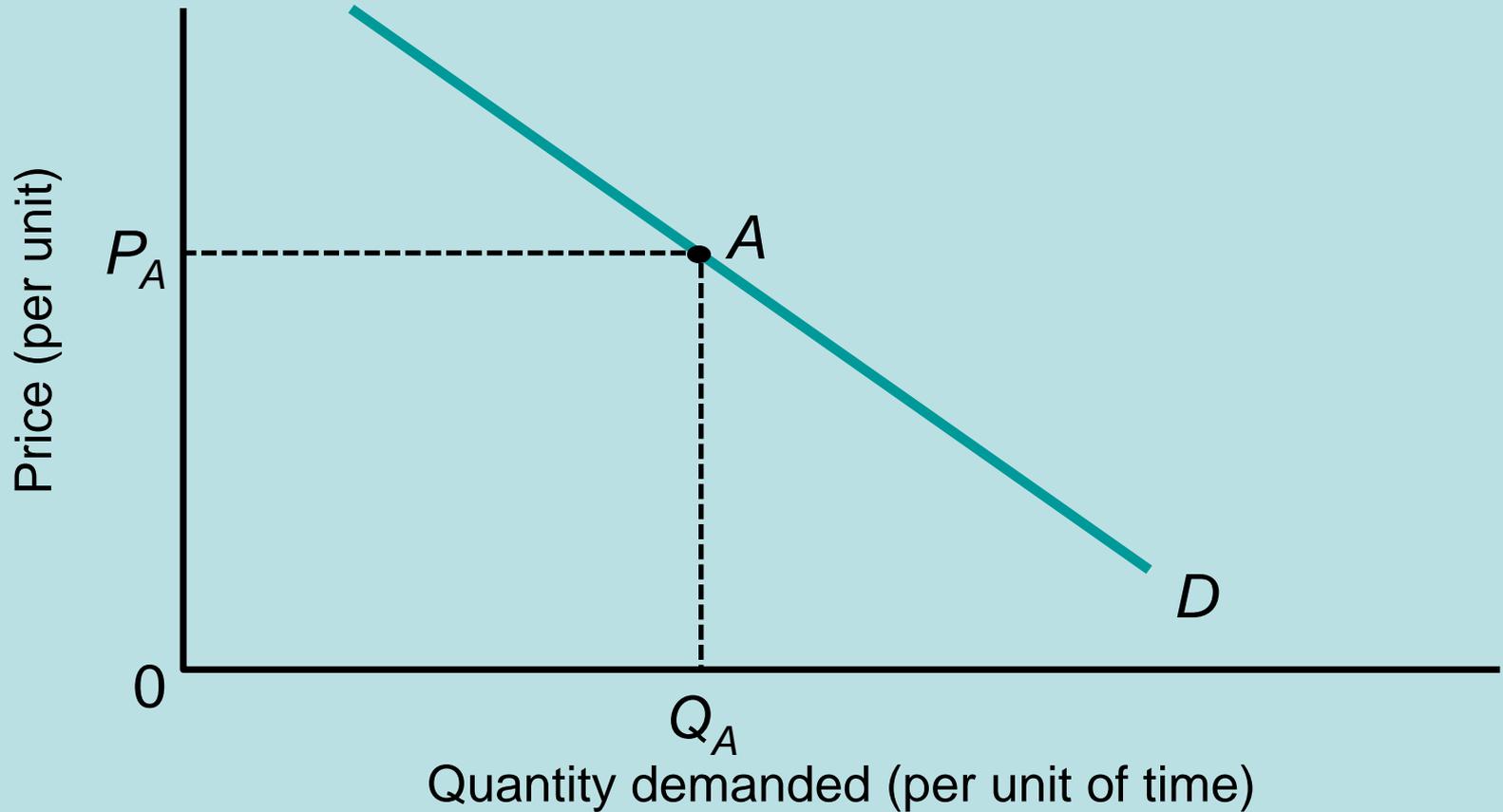
***Law of demand* – the inverse relationship between price and quantity demanded, holding all else constant.**

- Quantity demanded rises as price falls, other things constant.
- Quantity demanded falls as prices rise, other things constant.

Why?

People tend to substitute for goods whose price has gone up.

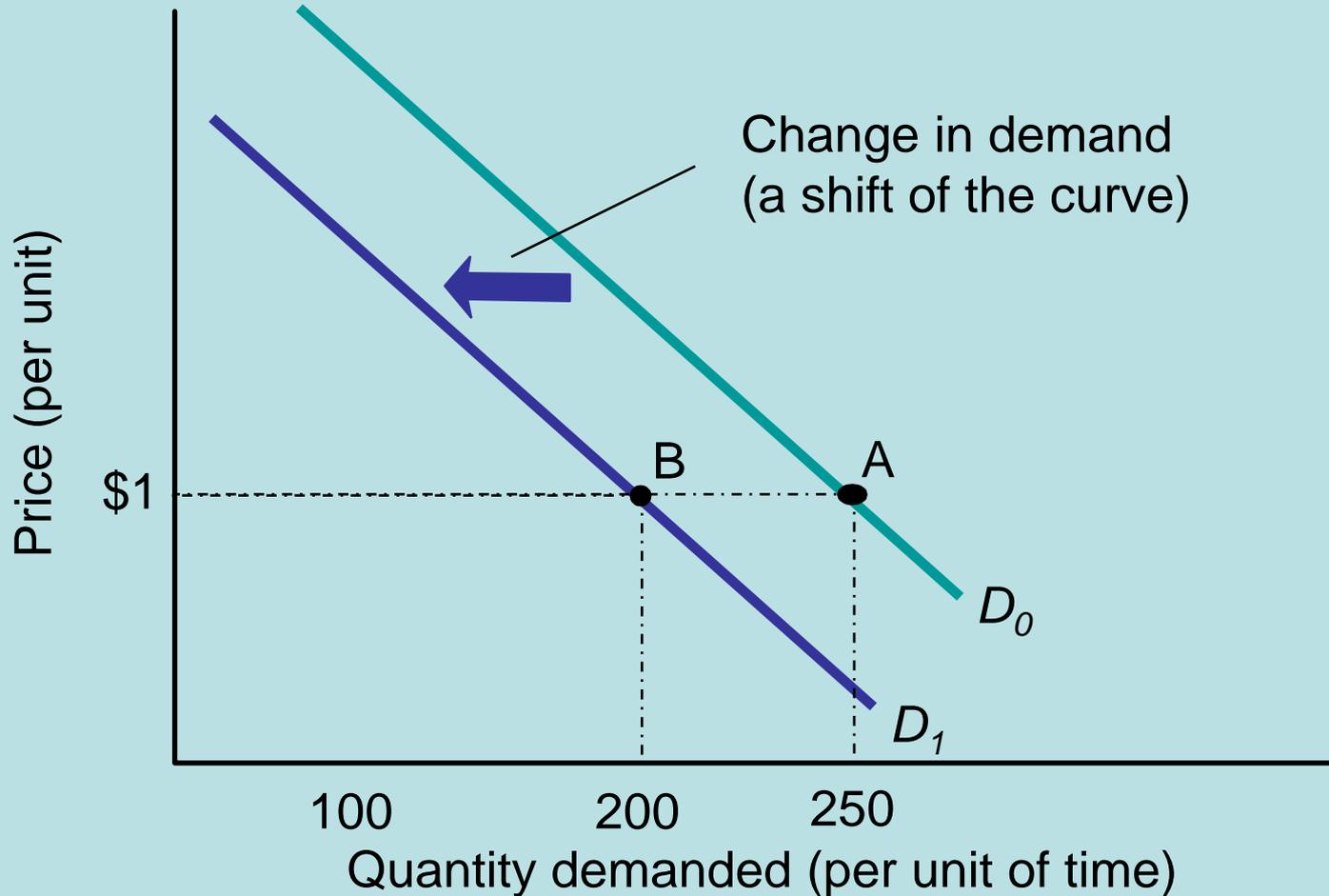
A Demand Curve



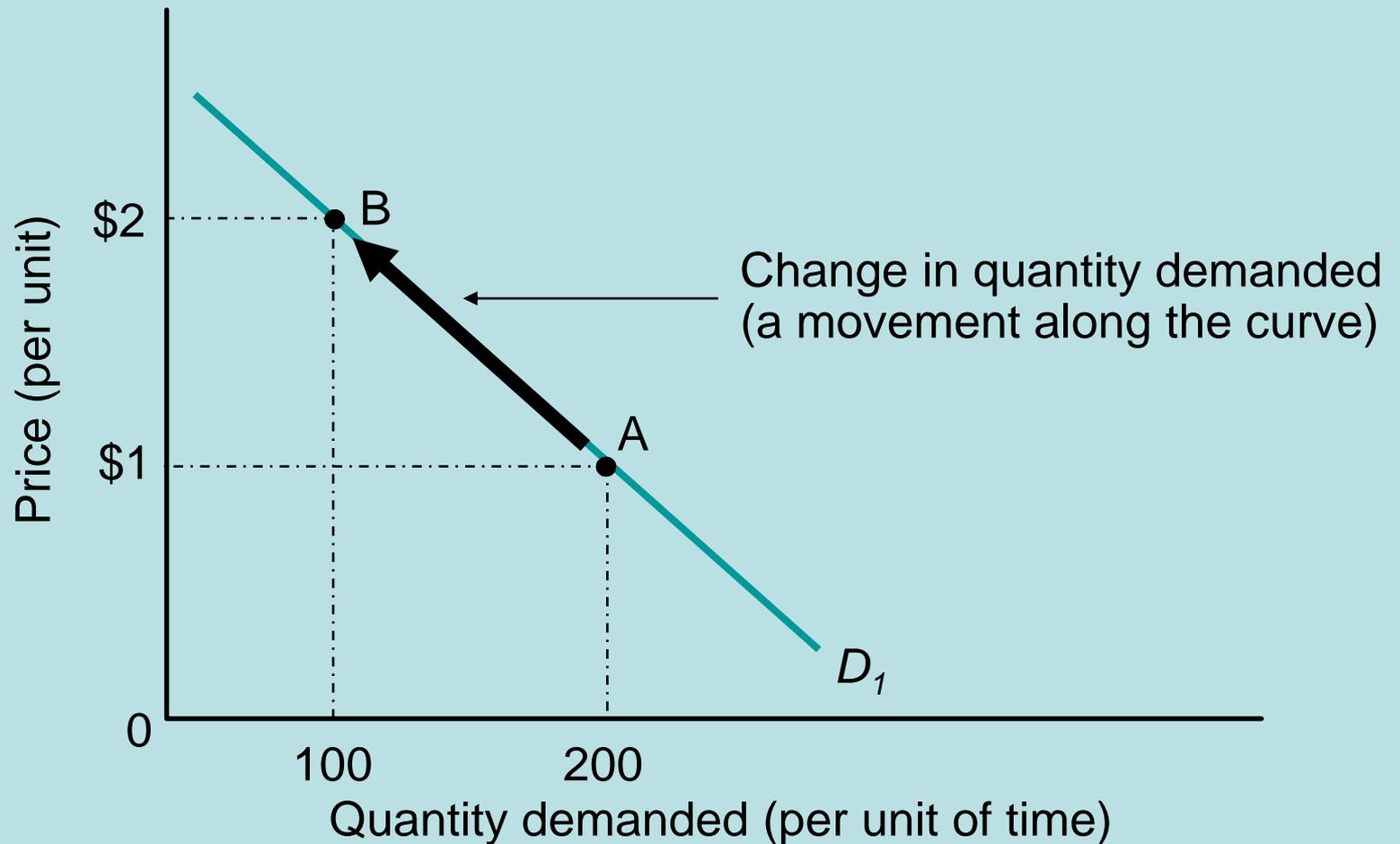
Other Things Constant

- ***Other things constant*** places a limitation on the application of the law of demand.
 - All other factors that affect quantity demanded are assumed to remain constant, whether they actually remain constant or not.
 - When one of these other factors changes, the entire demand curve shifts

Shift in Demand



Change in Quantity Demanded



Market Demand

Market demand is simply an aggregation of each individual's demand.

How they are aggregated may differ.

Private Good:

can be consumed in separate and possibly different amounts by each individual in a group, depending on their tastes, preferences, and wealth.

Public Good:

once made available to one person, automatically becomes available to others as well.

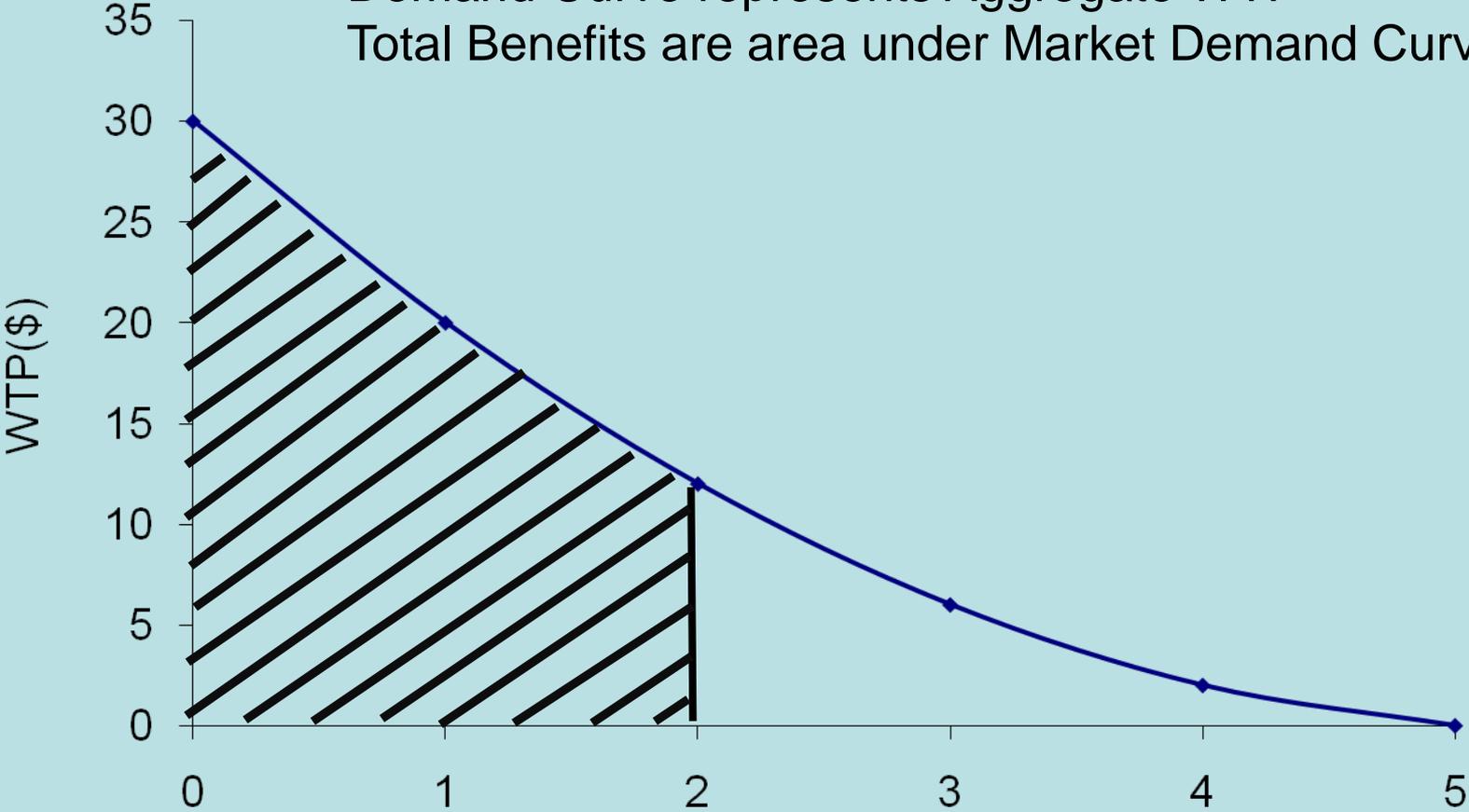
Going from WTP to Benefits.

The marginal benefit an individual receives from consuming another unit of a good equals the maximum they are willing to pay for that additional unit.

If we add up everyone's marginal WTP, it follows that we get a measure for total benefits across all consumers.

This suggests that we can measure benefits by examining market demand curve.

Demand Curve represents Aggregate WTP
Total Benefits are area under Market Demand Curve



Supply of Goods and Services

Supply

- Individuals control the factors of production – inputs, or resources, necessary to produce goods.
- Individuals supply factors of production to intermediaries or firms.

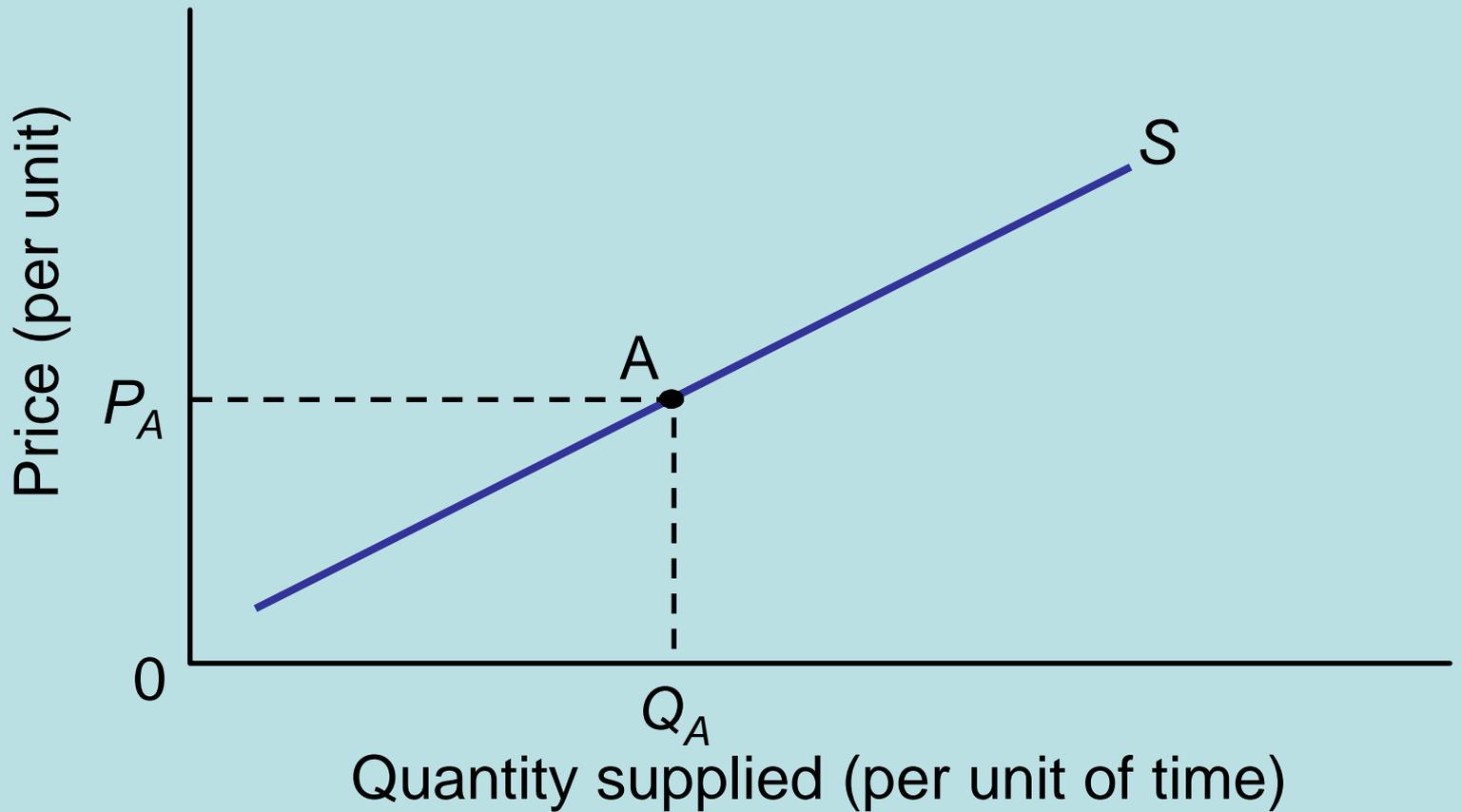
***The Law of Supply* - there is a direct relationship between price and quantity supplied.**

- Quantity supplied rises as price rises, other things constant.
- Quantity supplied falls as price falls, other things constant.

Why?

- When prices rise, firms substitute production of one good for another.
- A higher price means firms can incur higher marginal costs.

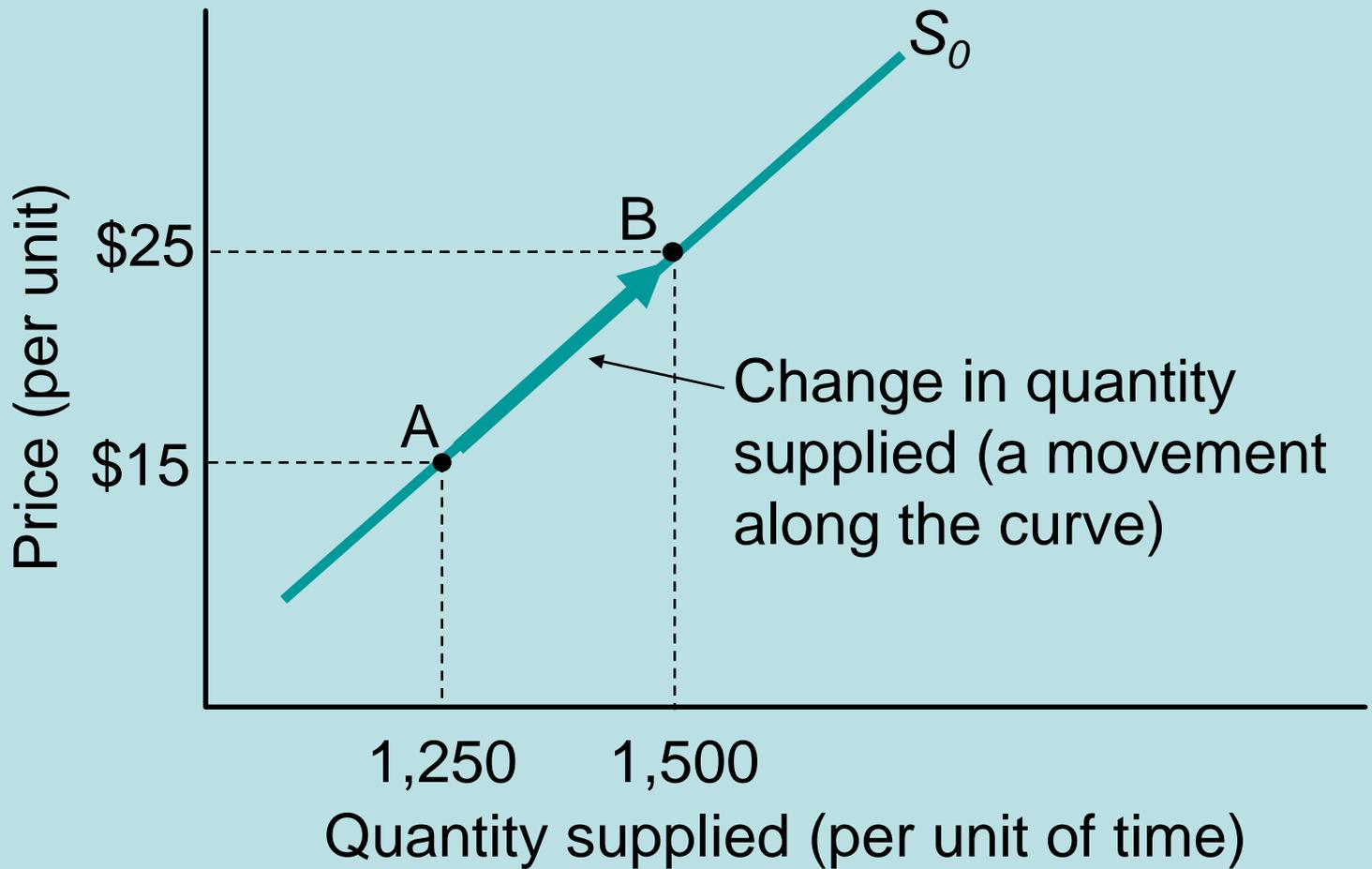
A Supply Curve



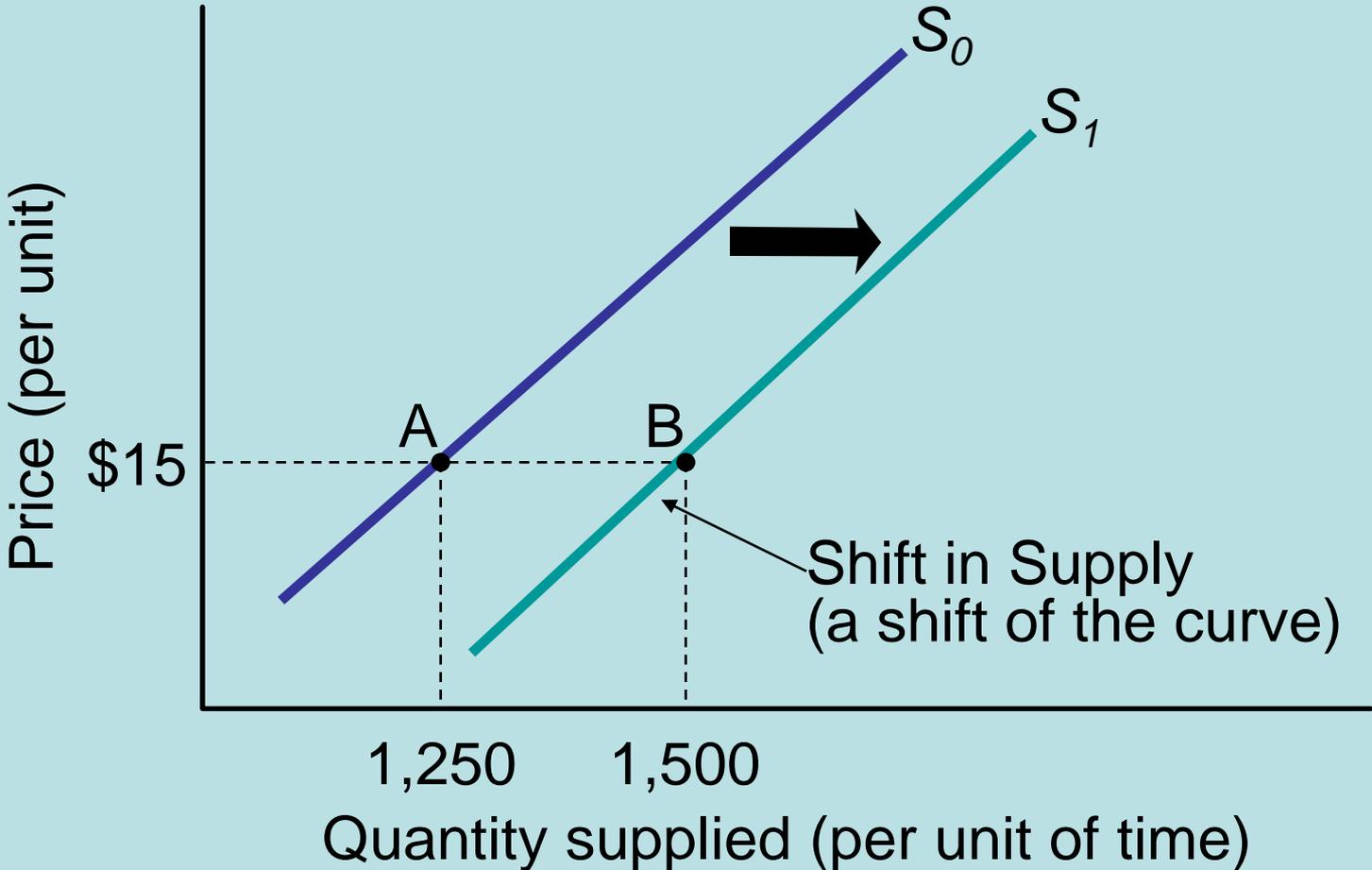
Shifts in Supply Versus Movements Along a Supply Curve

- ***Quantity supplied*** refers to a specific amount that will be supplied at a specific price.
- Changes in price causes changes in quantity supplied represented by a movement along a supply curve.

Change in Quantity Supplied



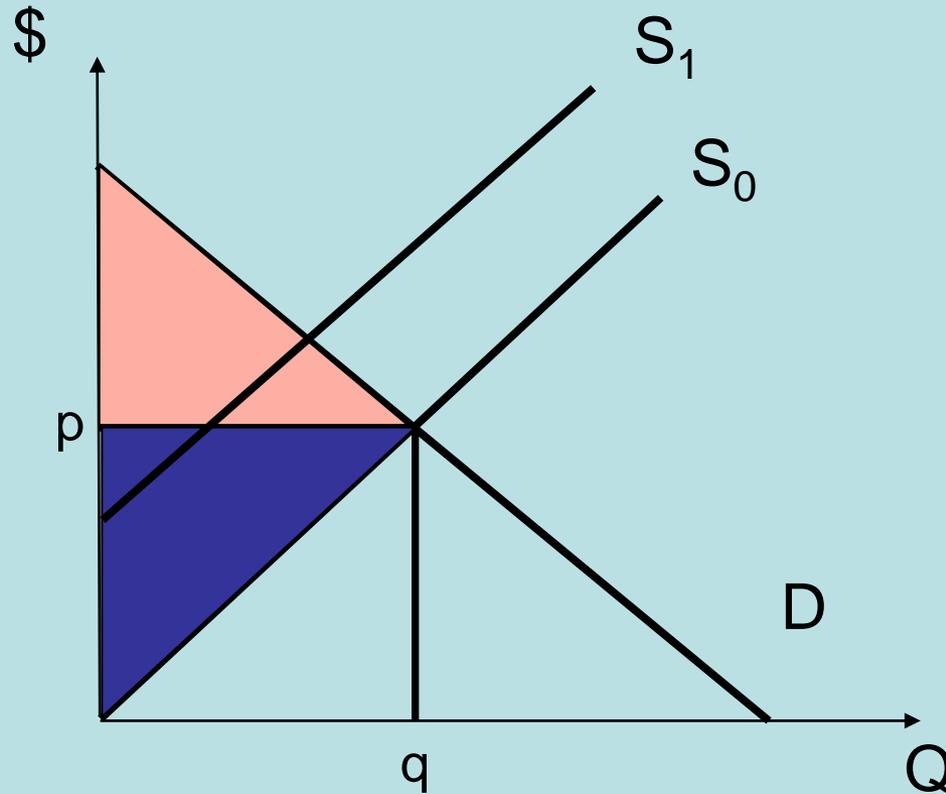
Shift in Supply



Individual and Market Supply Curves

- The *market supply curve* is derived by horizontally adding the individual supply curves of each supplier.

The Market Equilibrium

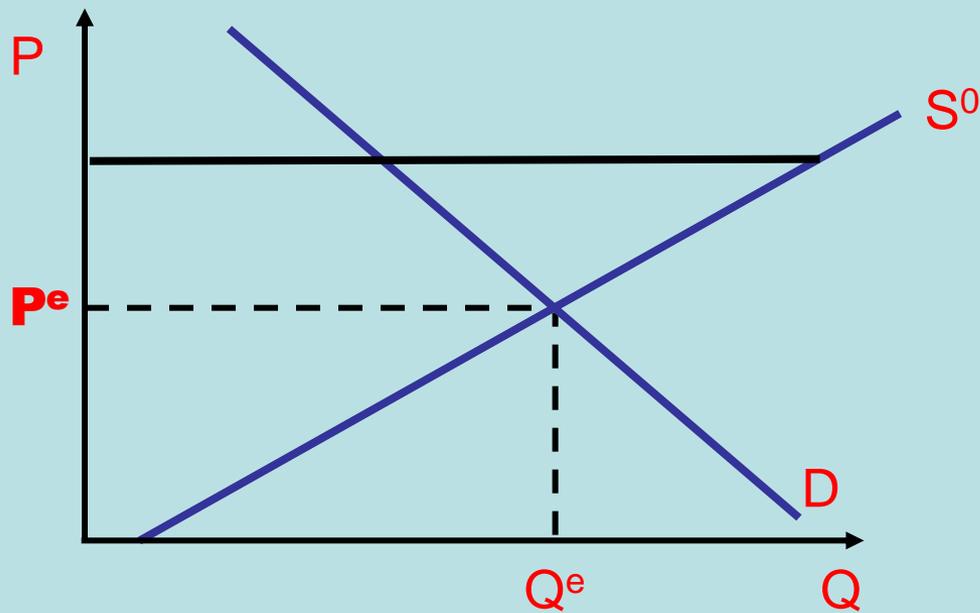


Consumer and Producer Surplus

Equilibrium

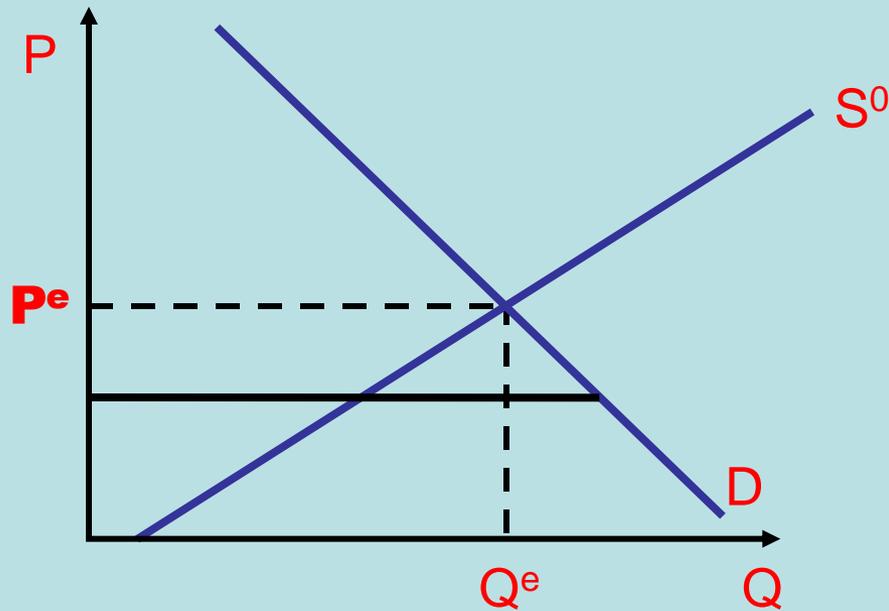
- Equilibrium is a concept in which opposing dynamic forces cancel each other out.
- In a market, the forces of supply and demand interact to determine equilibrium quantity and equilibrium price.
- Equilibrium isn't a state of the world, it is a characteristic of a model.
- Equilibrium isn't inherently good or bad, it is simply a state in which dynamic pressures offset each other.
- When the market is not in equilibrium, you get either excess supply or excess demand, and a tendency for price to change.

- **Excess supply** — a surplus, the quantity supplied is greater than quantity demanded



- Prices tend to fall.

- ***Excess demand*** — a shortage, the quantity demanded is greater than quantity supplied



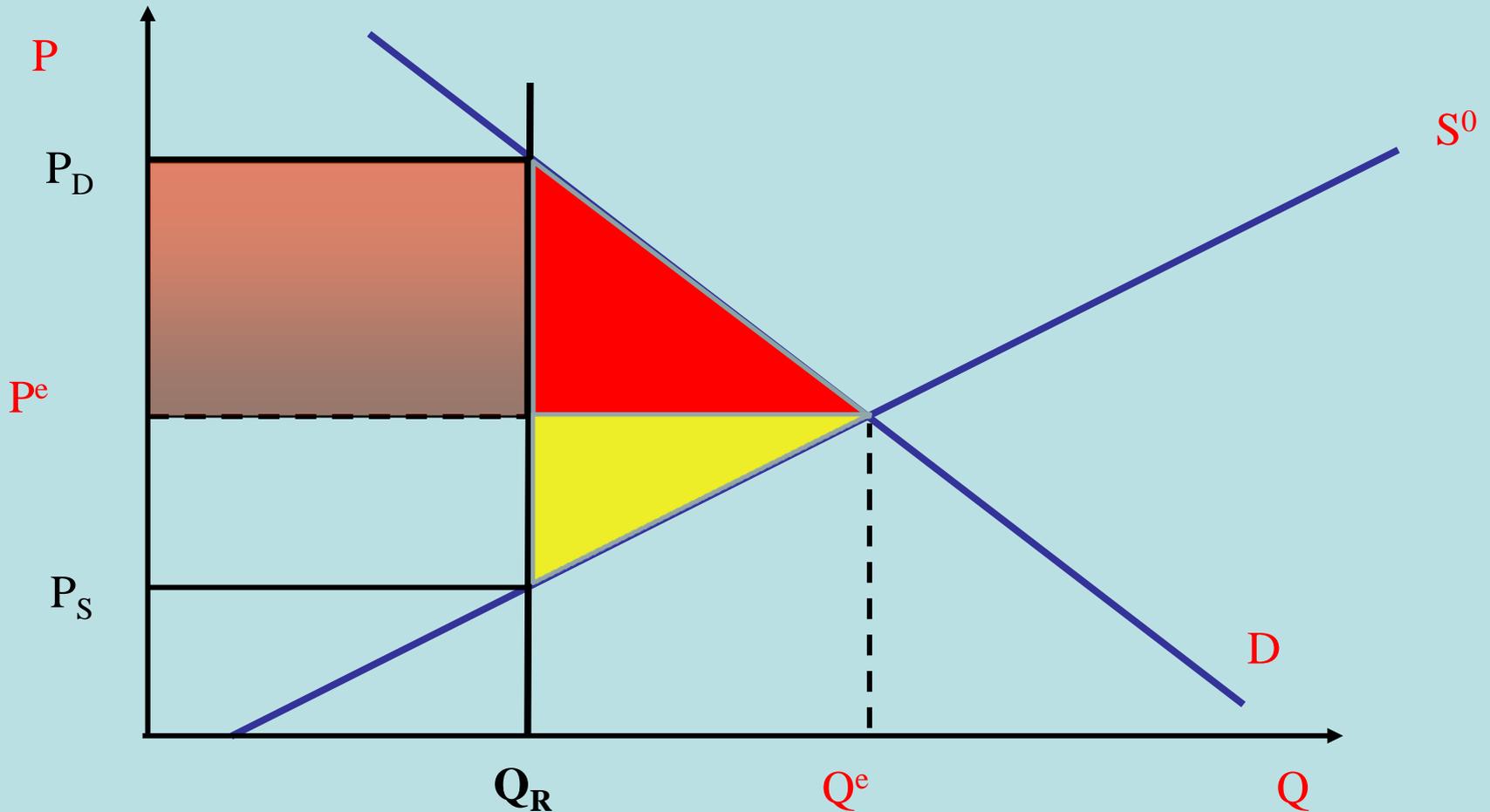
- Prices tend to rise.

Price Adjusts

- The greater the difference between Q_s and Q_d , the more pressure there is for prices to rise or fall.
- When Q_d equals Q_s , prices have no tendency to change.
- Political and social forces can push price away from a market equilibrium.
- These forces create an equilibrium where $Q_s \neq Q_d$.

Quantity Restrictions

- Governments often regulate markets with licenses which limit entry into a market.
- Quantity restrictions tends to increase price.

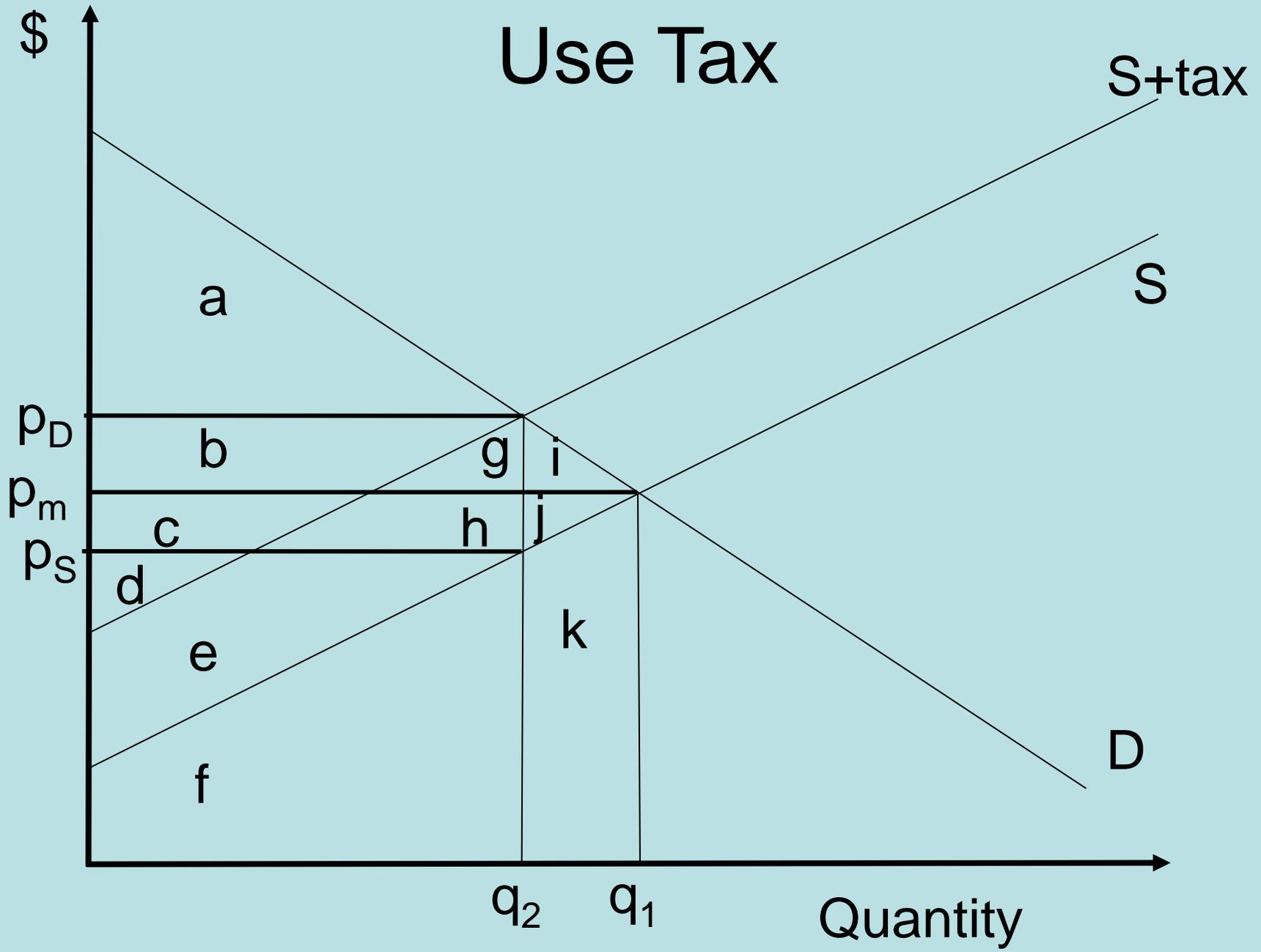


Government Policies

Excise Taxes

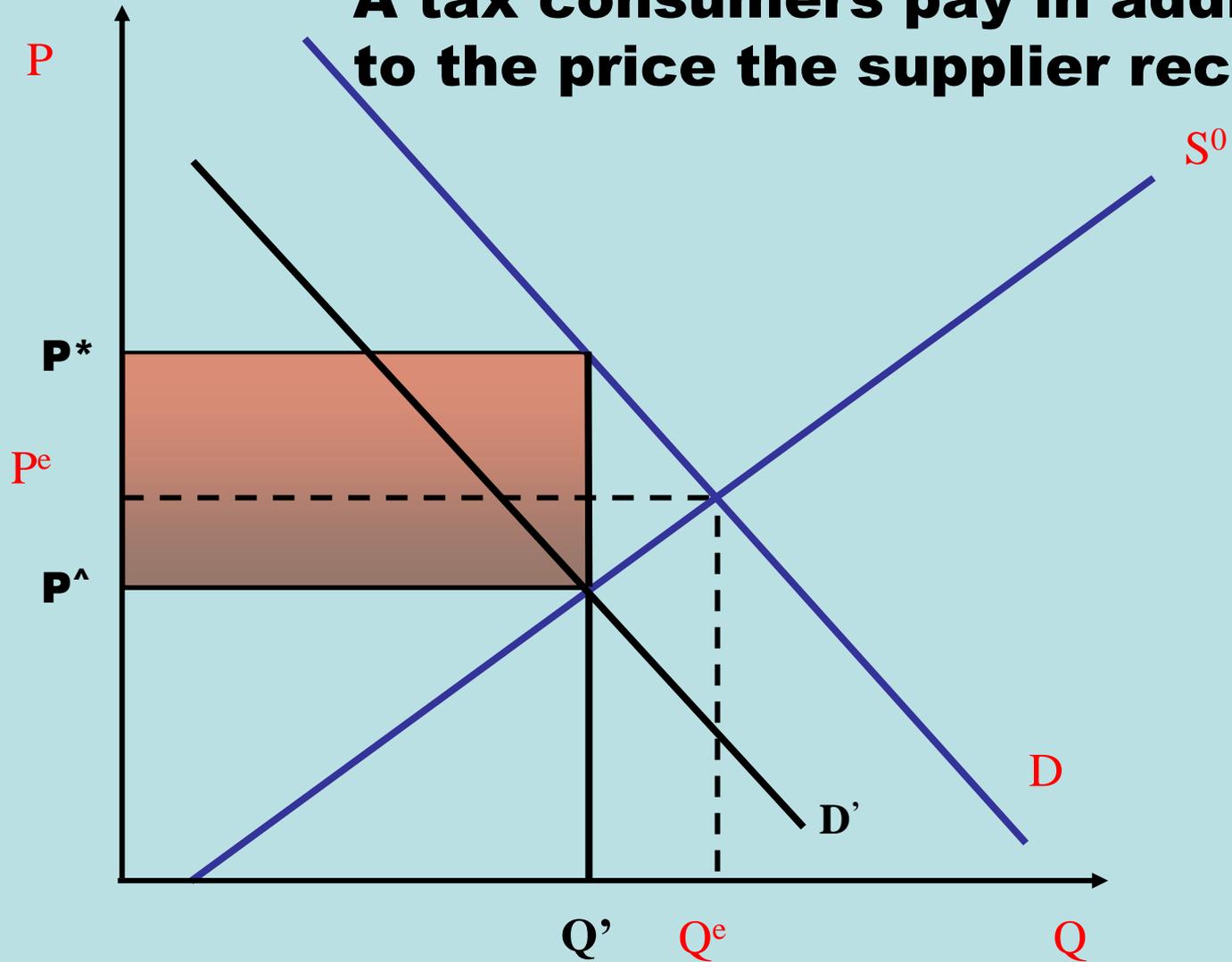
- An ***excise tax*** is a tax that is levied on a specific good.
- A ***tariff*** is an excise tax on an imported good.

Use Tax

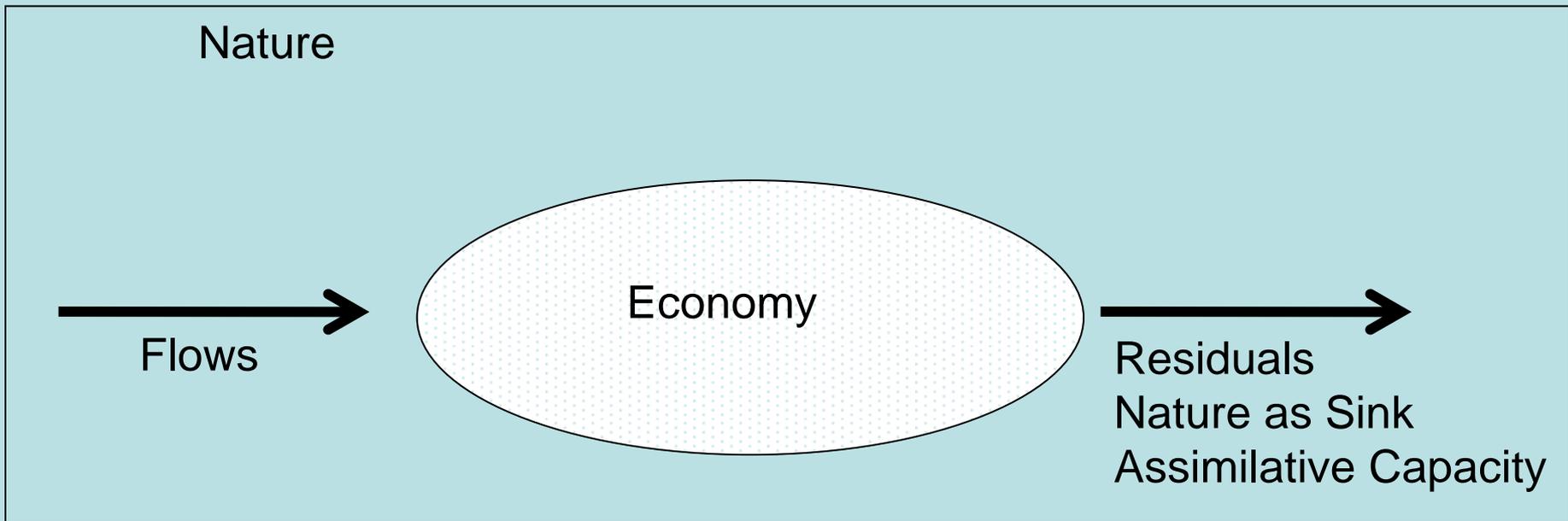


Sales Tax

A tax consumers pay in addition to the price the supplier receives



**Environmental
(Natural Resource)
Economics**



The flows from nature that have value will depend on
Technological Adoption
Economic, Legal, and Regulatory Institutions
Socio-demographic factor
Tastes and Preferences

External costs or benefits generate a gap between market efficiency and social efficiency

Dynamics implies use today can affect future use

Value may be difficult to measure because flow is not traded in a market.

Socially Optimal Rates of Resource Use

Social Efficiency

Resources are used *efficiently* if they produce the maximum net social benefits.

optimal use will depend upon

value of resources in alternative uses

natural rate of replenishment

economic incentives

institutional arrangements (property rights)

Are there other criteria to determining best use?

Sustainability

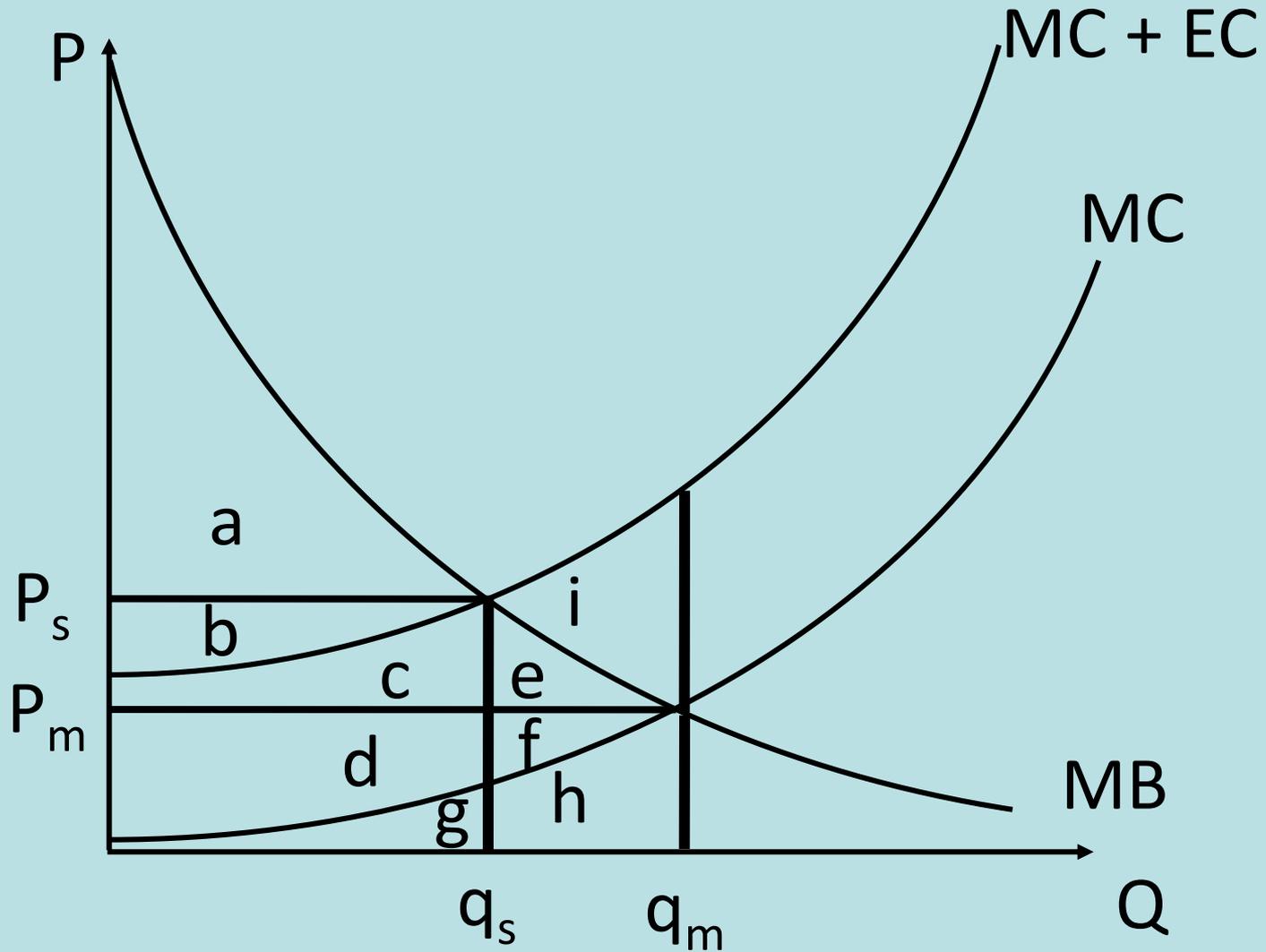
Equity

Externalities

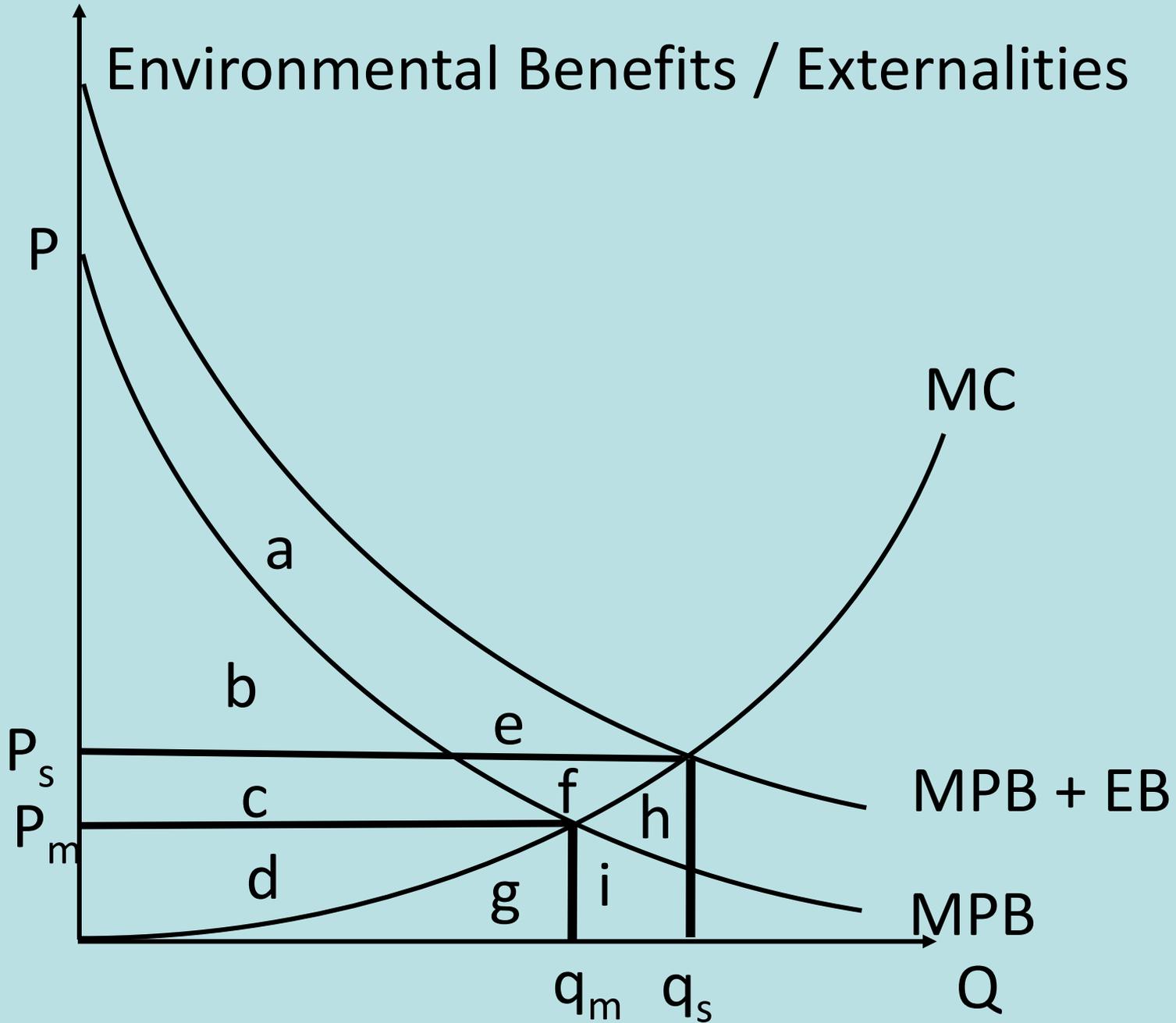
External Costs are costs incurred by people who are not party to the decision making process.

External Benefits are benefits enjoyed by people who are not party to the decision making process.

Environmental Costs / Externalities



Environmental Benefits / Externalities



Accounting for Benefits and Costs Over Time

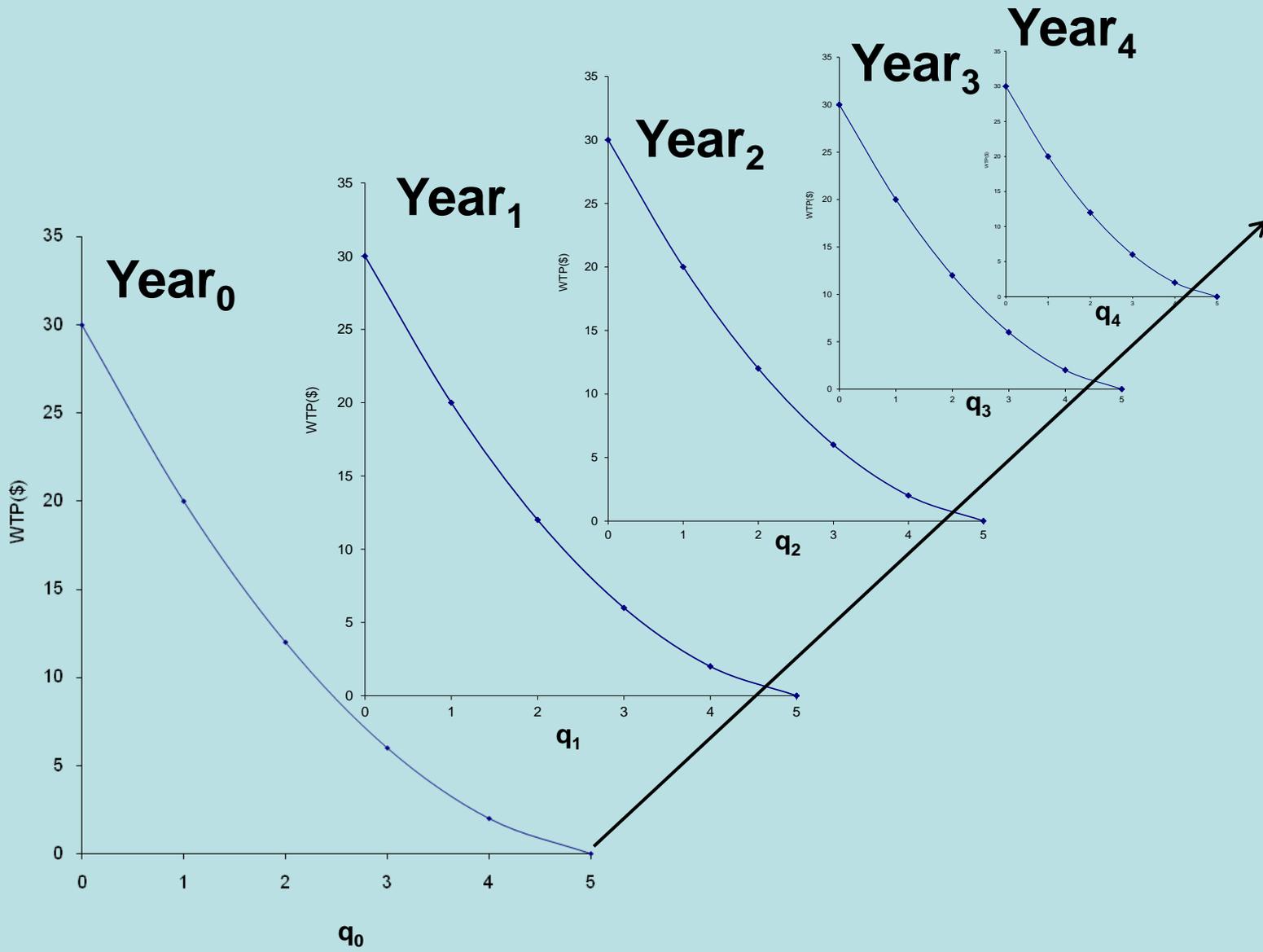
Aggregate Stream of Current and Future Net Benefits

Resource Use is Inherently Dynamic

Benefits and costs may accrue today and in the future

How then do we add up the net benefits from use today with use in the future?

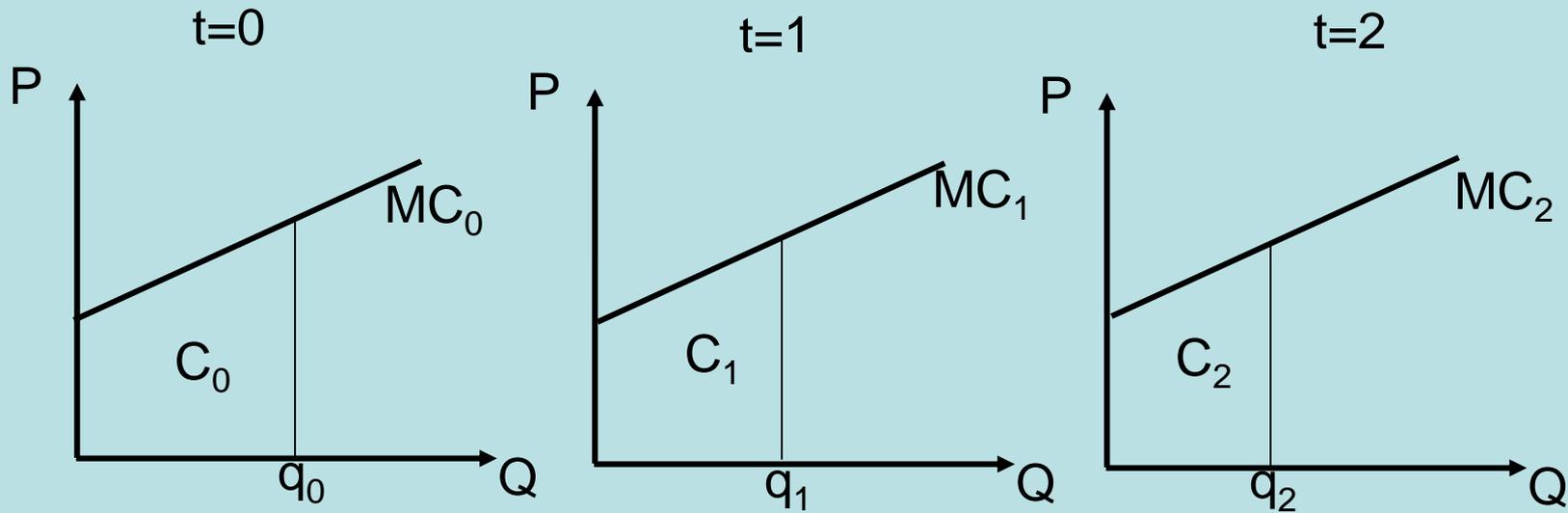
$$PV = \frac{FV}{(1+r)^t}$$



$$PV = \frac{M_0}{(1+r)^0} + \frac{FV_1}{(1+r)^1} + \frac{FV_2}{(1+r)^2} + \dots = \sum_t \frac{FV_t}{(1+r)^t}$$

	<u>Benefit</u>	<u>5%</u>
year0	100	100
year1	100	
year2	75	
year3	50	
year4	25	
PV	350	

Present Value of Costs



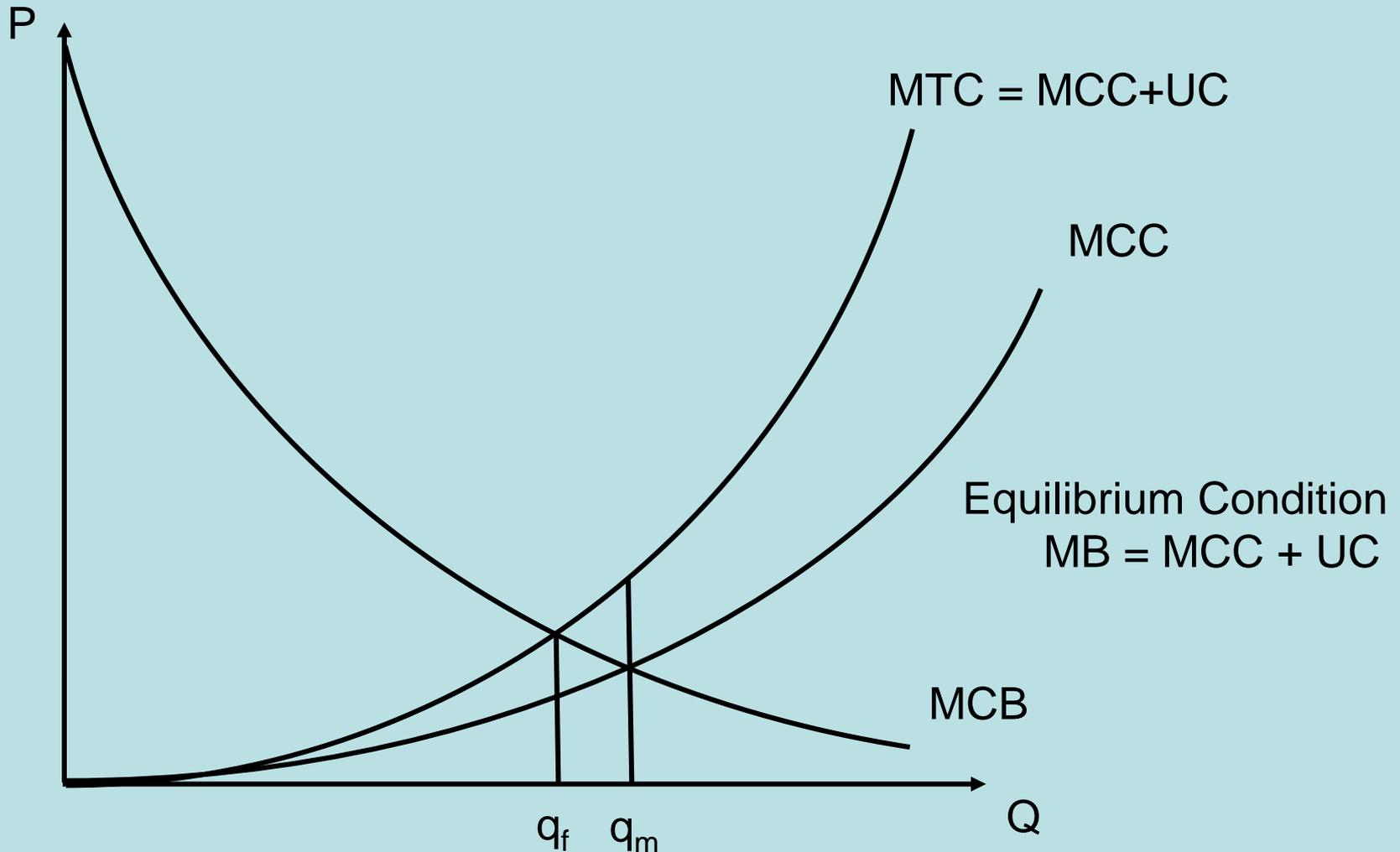
$$\text{PV of Costs} = \frac{C_0}{(1+r)^0} + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \dots = \sum_t \frac{C_t}{(1+r)^t}$$

$$PV = \frac{B_0 - C_t}{(1+r)^0} + \frac{B_t - C_t}{(1+r)^1} + \frac{B_t - C_t}{(1+r)^2} + \dots = \sum_t \frac{NB_t}{(1+r)^t}$$

	year0	year1	year2	year3	sum	0.05 PV	0.06 PV
benefit	500	450	120		1070		
cost	400	350	337		1087		
	year0	year1	year2	year3	sum	PV	PV
benefit		500	450	120	1070		
cost	400	350	337		1087		
	year0	year1	year2	year3	sum	PV	PV
benefit	500	450	120	0	1070		
cost	0	400	350	337	1087		

Dynamic Efficiency = Maximum Present Value of Flow of Net Benefits

Requires selection of a time series of decisions that incorporates future consequences stemming from today's decisions (user costs)



Public Policy

Public Policy - Collective Action

- Different policies for different circumstances
- Policies involve political Ideologies and strategies
- What are the economic incentives embodied in various policies?
- Which policy is “Best” for the given resource problem?

What criteria shall we use to evaluate policies?

Policy Objective: Economic Efficiency

Max Social Net Benefits

Why is this Difficult?

-Includes Market And Nonmarket Benefits and Costs

Information Problem

Goal of Max Social Net Benefits seems reasonable for policy that favors public interest.

All else the same, an efficient policy is preferred to an inefficient policy

Policy Objective: Equity

– “Fair” Distribution of Net Benefits

Why Is This Difficult?

-Hard to determine what is a fair distribution.

-Benefits are widely spread across population while costs are localized

-Costs are widely spread across population while benefits are localized

-Local optimal rates of use may differ from national rates

-Ability to pay may provide access to political markets

-Intergenerational equity

All else the same, a more equitable distribution of the PVNB is preferred to a less equitable distribution

Flexibility

- Does a policy adapt to changing circumstances

Policy must be able to adapt to new circumstances

Enforceability

- Enforcement is costly and budgets are limited
- Leads to less than perfect enforcement

Types Of Policies

Incentive-based Policies

- Market/Property Right Policies

Ill-Defined Property Rights Are Commonplace Among Resource Use Problems

These Policies Define and Enforce Property Rights and Markets For Trading

- Government-Sponsored Incentive Policies

Taxes and Subsidies

Direct Controls

- Command and Control Policies

Establish Controls on Private Use of Resources

Examples: Catch Limits, equipment limits, season limits

- Direct Government Ownership of Resource

Government Produces and Distributes Resource

Examples: National Parks, Grazing on BLM Land, Timber Sales

Consider the problem of protecting the CA sea urchin fishery from being overfished due to ill-defined property rights.

Divers Pluck Urchins From Rocky Coastline

How would each policy look?

The Sea Urchin Fishery

Market/ Property Right Regime

- ⇒ Delineate Coastline And Provide Individual Tradable Leases For Each Segment
- ⇒ Agency Records Lease Ownership and Trades, and Enforces Exclusive Rights – No trespassing

Policy Internalizes Externality and User Costs

Important Characteristics of Property Rights

1) Completeness -Non-attenuated

No limits impede the owners ability to maximize stream of net benefits

2) Enforceable

Exclusion provides strong incentive to maintain maximum stream of net benefits

3) Transferable

Without transferability there is no incentive to maintain maximum market value of resources (i.e., Include user costs)

4) Competitive Marketplace

Markets must exist so resource owners can capture the full value of services produced by the resources

Ensures resources are used in a way that maximizes social value

Market/property right policy creates excludability of access to resource!

What incentive does this create for owners of the resource?

Incentive to invest in long-term viability of urchin beds

Problem:

How should property rights or leases be distributed?

Government-sponsored Incentive Policy

Agent can impose tax per pound of harvested urchins

Tax increases the cost of harvesting urchins thereby affecting the harvest rate

The agent now must determine tax rate, acquire data on harvest rate, and then collect tax

Taxes And Subsidies

Distributional implications?

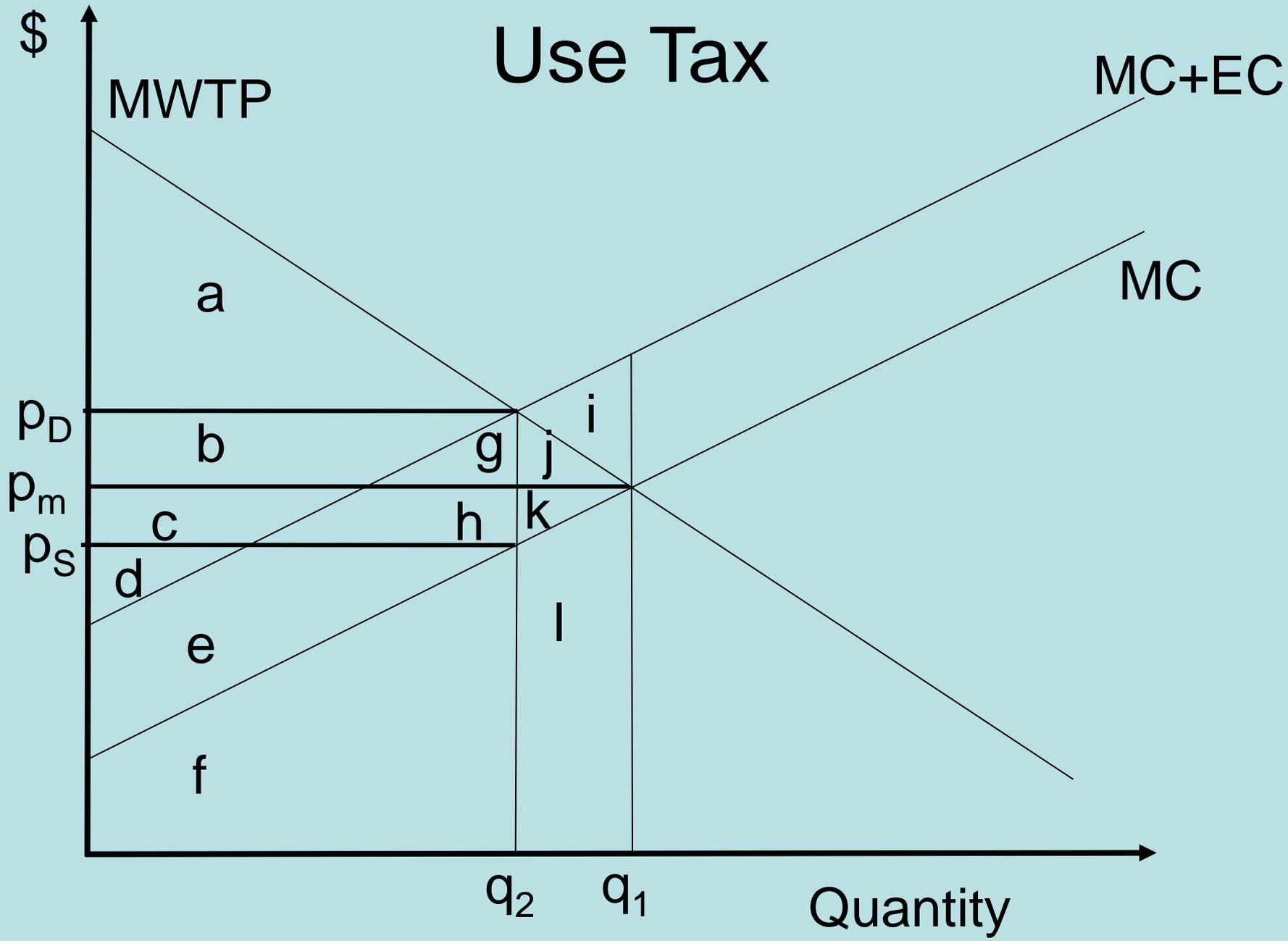
The agency collects the tax and thus the bulk of net benefits from optimal use go to the agency not the divers.

Will this be a politically attractive policy?

How can we see distribution of social net benefits?

How can we see the change in this distribution after a policy is enacted or removed?

Use Tax

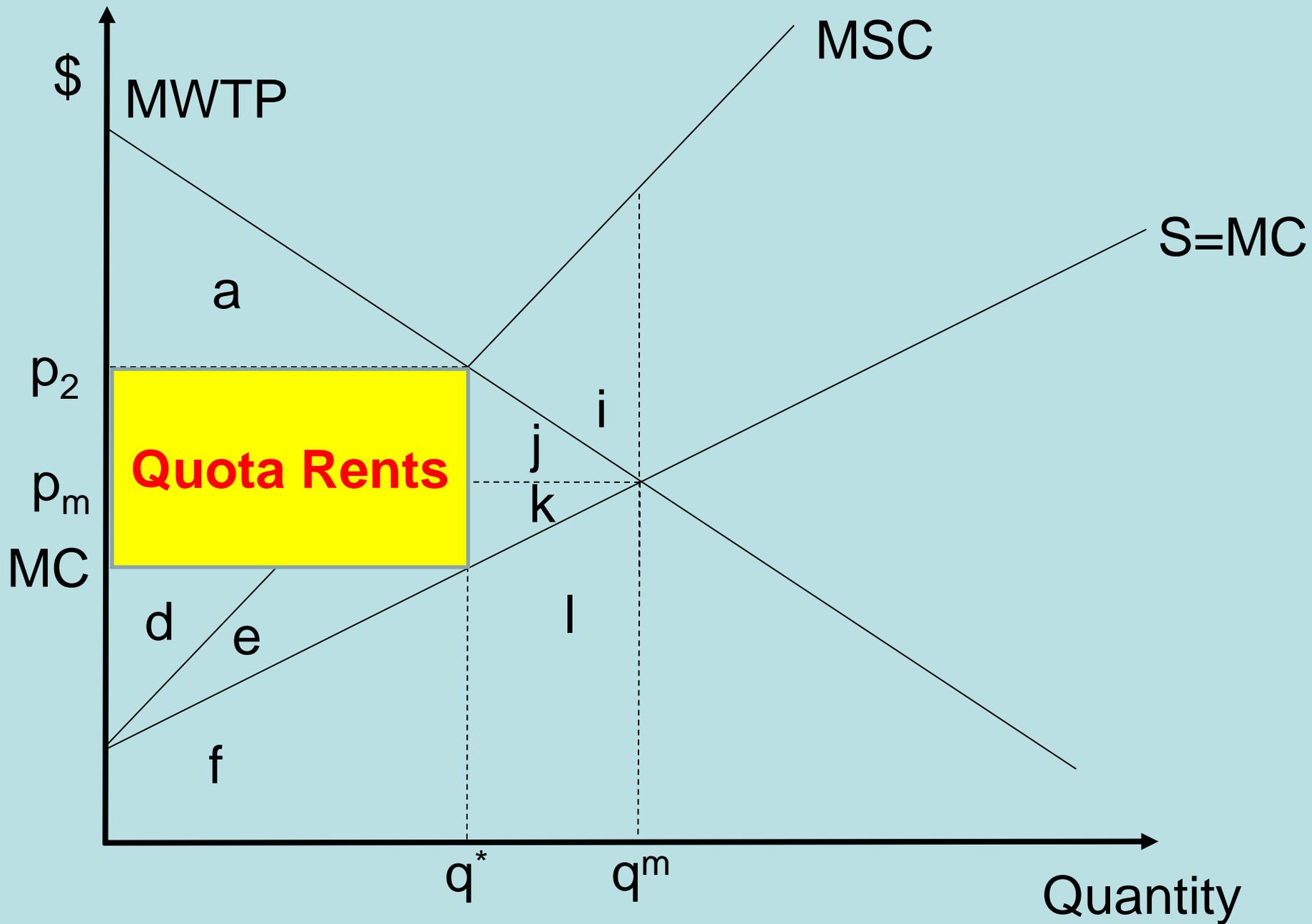


Command And Control Approach

Specify use rate and then enforce

What use rate?

Agent needs to gather info on market and nonmarket costs and benefits



How are quota rents allocated?

What if q^* is aggregate output level?

Need to know costs to each firm to allocate q^* efficiently

What other means would you propose for allocating q^* ?

What is the incentive to be noncompliant?

Direct Government Production

Examples: Public Parks

National Forests

National Monuments

Utilities

Would we expect government agencies to manage resources use such that social net benefits are maximized?

1) Private Firms are Residual Claimant

They get to keep the rewards (resource rents) from resource use

This reward creates an incentive for firms to strive toward efficiency

2) Disjoint Between Generated Net Benefits and Politically-Determined Government Budgets

We can also consider combinations of these policies

Cap and Trade

A combination of a quantity restriction and tradable property rights.

Whoever receives quota can then trade it

Market Failures Versus Gov't Failures

Markets left to themselves results in resource use that is not socially equitable or efficient

What Gives Rise to Market Failures?

External Costs and Benefits
Myopia

Government action may also result in less than socially efficient and equitable resource use.

What gives rise to government failures?

Inadequate enforcement
Perverse incentives
Redistributive not efficiency improving
Protection of privilege
Excessive information requirement

Government Failure

Subsidies as a tool to encourage resource development

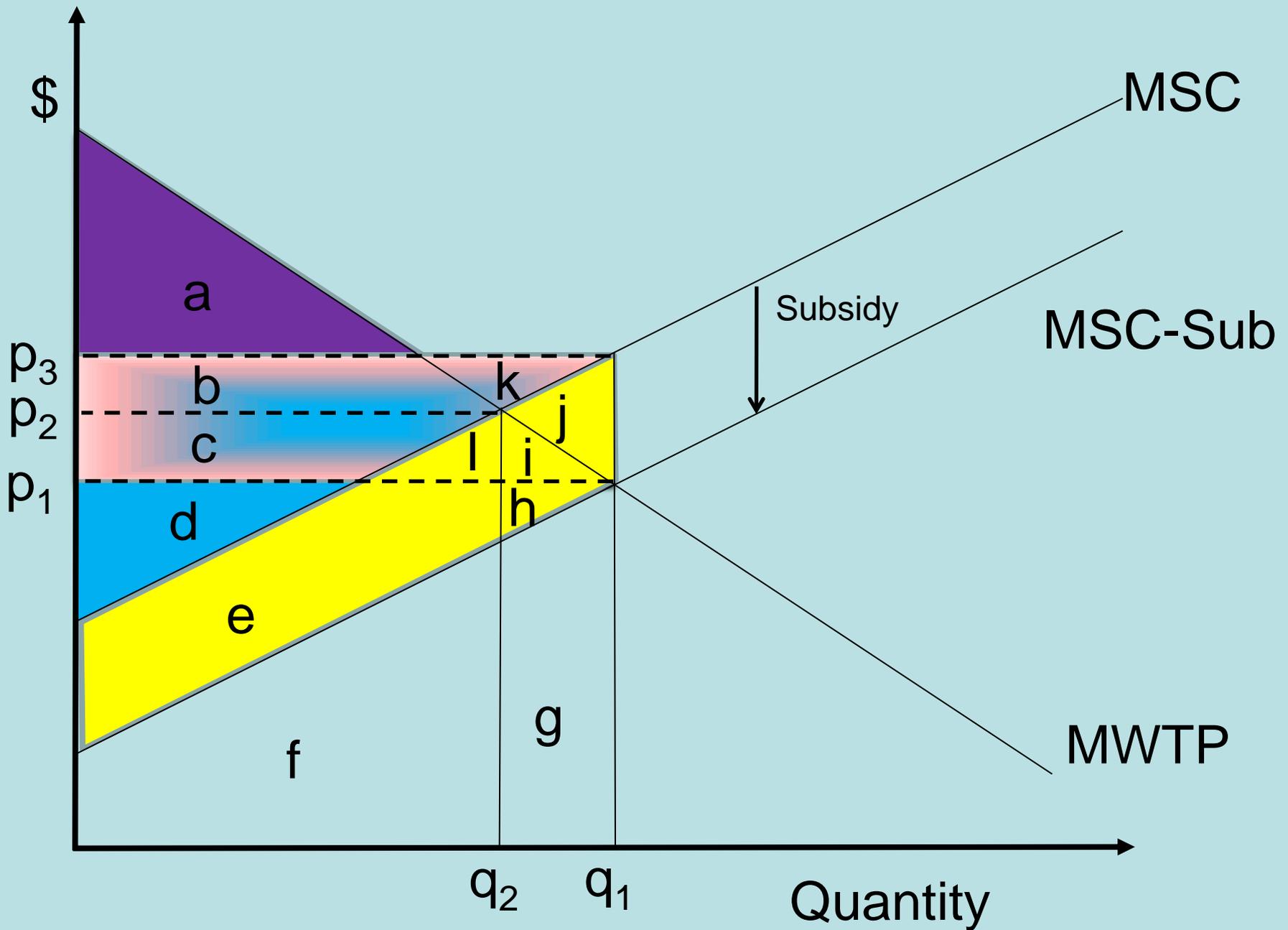
Examples:

Constructing Logging Roads

Building Dams

Below-cost Grazing On Public Land

Lifting these subsidies improves social welfare.



LUNCH?