

# Lecture 02

## Market Failures

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AEM 4510

# Roadmap

- What are market failures?
- When do they happen?
- What are the consequences?

# Market failures and the environment

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# The ideal world

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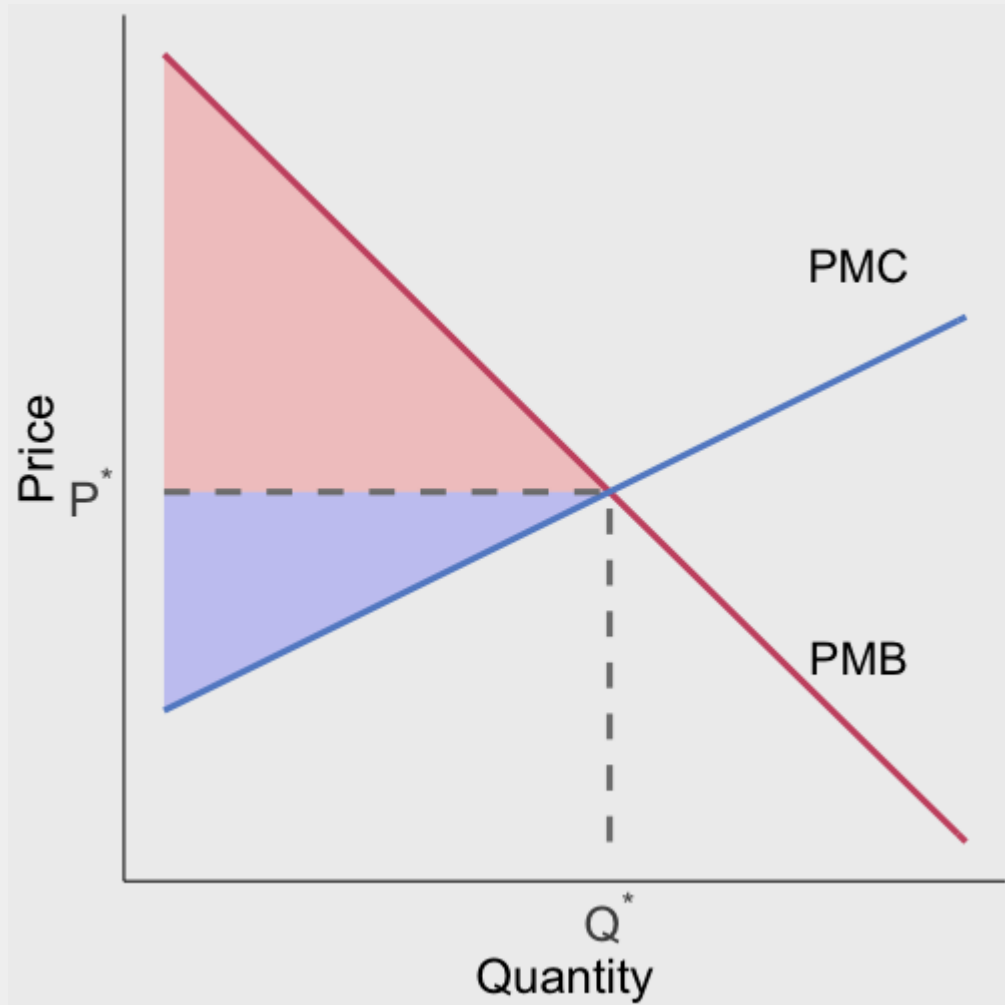
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For bread, the private costs and benefits are very likely the social costs and benefits

# Market equilibrium

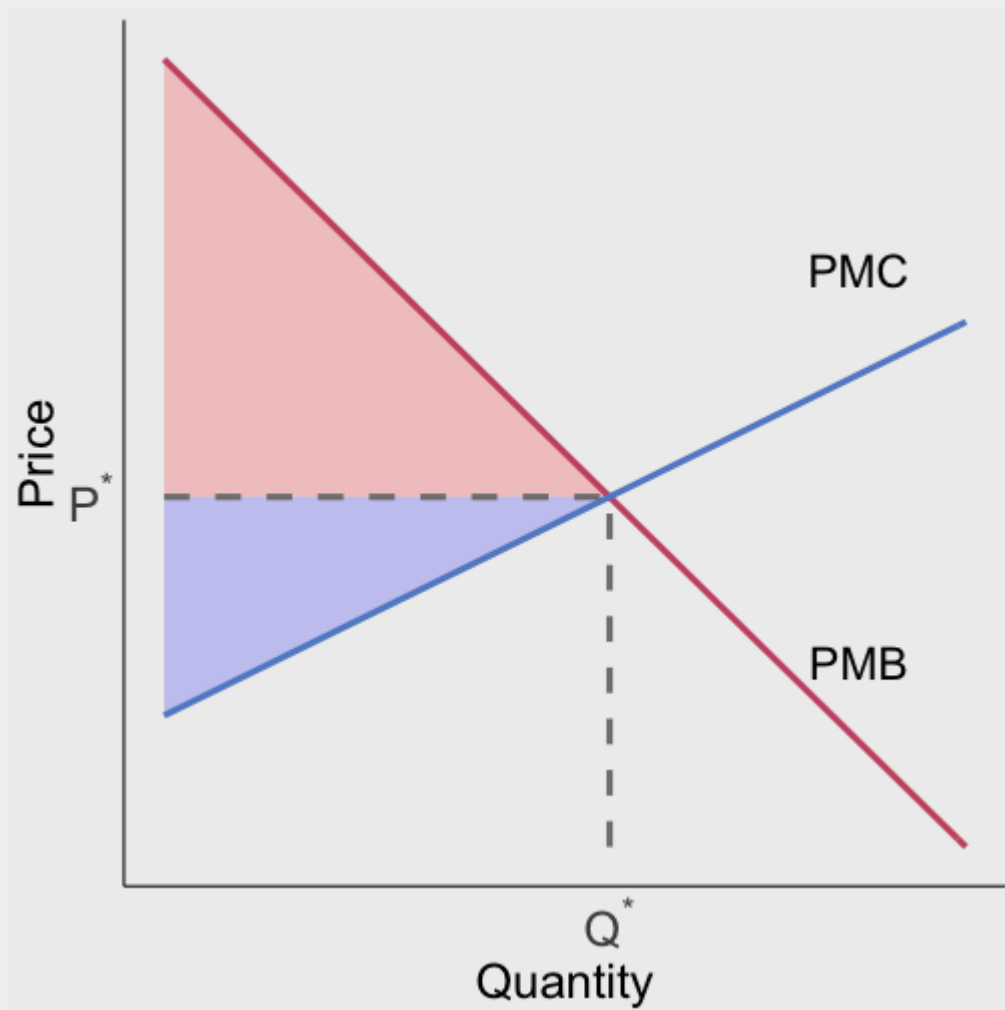


**Consumer surplus** is the difference between willingness to pay (demand) and price

**Producer surplus** is the difference between price and marginal cost (supply)

**Total surplus** is the sum of CS and PS

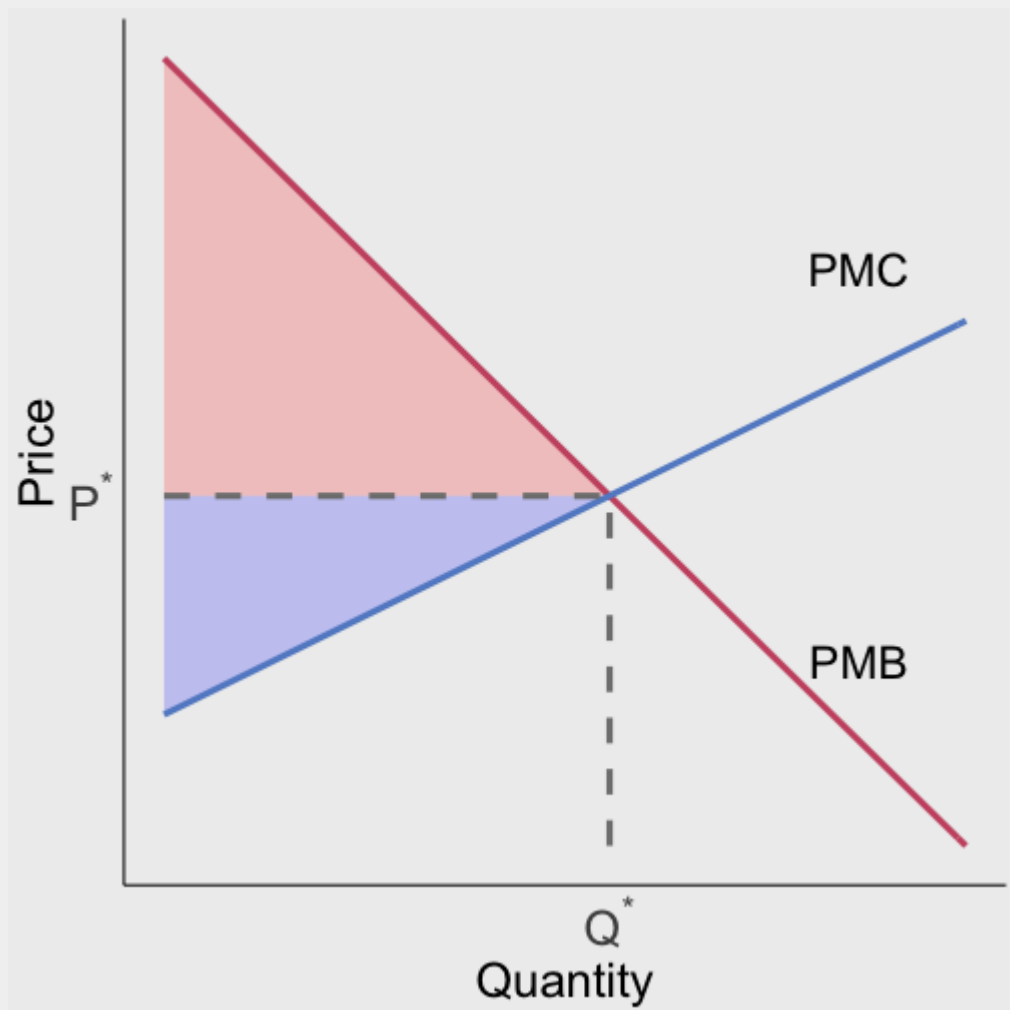
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What does this mean about the market allocation?

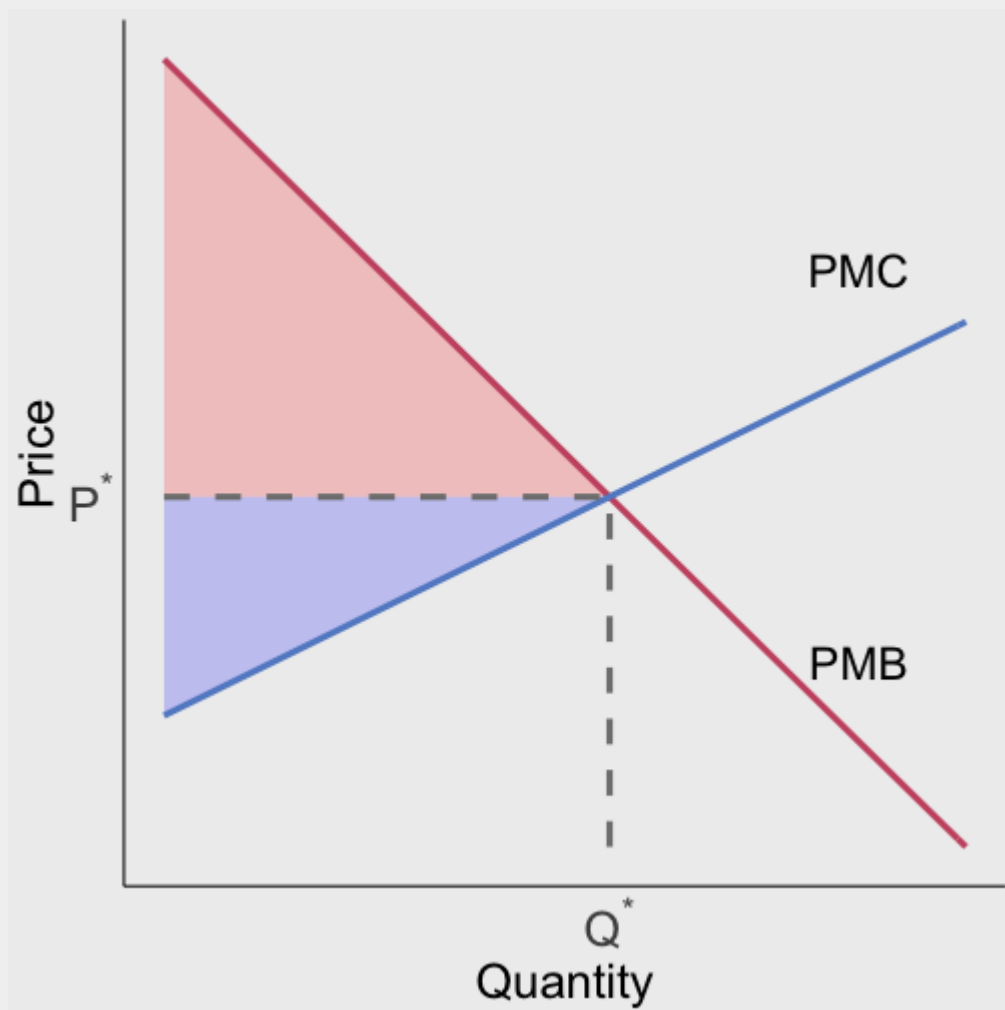
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Why?

# Market equilibrium

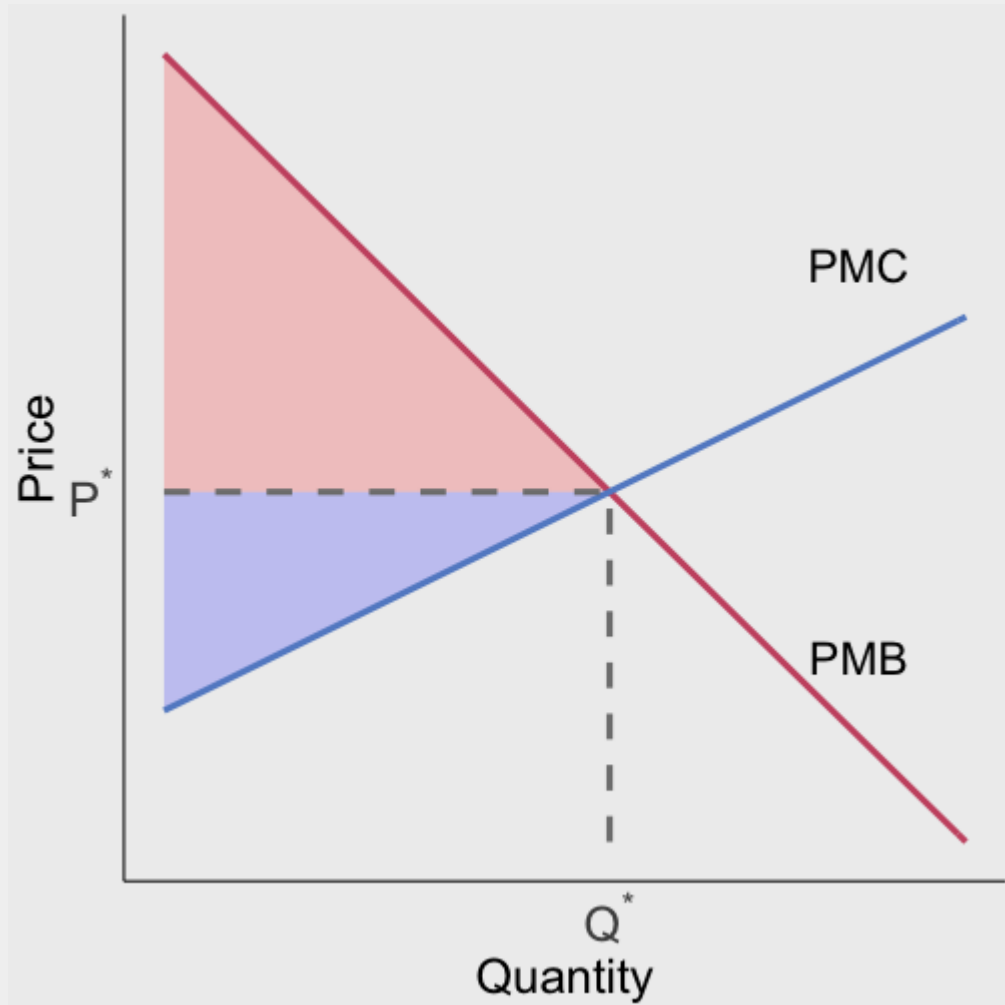


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Why?

Consider deviating from  $(P^*, Q^*)$

# Market equilibrium



Cost of next unit after  $Q^* >$  benefit

Benefit of last unit  $\geq$  cost of last unit before  $Q^*$

Competitive market allocations are efficient for private goods

# Externalities

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In the real world we have **externalities**

An externality exists whenever an individual or firm undertakes an action that impacts another individual or firm in an unintended way for which the latter is not compensated (a negative externality), or for which the latter does not pay (a positive externality)

# Externalities

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- Cleaner air outside
- Biodiversity in the Amazon

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Markets rely on prices to reflect value and have people make good decisions

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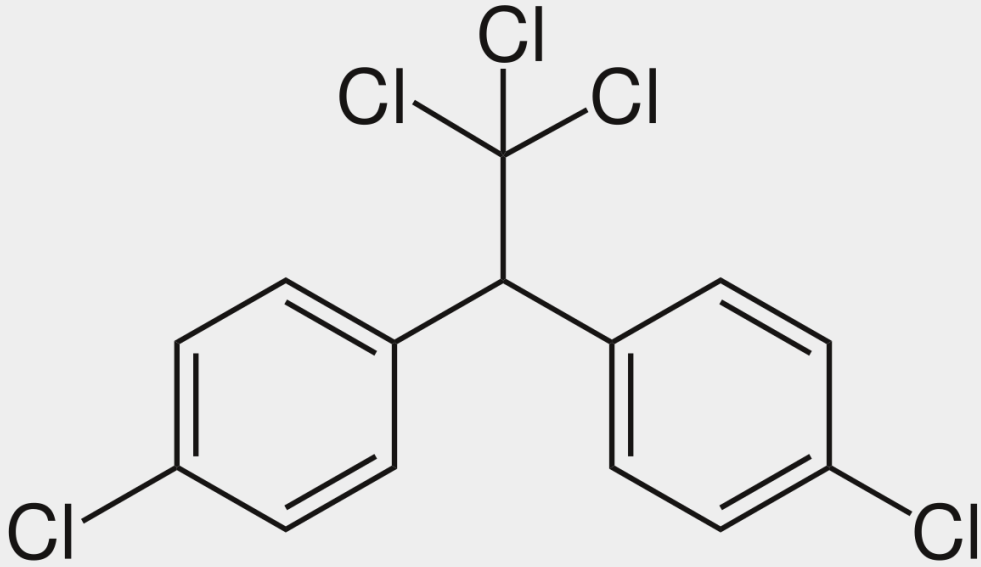
**Negative externalities:** imposes external **costs** (e.g. pollution)

**Positive externalities:** imposes external **benefits** (e.g. vaccination)

# Negative externalities: what is this?



# Negative externalities: DDT, shockingly bad for you

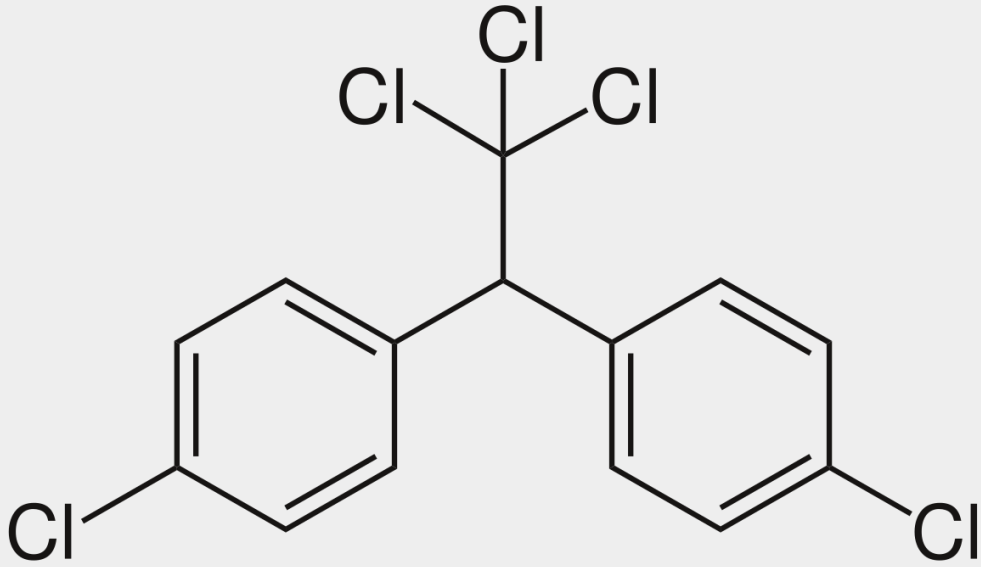


DDT is a chemical that was widely used as an insecticide in the early-mid 1900s

Widely used to eradicate Typhus and Malaria

Used to treat lice

# Negative externalities: DDT, gives you cancer



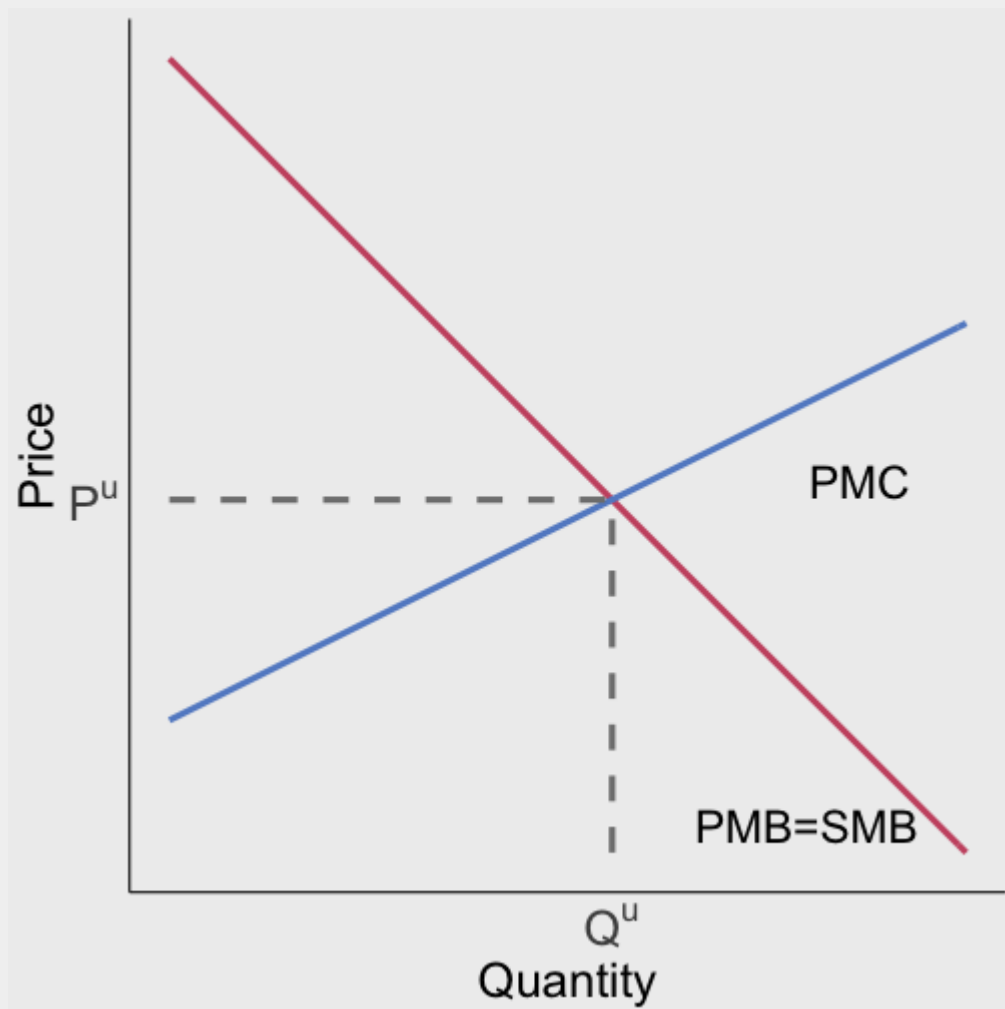
A relationship between DDT exposure and reproductive effects in humans is suspected, based on studies in animals. In addition, some animals exposed to DDT in studies developed liver tumors. As a result, today, DDT is classified as a probable human carcinogen.

# The birth of the environmental movement





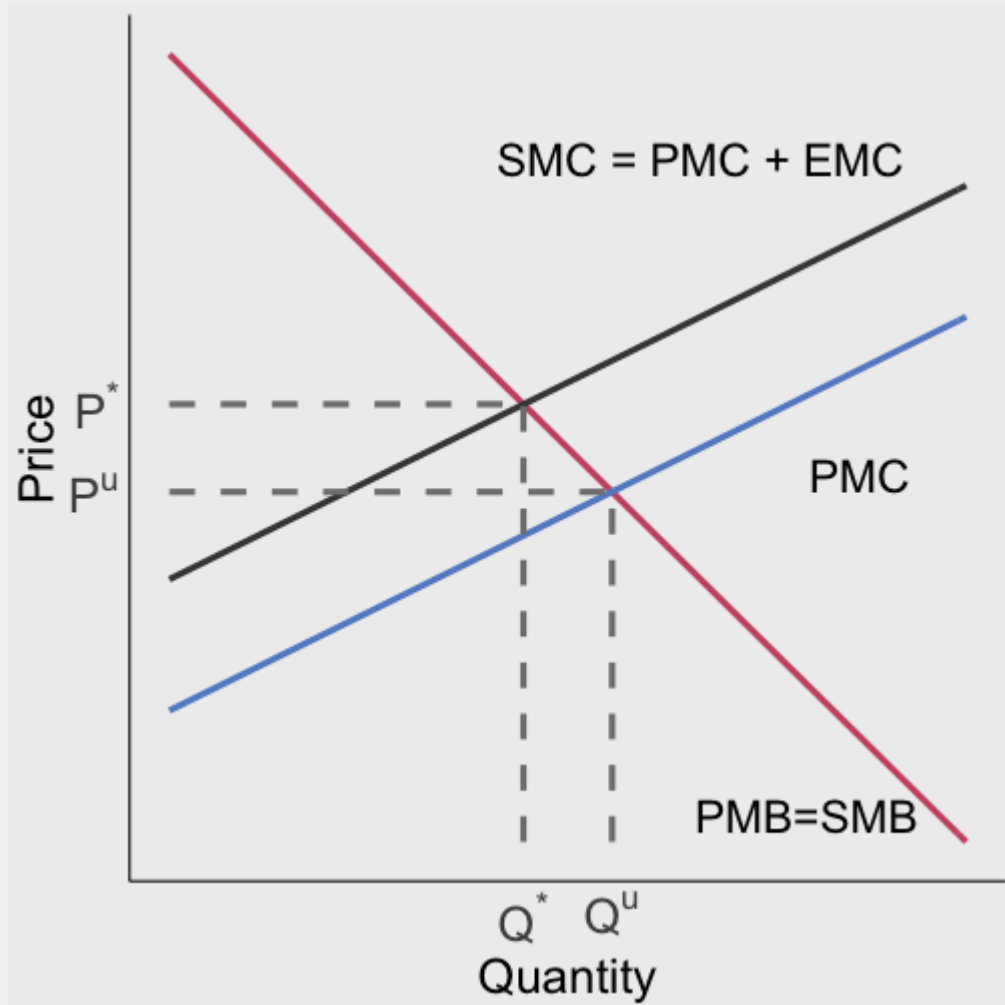
# Negative externalities: graphical



**Social marginal cost (SMC)** is the sum of private marginal cost (PMC) and the external marginal cost (EMC)

Where is the SMC?

# Negative externalities: graphical



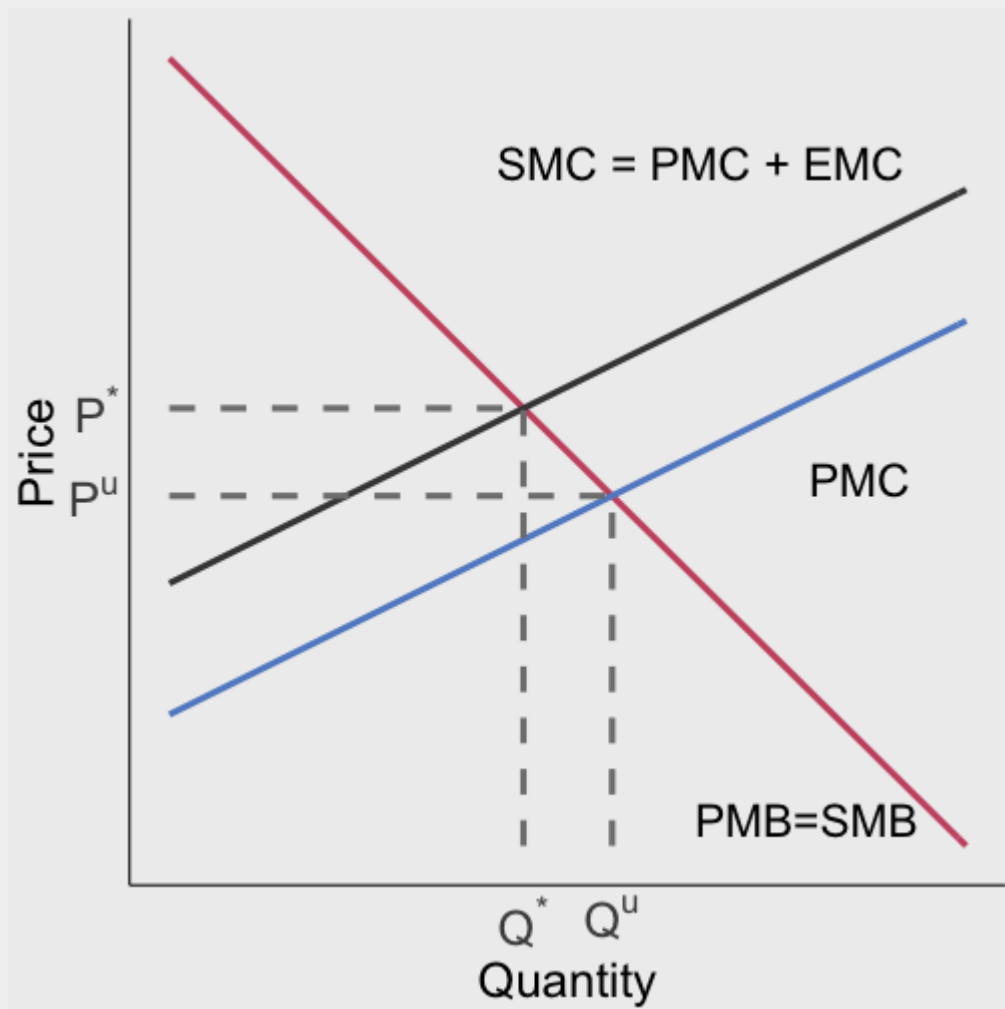
**Social marginal cost (SMC)** is the sum of private marginal cost (PMC) and the external marginal cost (EMC)

The PMC curve only reflects the **private costs** of making the DDT

It does not account for the external health and wildlife costs

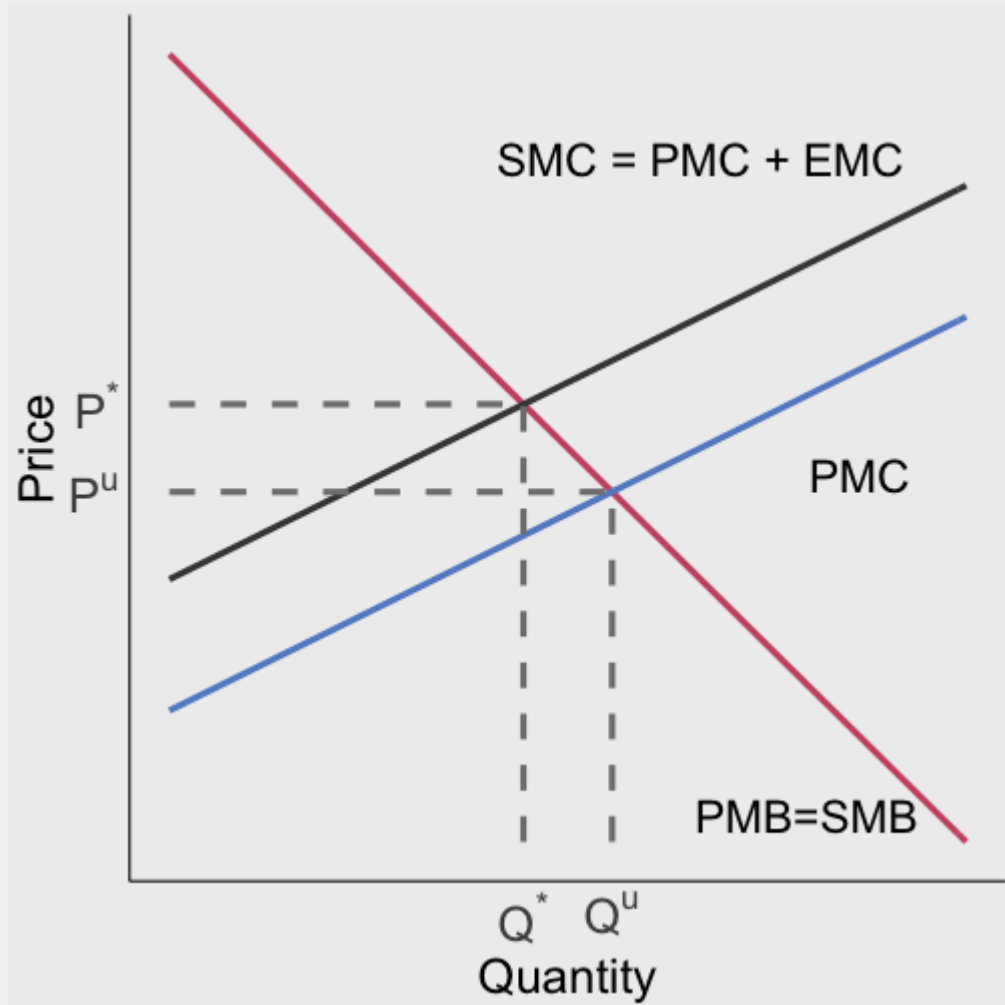


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Adding the private and external marginal costs together gives us the SMC, what we care about from the social planner or regulator's perspective

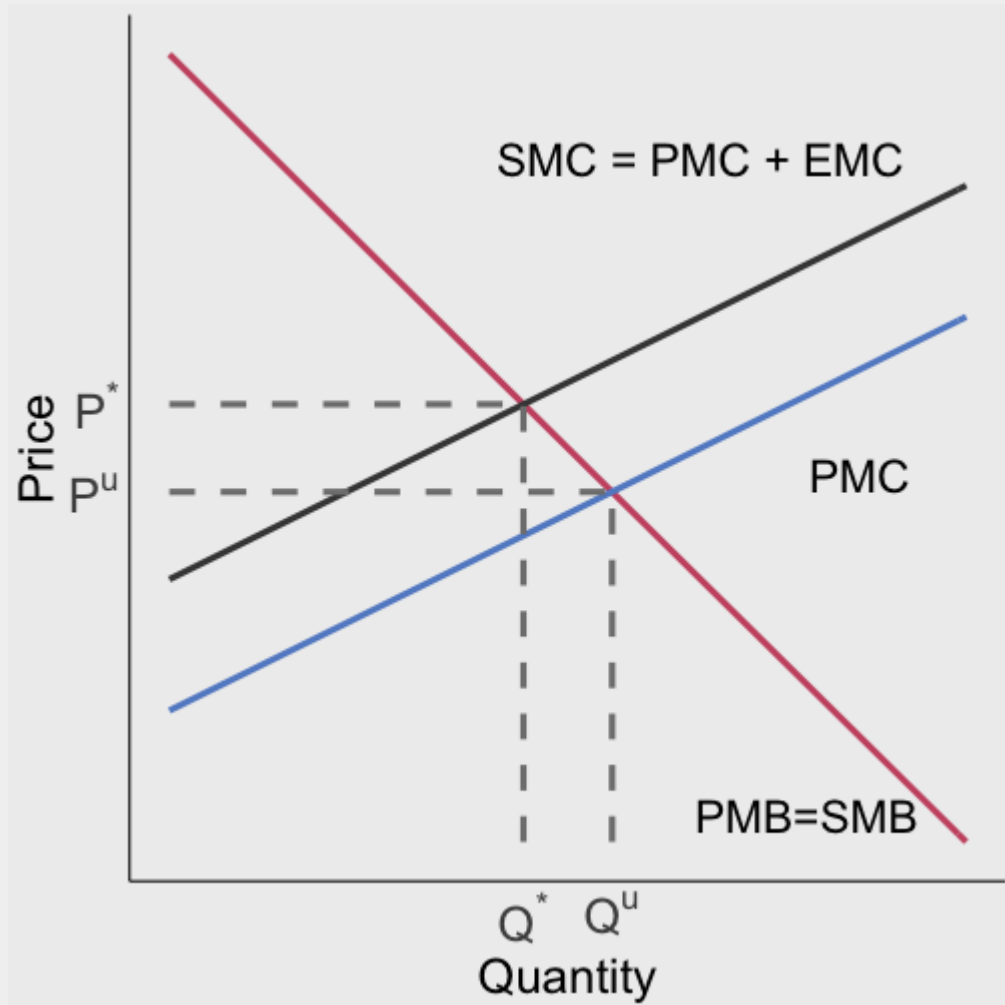
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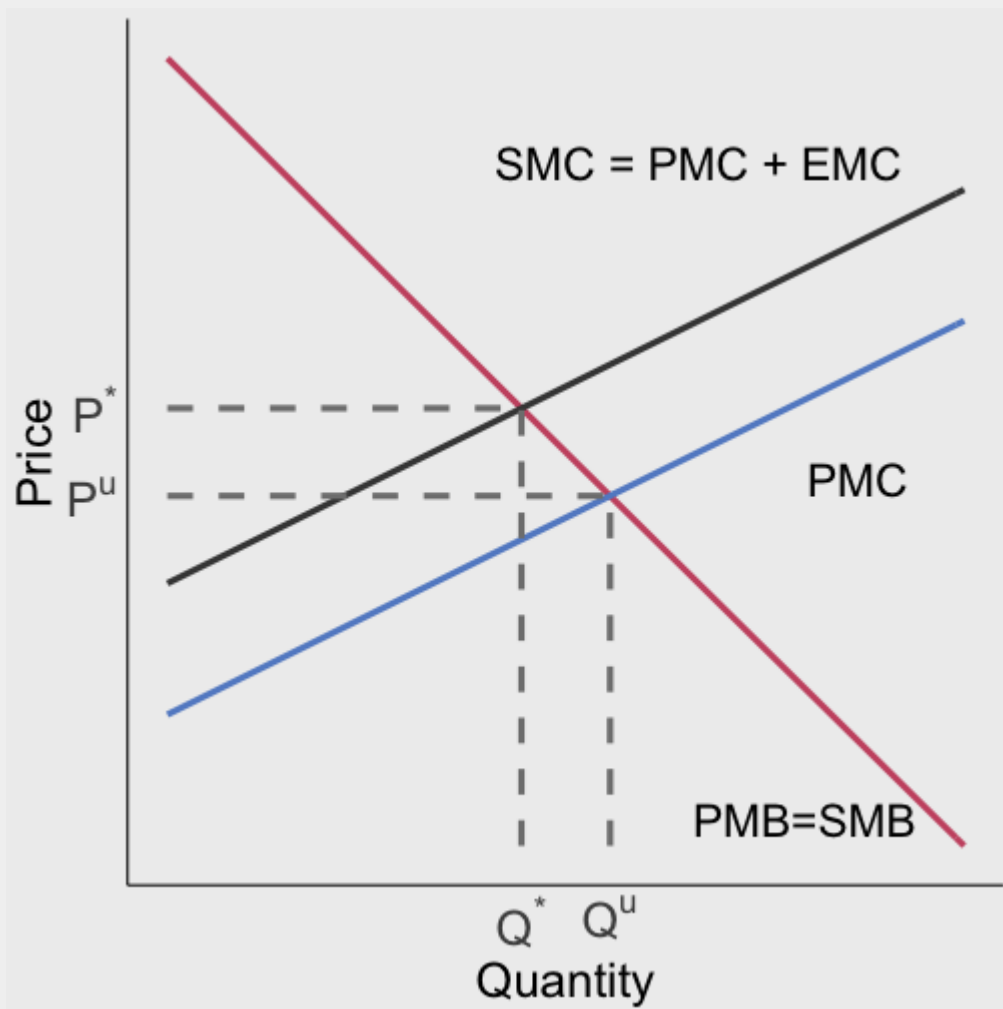


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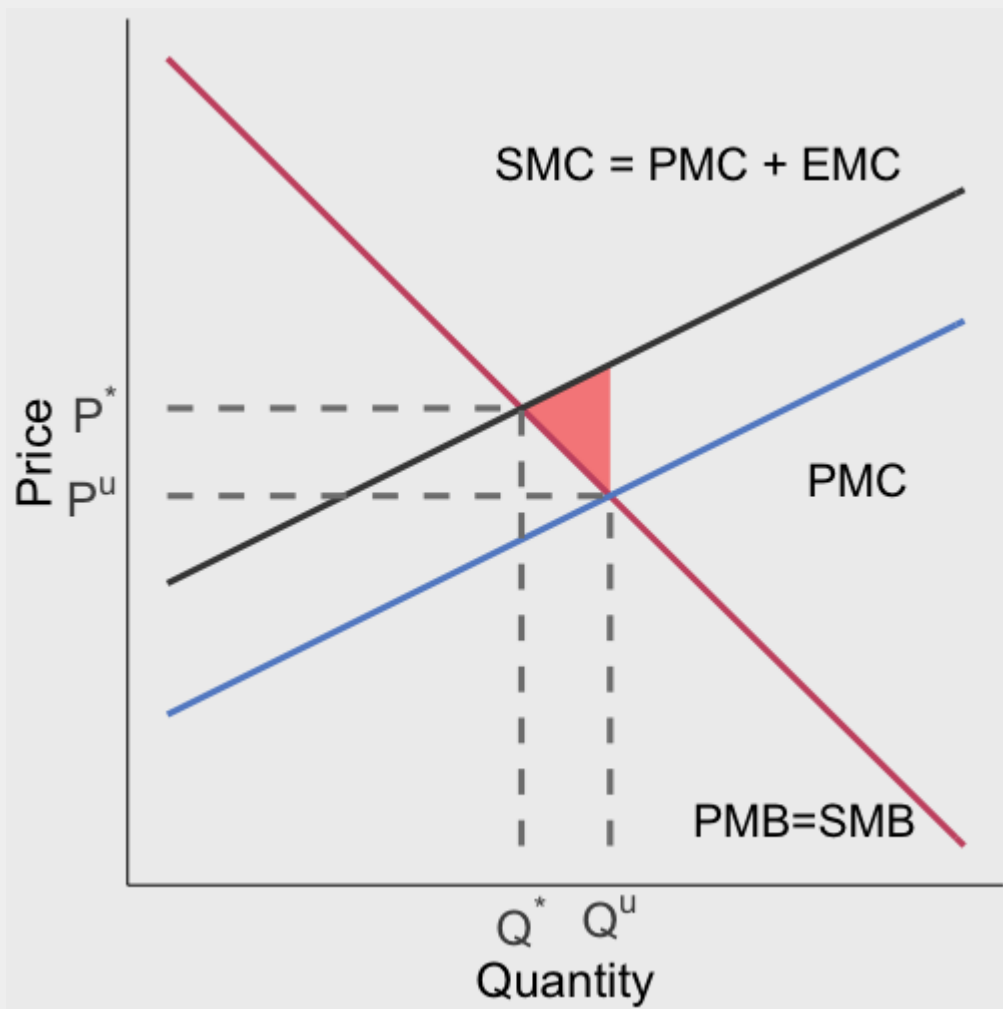
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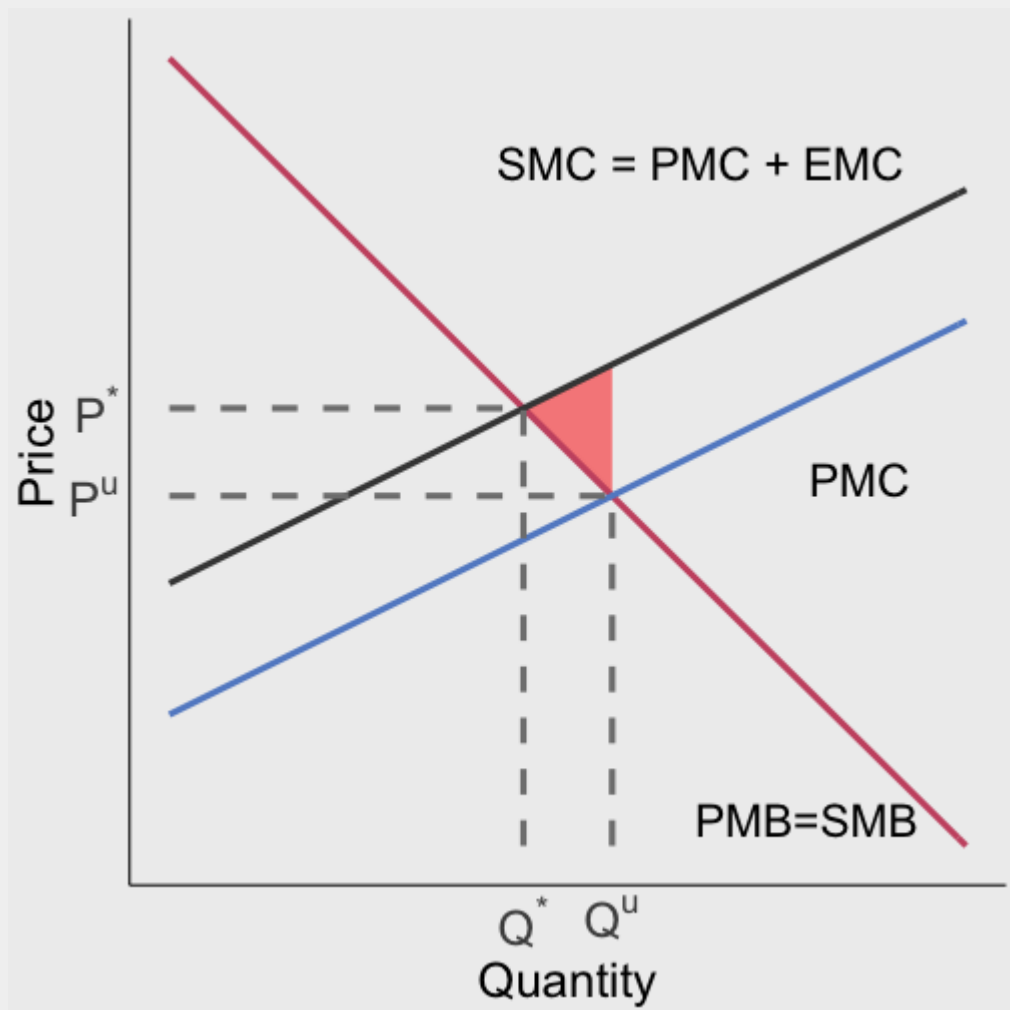
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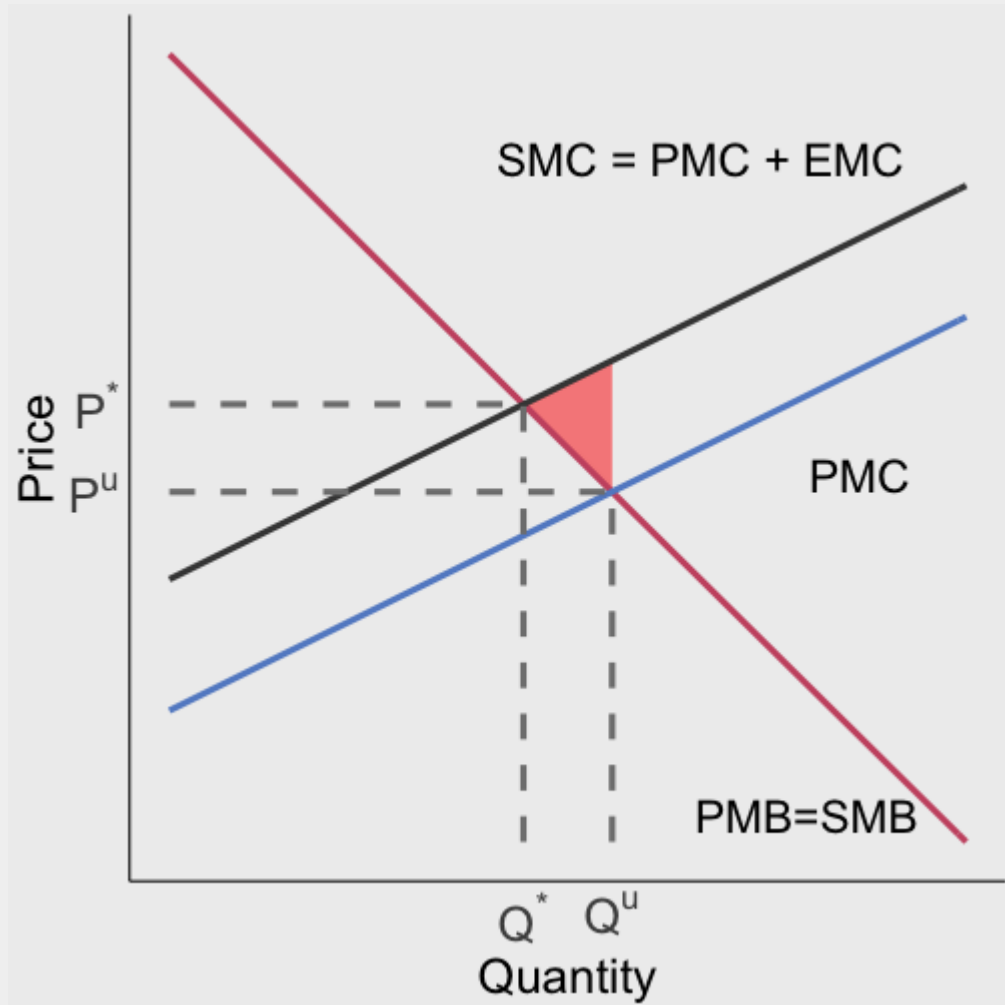


Negative externalities generate deadweight loss equal to the **red** area

This is the difference in SMC and SMB for units bought/sold where  $SMC > SMB$ :

Total  $SMC - SMB$  from  $Q^*$  to  $Q^u$

# Negative externalities: graphical



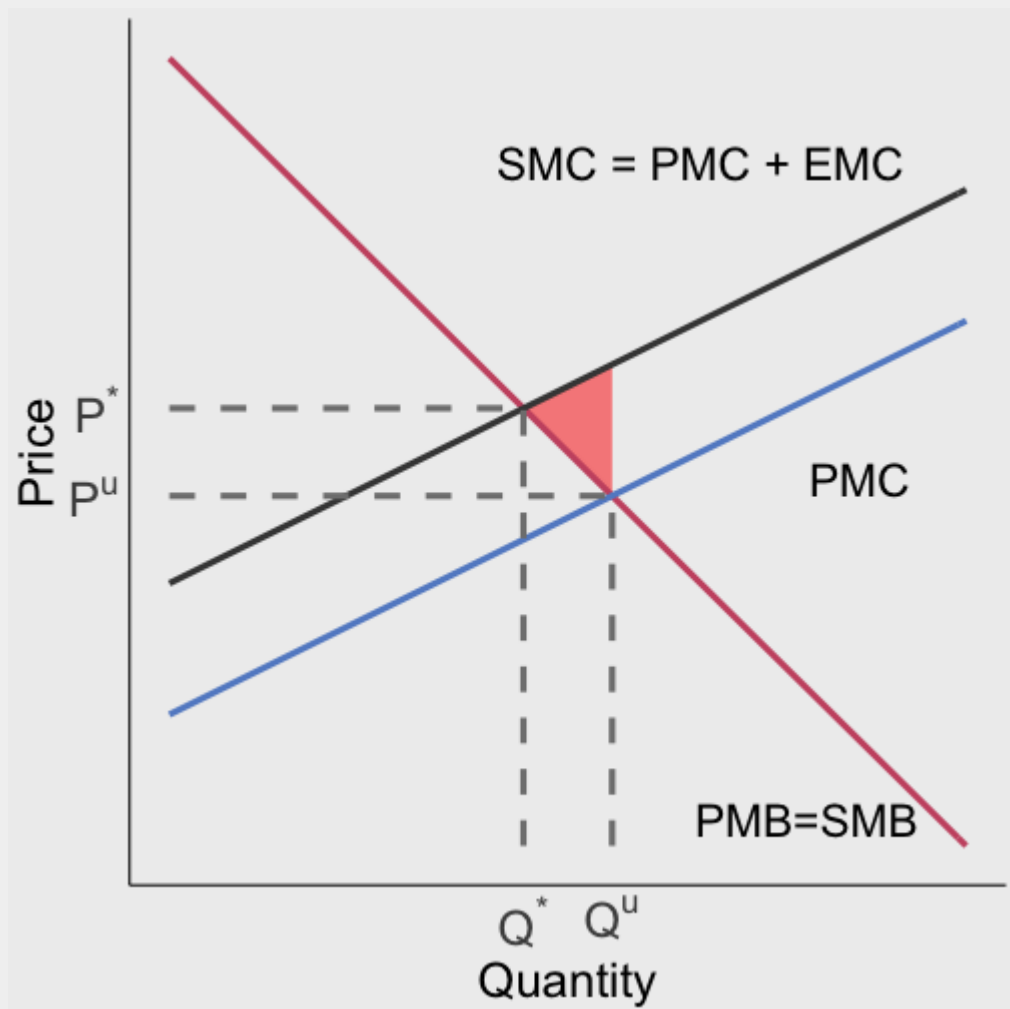
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This is the difference in SMC and SMB for units bought/sold where  $SMC > SMB$

This is the loss to society caused by the externality in the unregulated private market

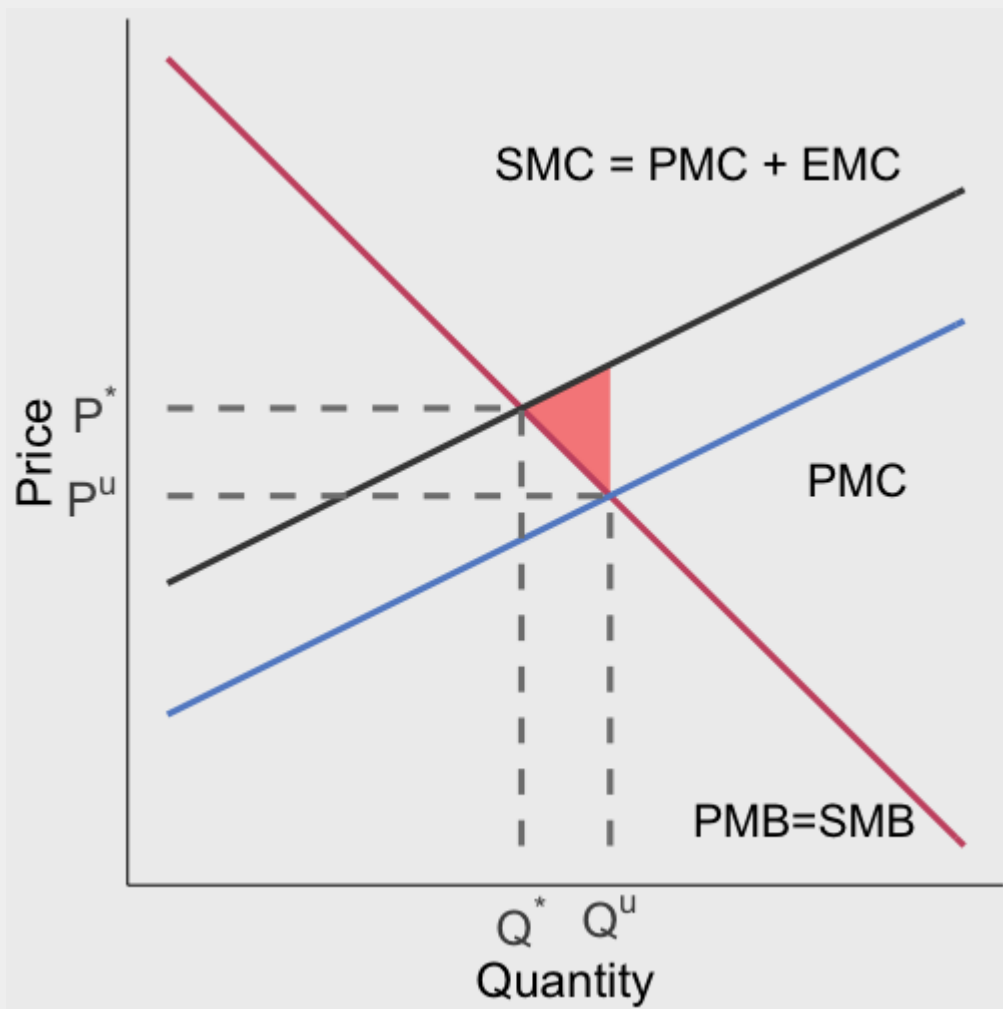
# Negative externalities: graphical

Key takeaway:





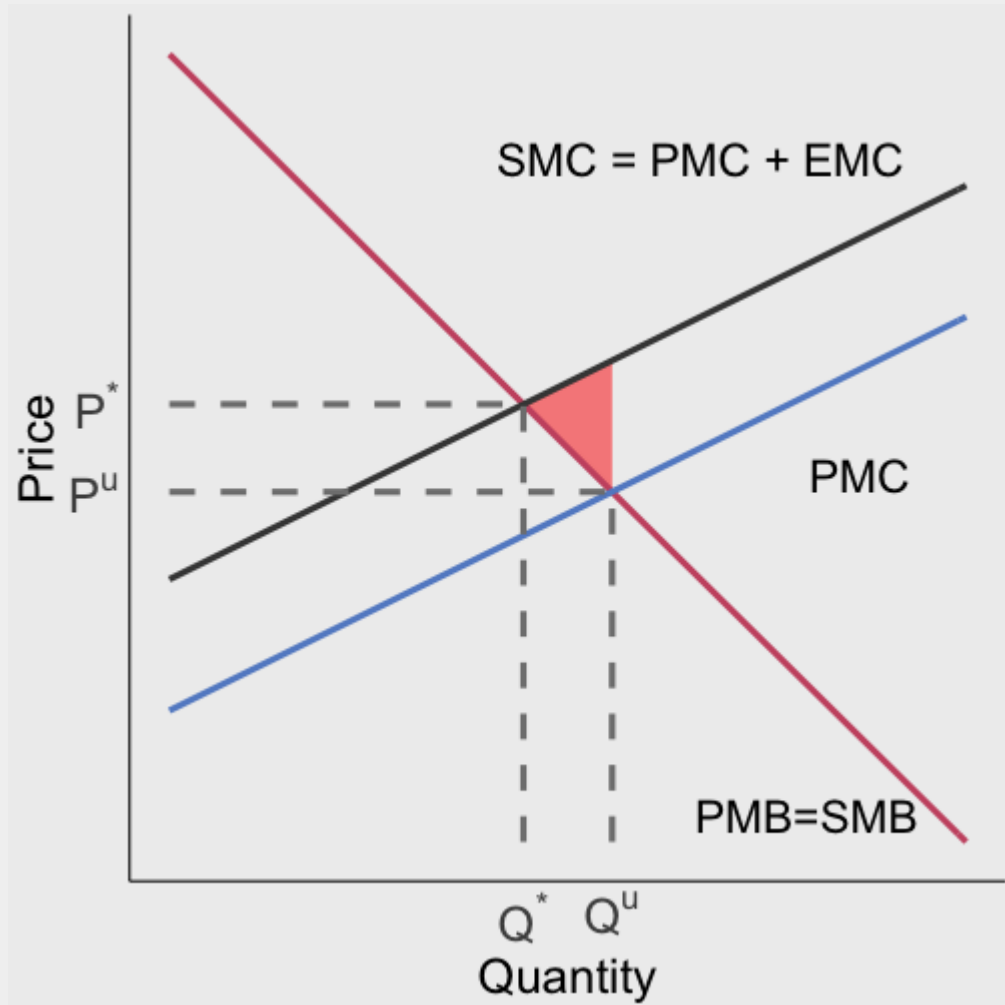
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The private market produces too much DDT

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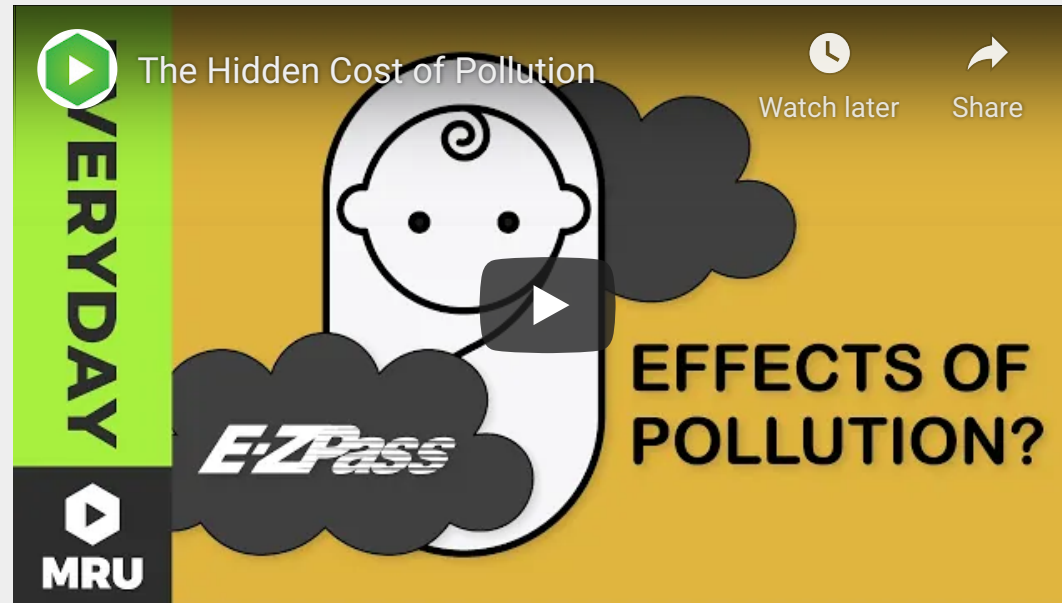


Key takeaway:

The private market produces too much DDT

The private actors are not accounting for the **external costs** they are imposing on people who are not in the DDT transaction (e.g. third parties whose health is being affected)

# Estimating marginal damages with EZ-Pass

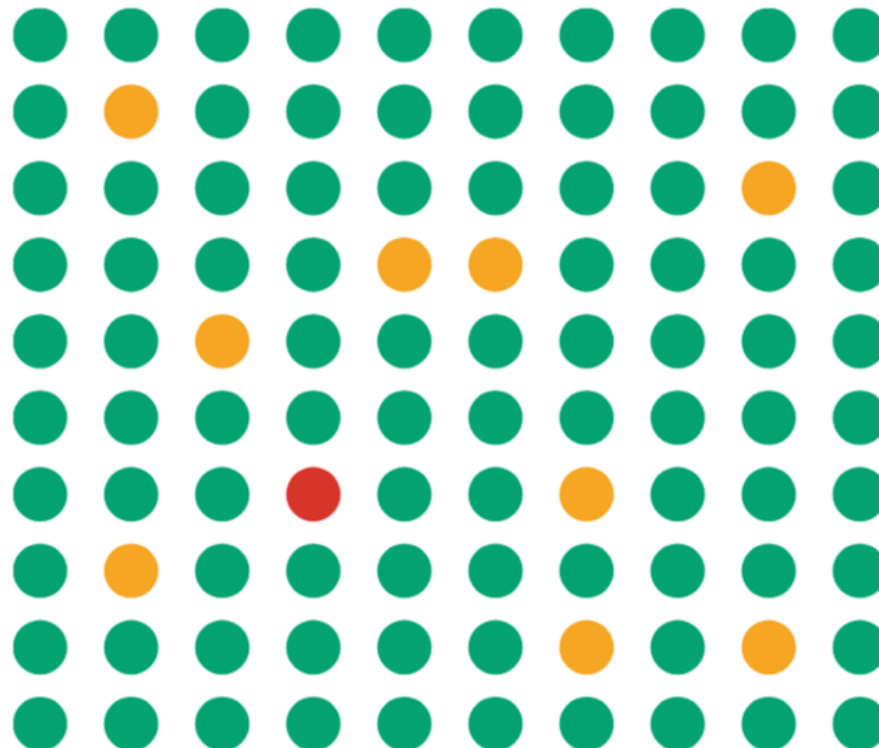


# Positive externalities

## Visualizing herd immunity

If enough people have immunity, the virus is less likely to spread because the few who aren't immune are less likely to come in contact with someone who is infected.

■ Immune ■ Not immune ■ Infected



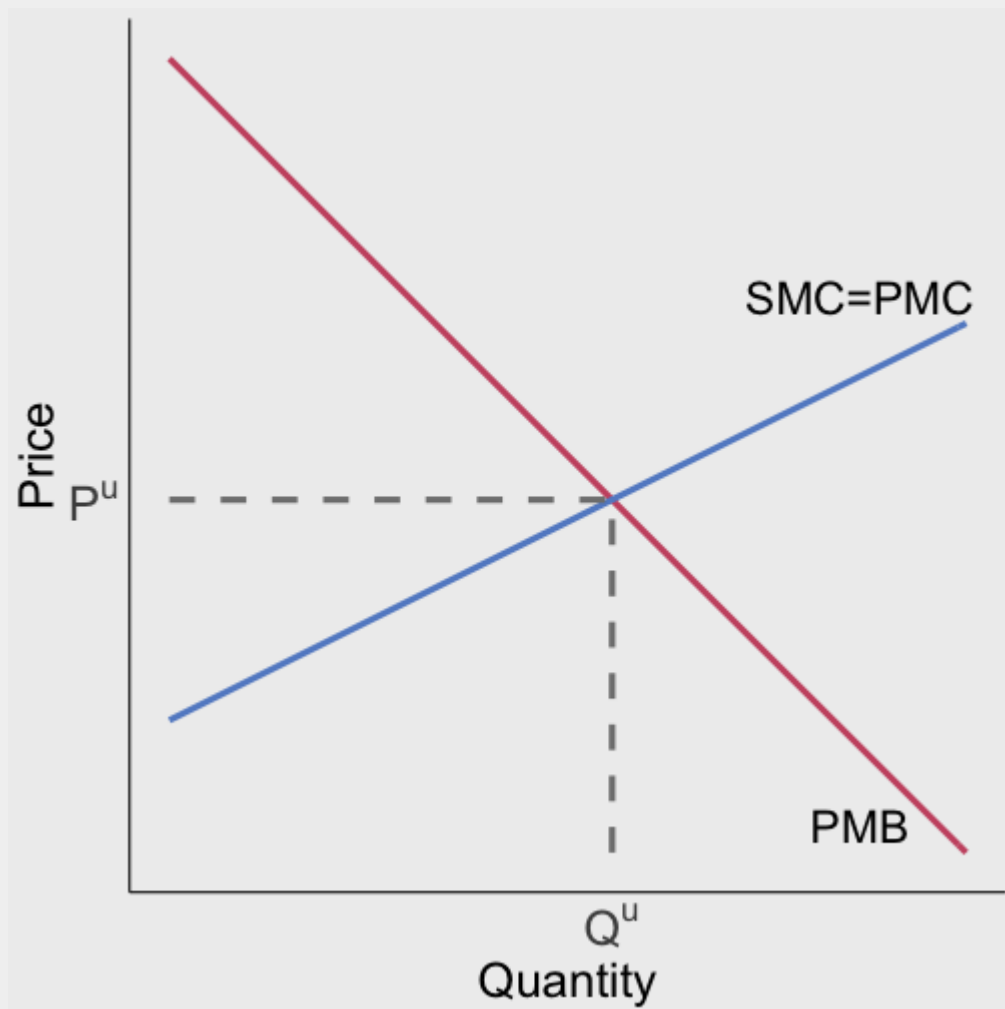
# Positive externalities



Vaccines and masks are examples of good with positive externalities

You getting or using them has benefits for other people not involved in your vaccine or mask transaction

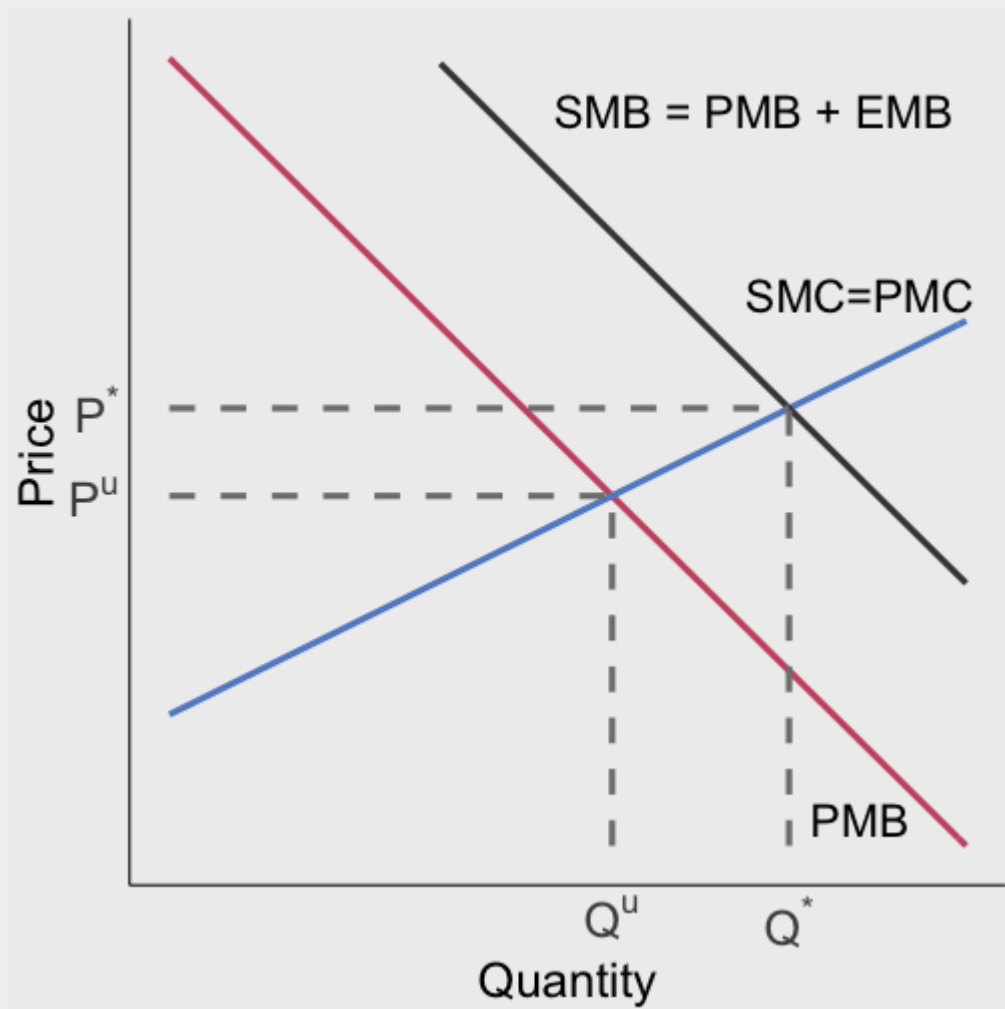
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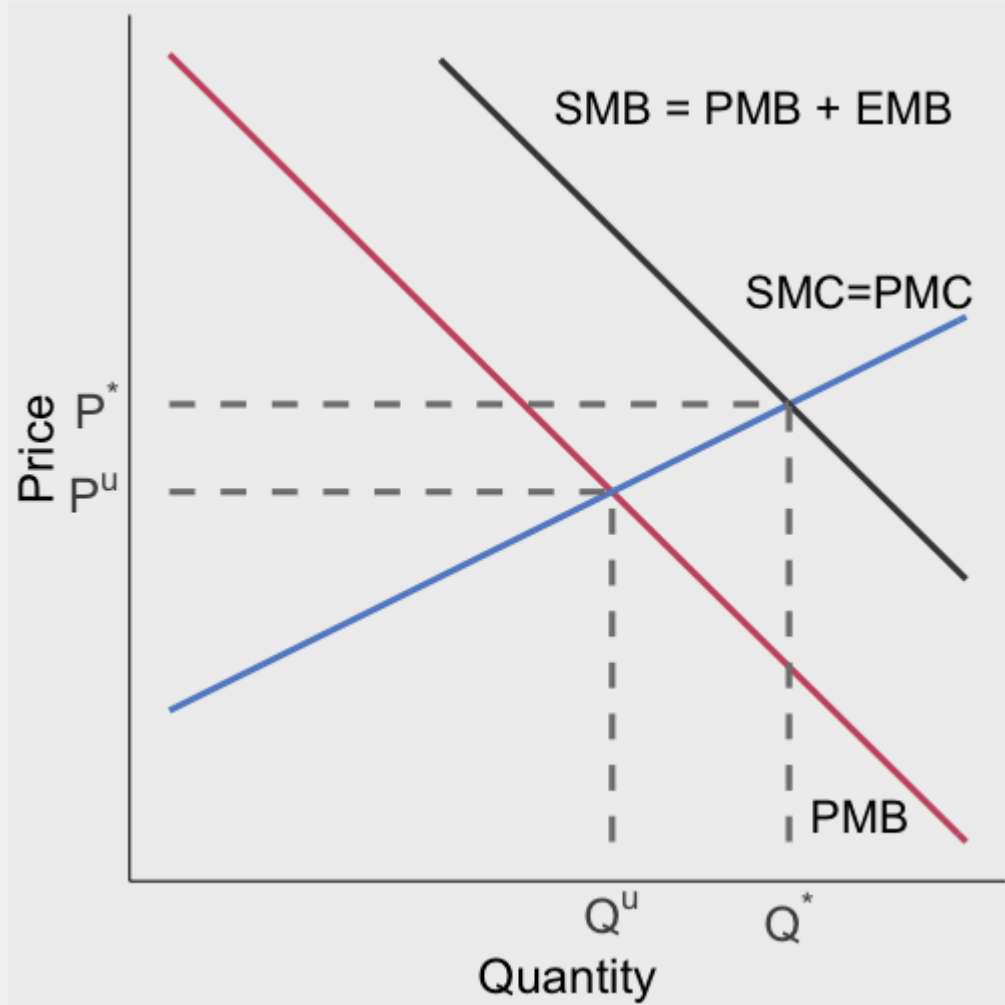
Where does the SMB curve lie?

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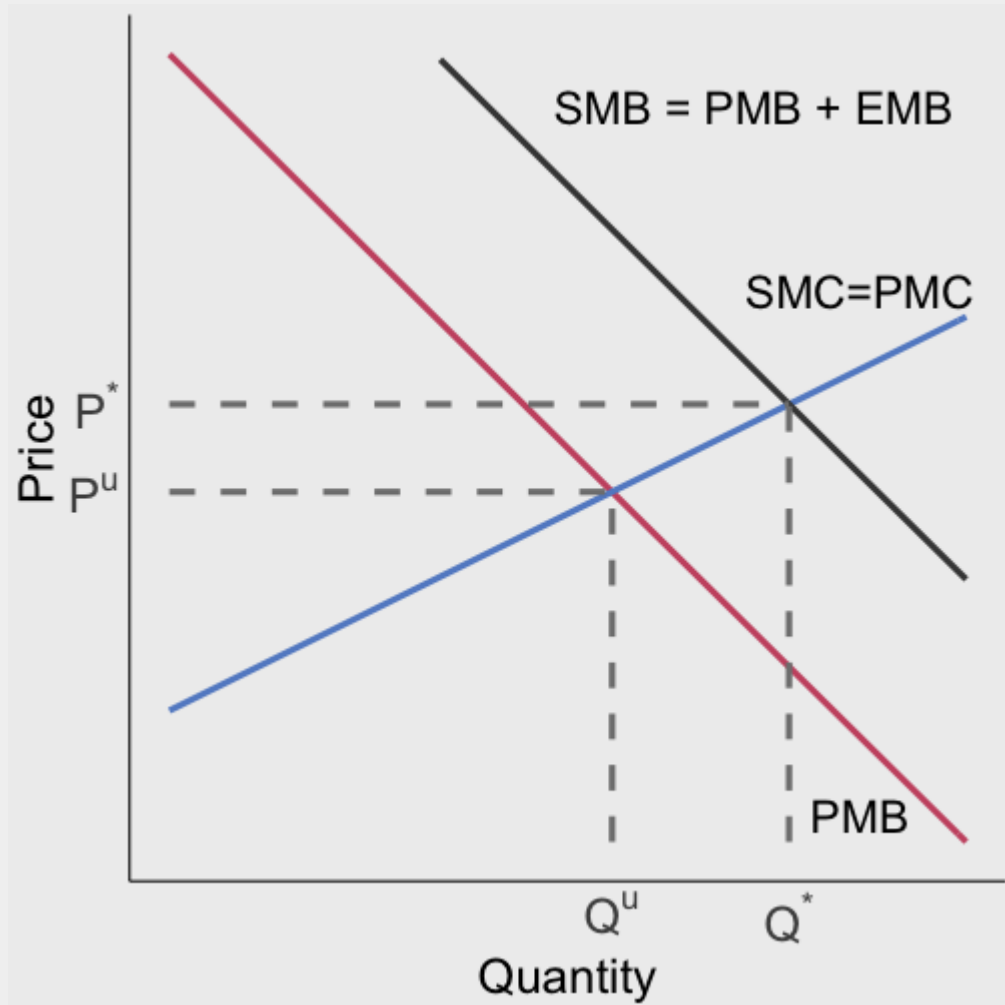


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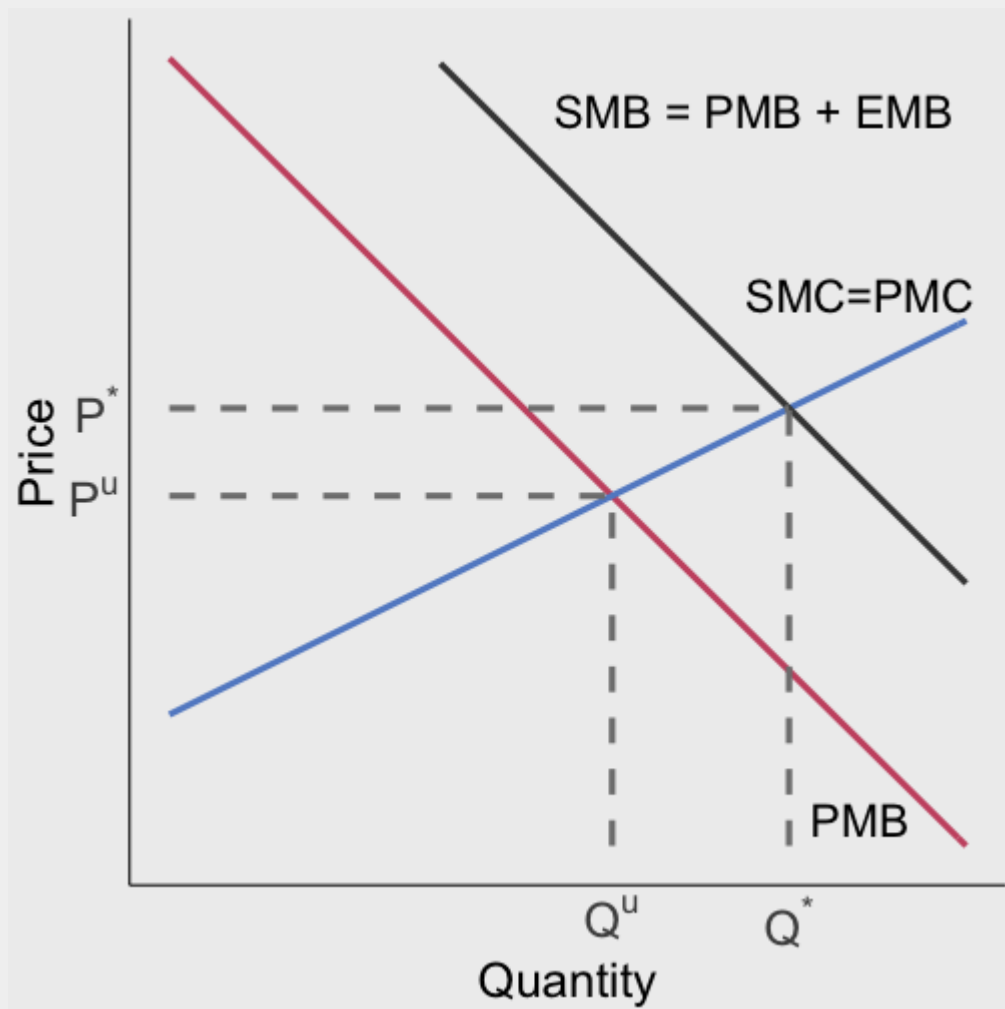


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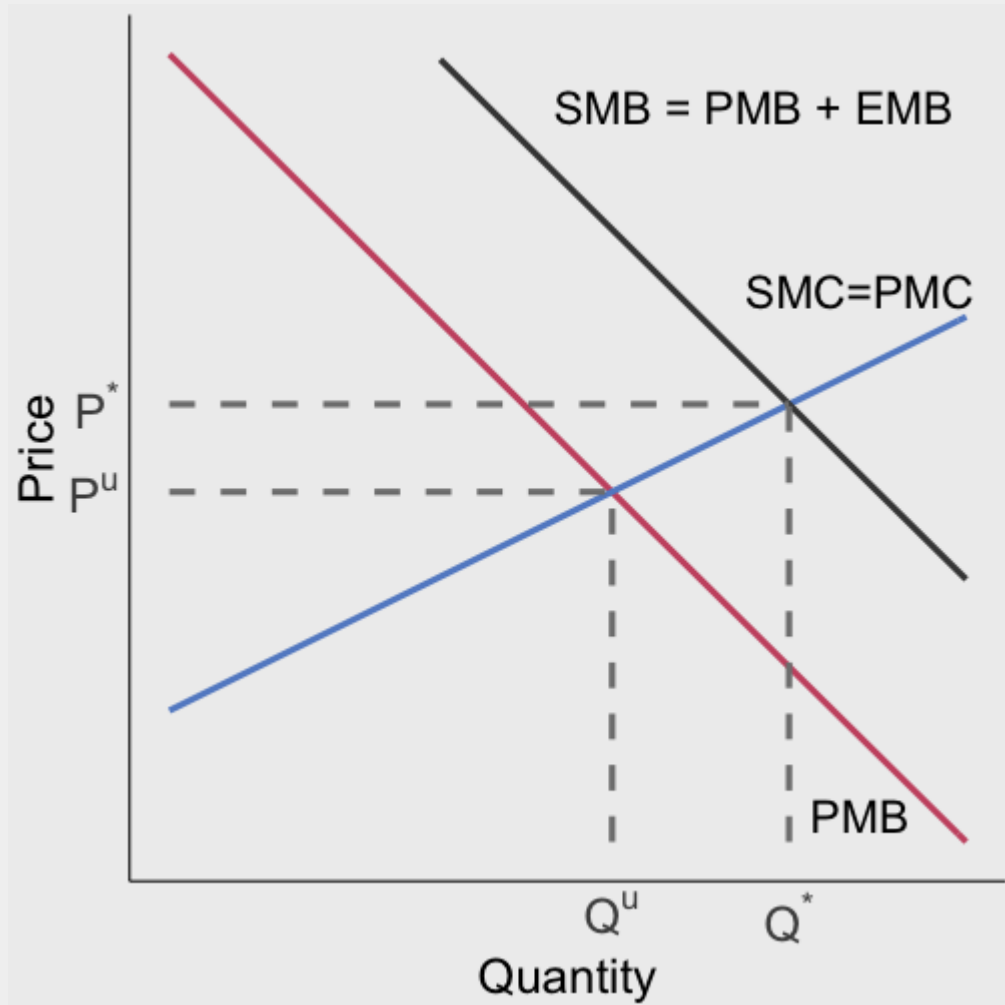
It does not account for the external herd immunity benefits

# Positive externalities: graphical



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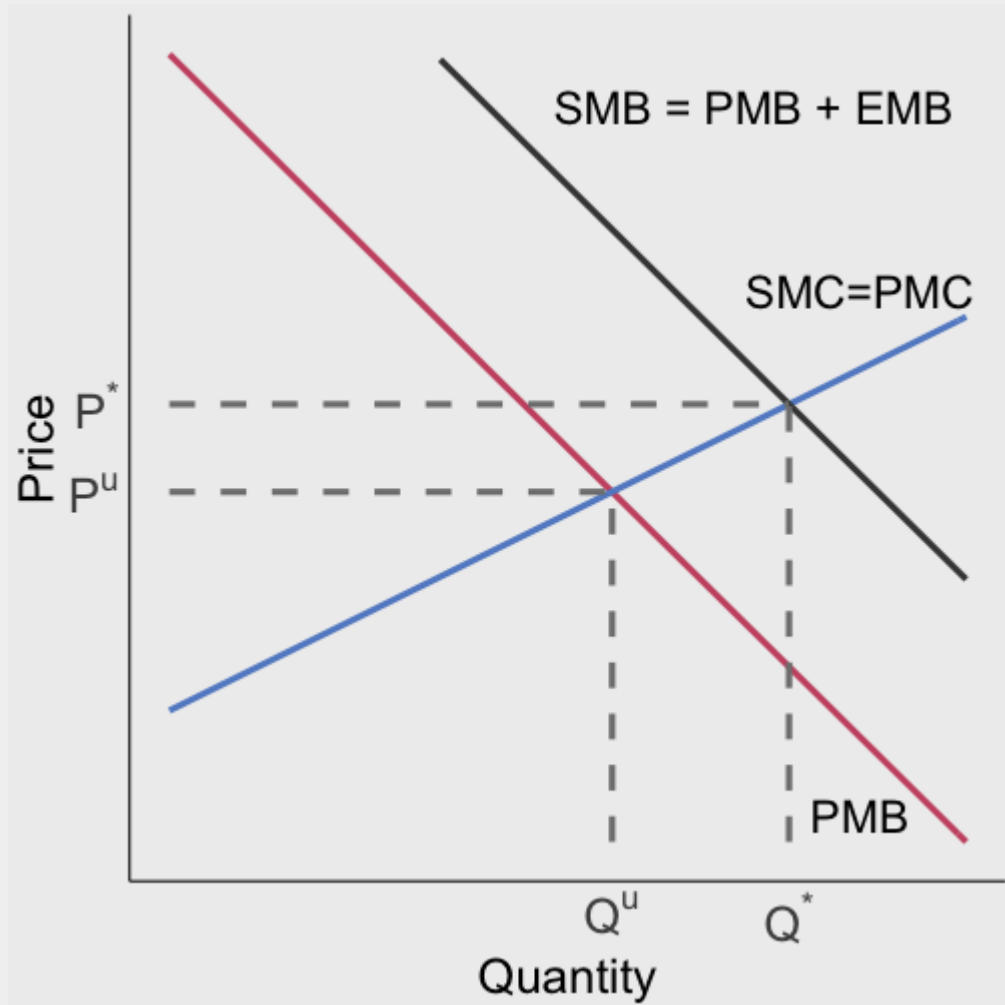
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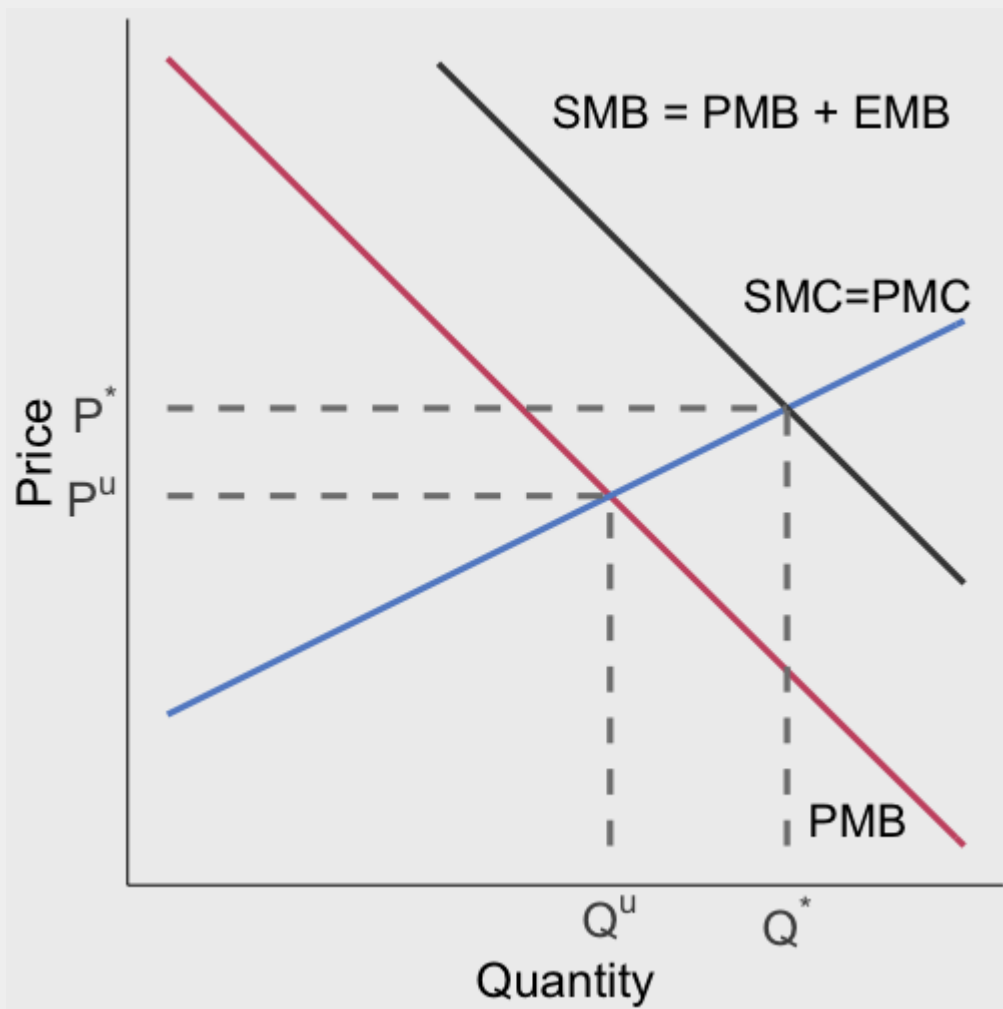


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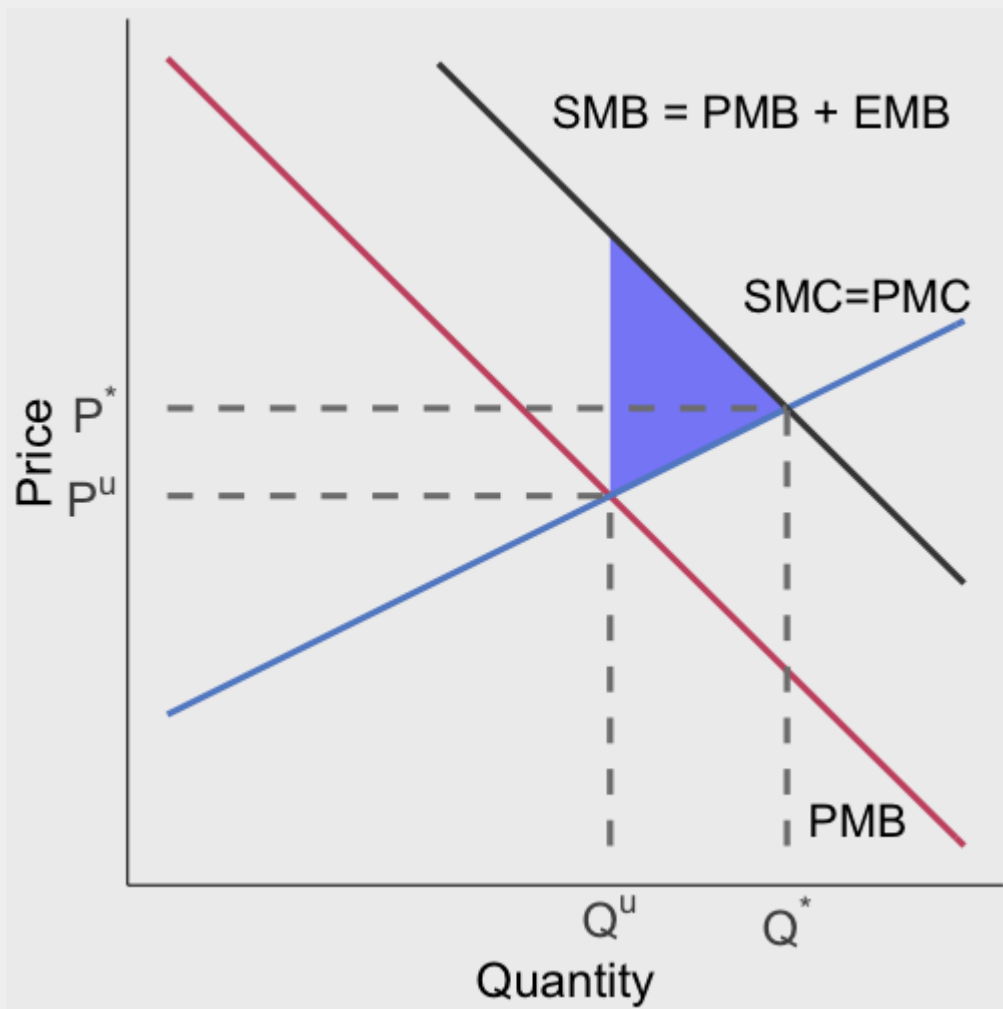
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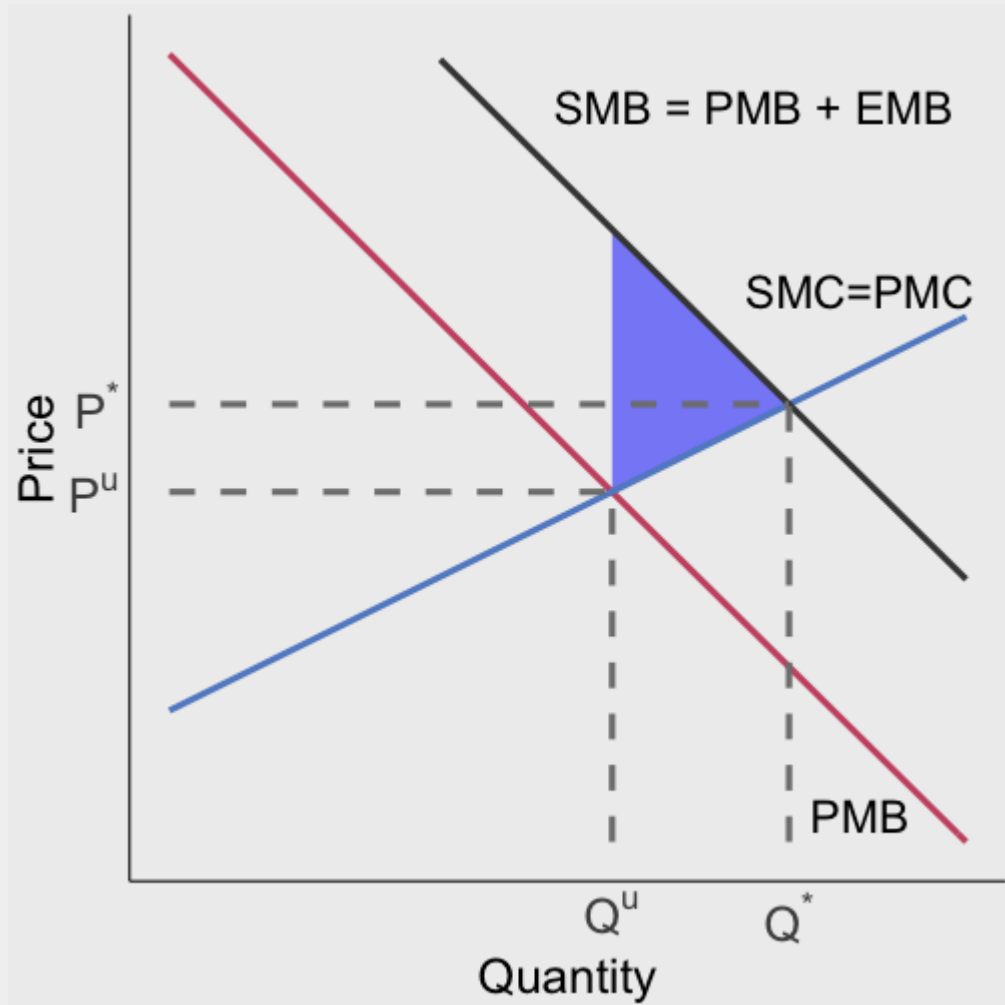
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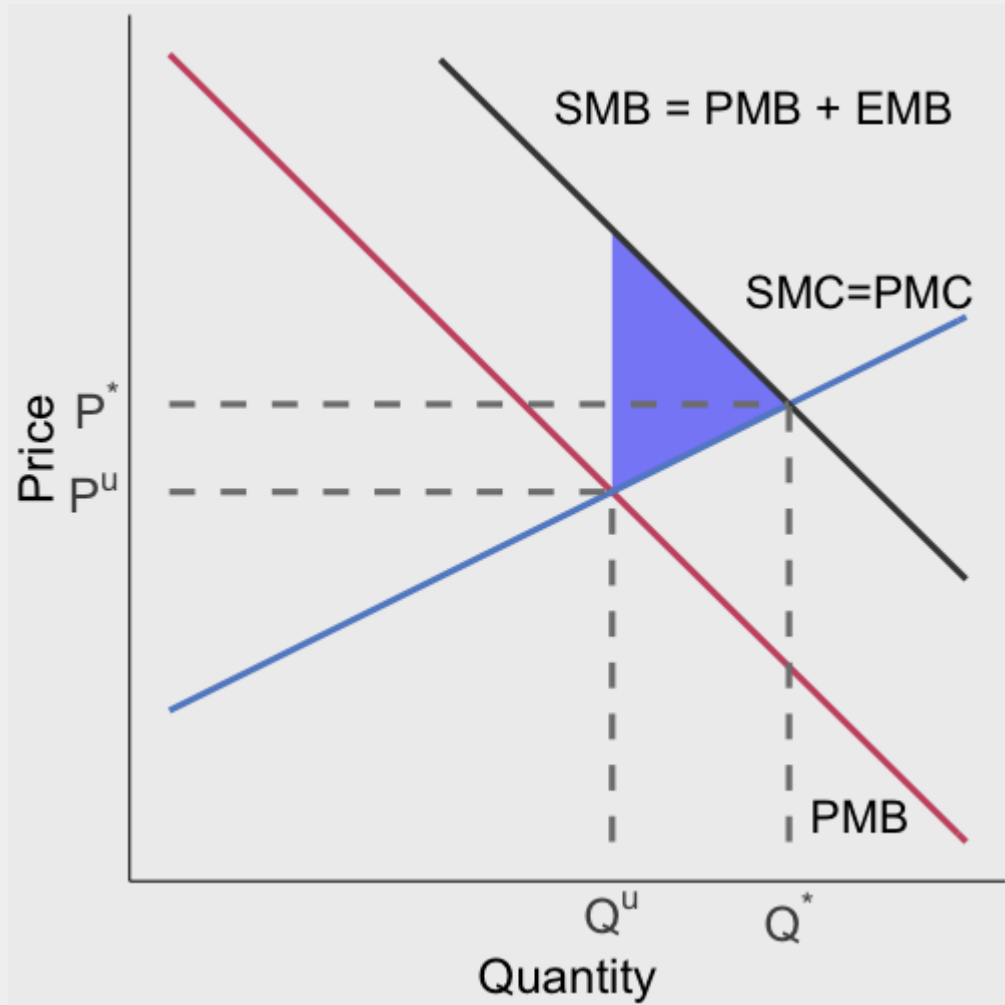


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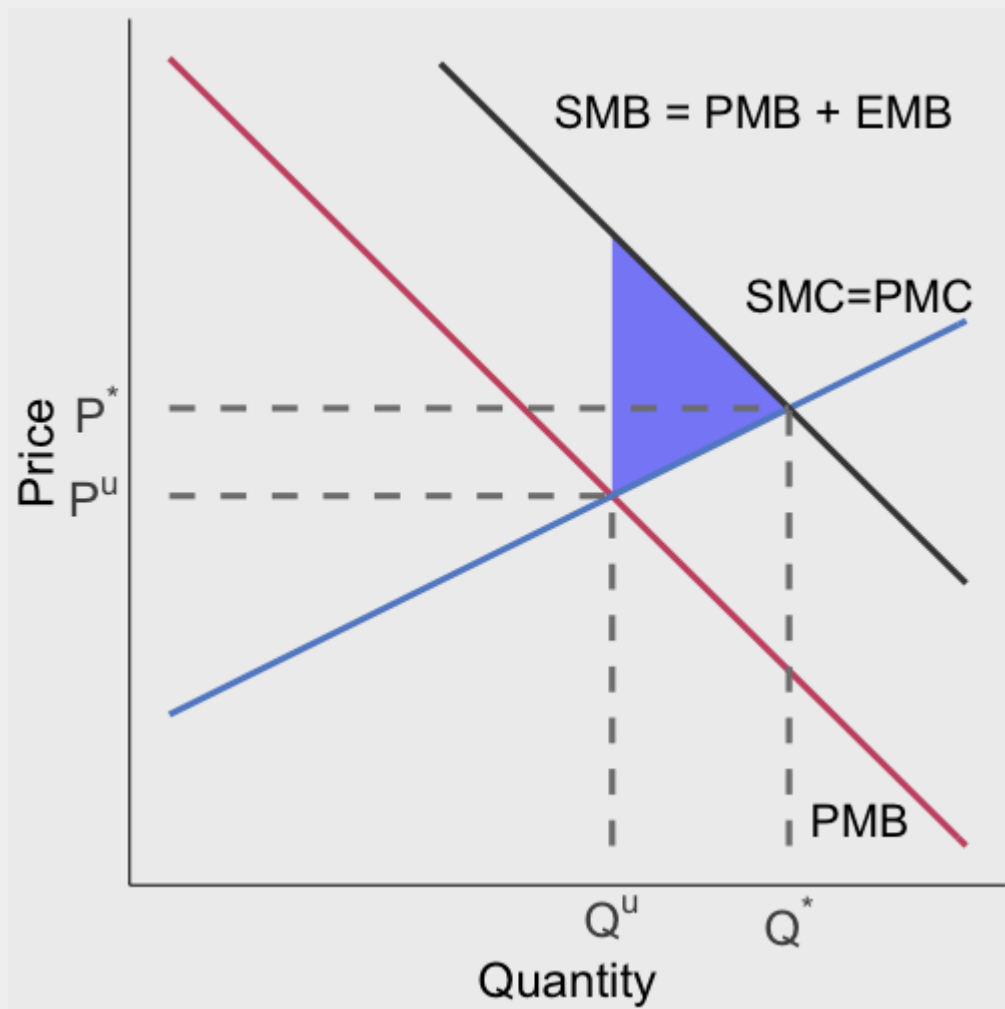
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1. Poorly defined property rights

- Who owns the right to the air?

2. High transactions costs

- Hard to bargain over desired air quality with millions of people

Lets conceptualize a model of efficient bargaining using an Edgeworth Box

# Why do externalities arise? Edgeworth Box

- Two individuals: A and B
- Two private goods: X and Y

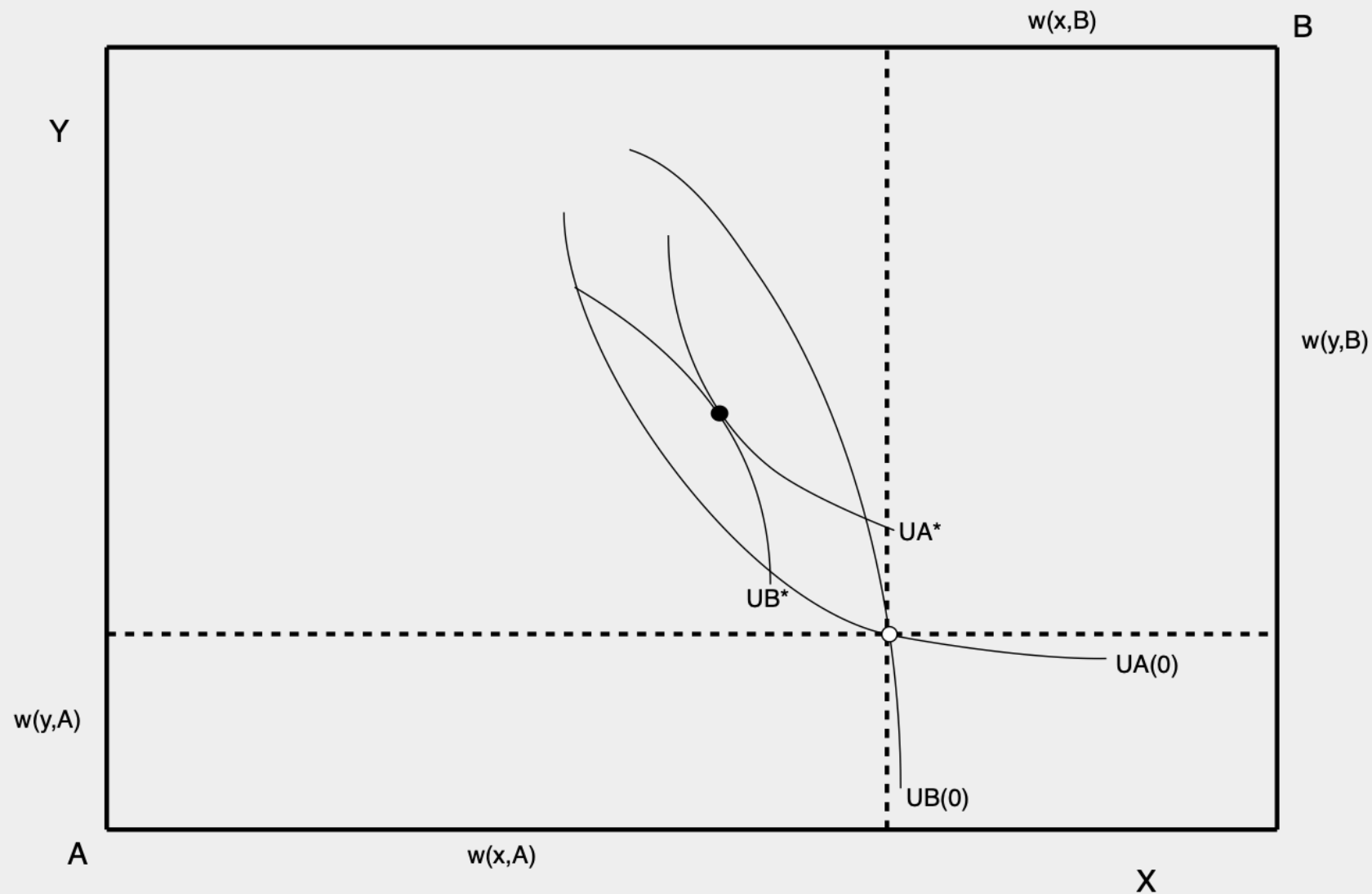
Each individual begins with an initial endowment of each good:

- $A : w_X^A, w_Y^A$
- $B : w_X^B, w_Y^B$

This gives us a total endowment:

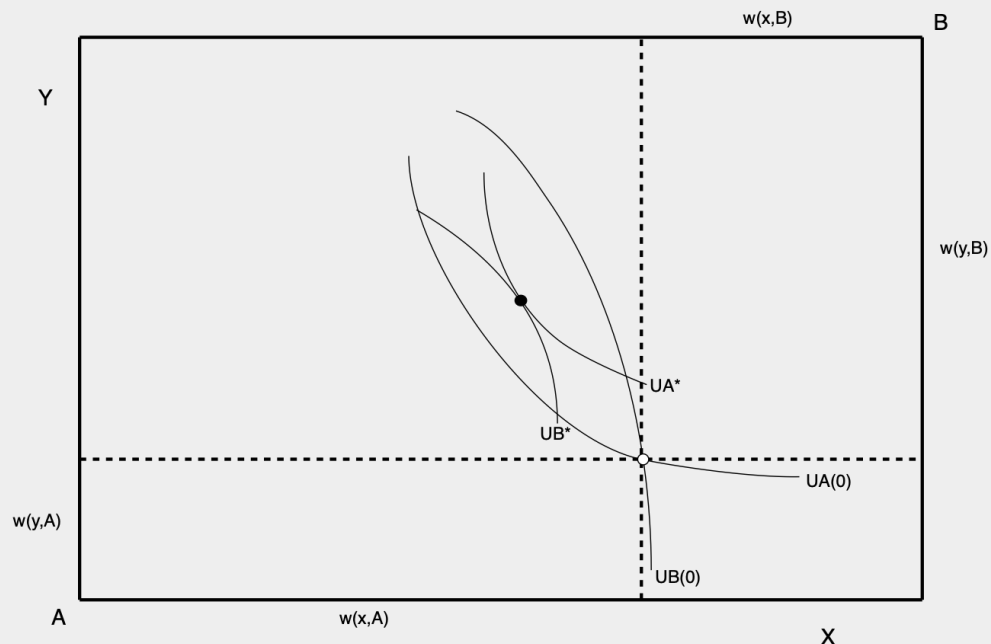
- $W_X = w_X^A + w_X^B$
- $W_Y = w_Y^A + w_Y^B$

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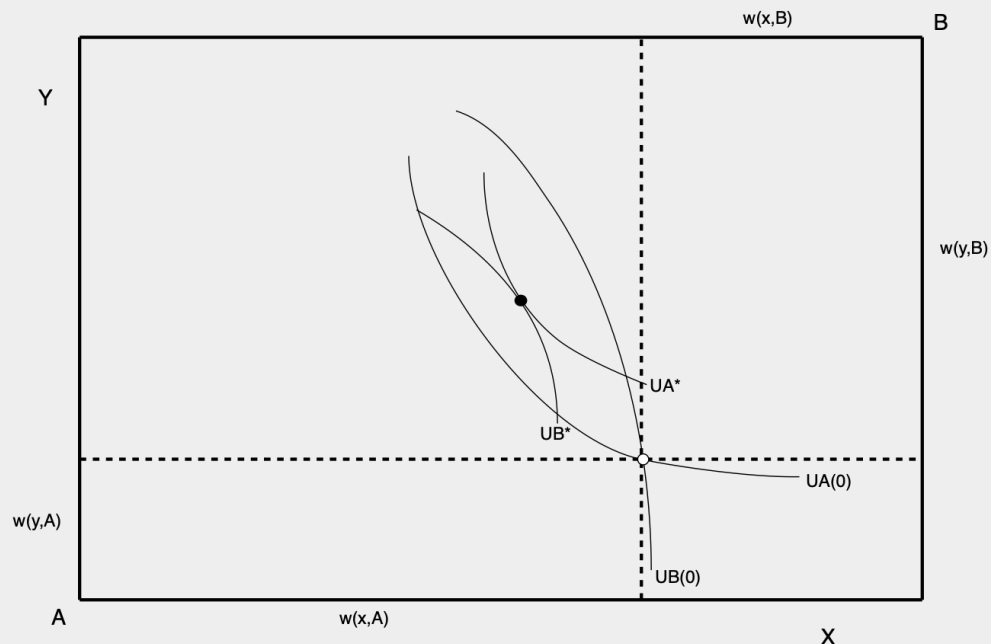
Total vertical distance is  $W_Y$

Total horizontal distance is  $W_X$

Initial endowment is given by the empty circle

Initial indifference curves for A and B are  $UA(0)$  and  $UB(0)$

# Why do externalities arise? Edgeworth Box

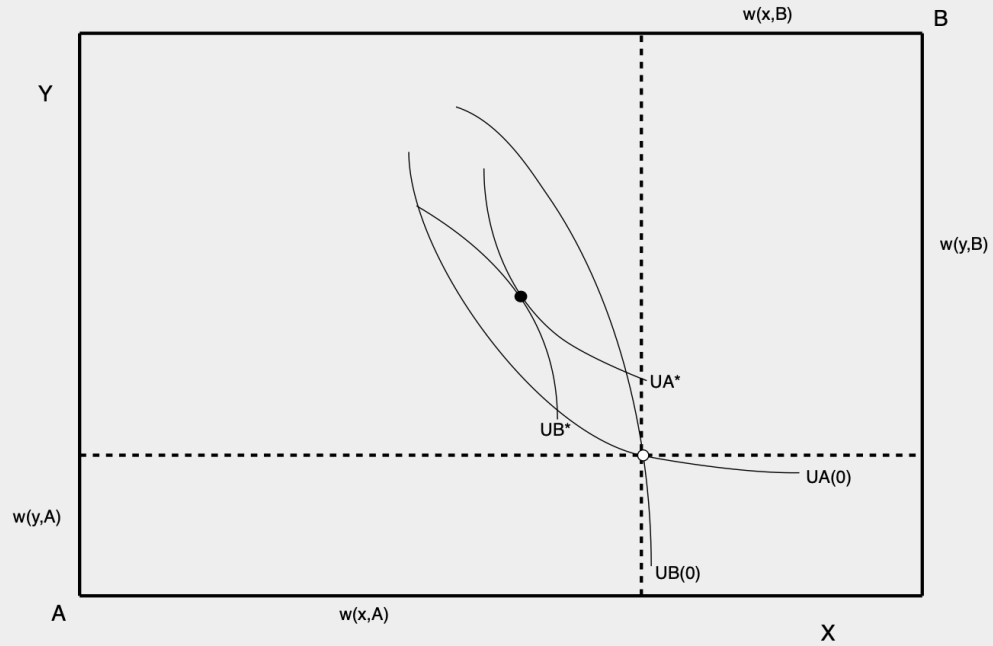


Is there a possible Pareto improvement?

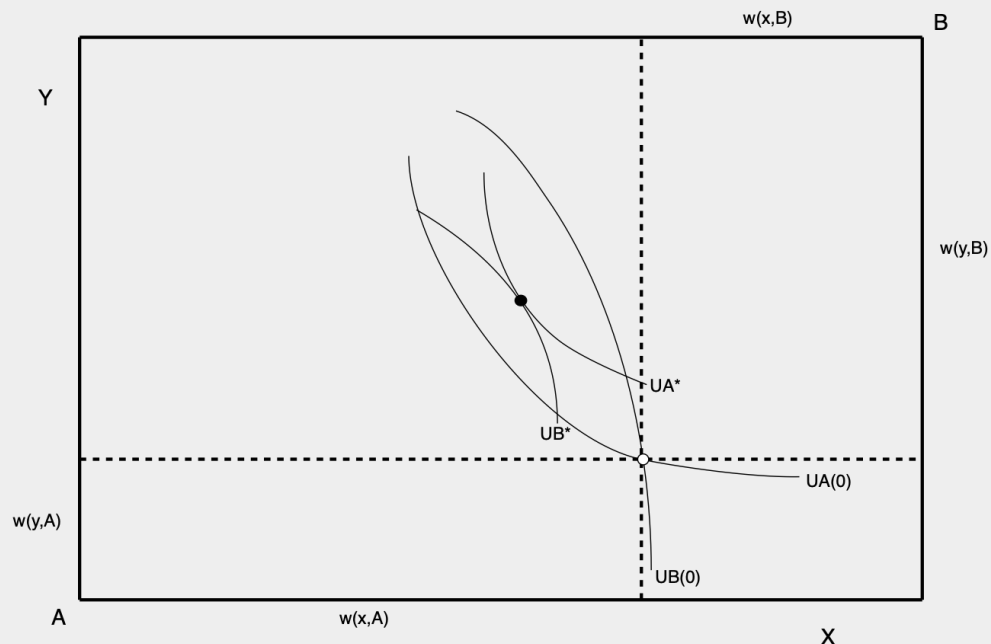
e.g. can we make both A and B better off?

# Why do externalities arise? Edgeworth Box

Yes!



# Why do externalities arise? Edgeworth Box



Yes!

If we move anywhere in the lens of their initial indifference curves we have a Pareto improvement

If we move to an allocation where their indifference curves are **tangent** to one another (e.g. the filled-in point), we have a Pareto optimum

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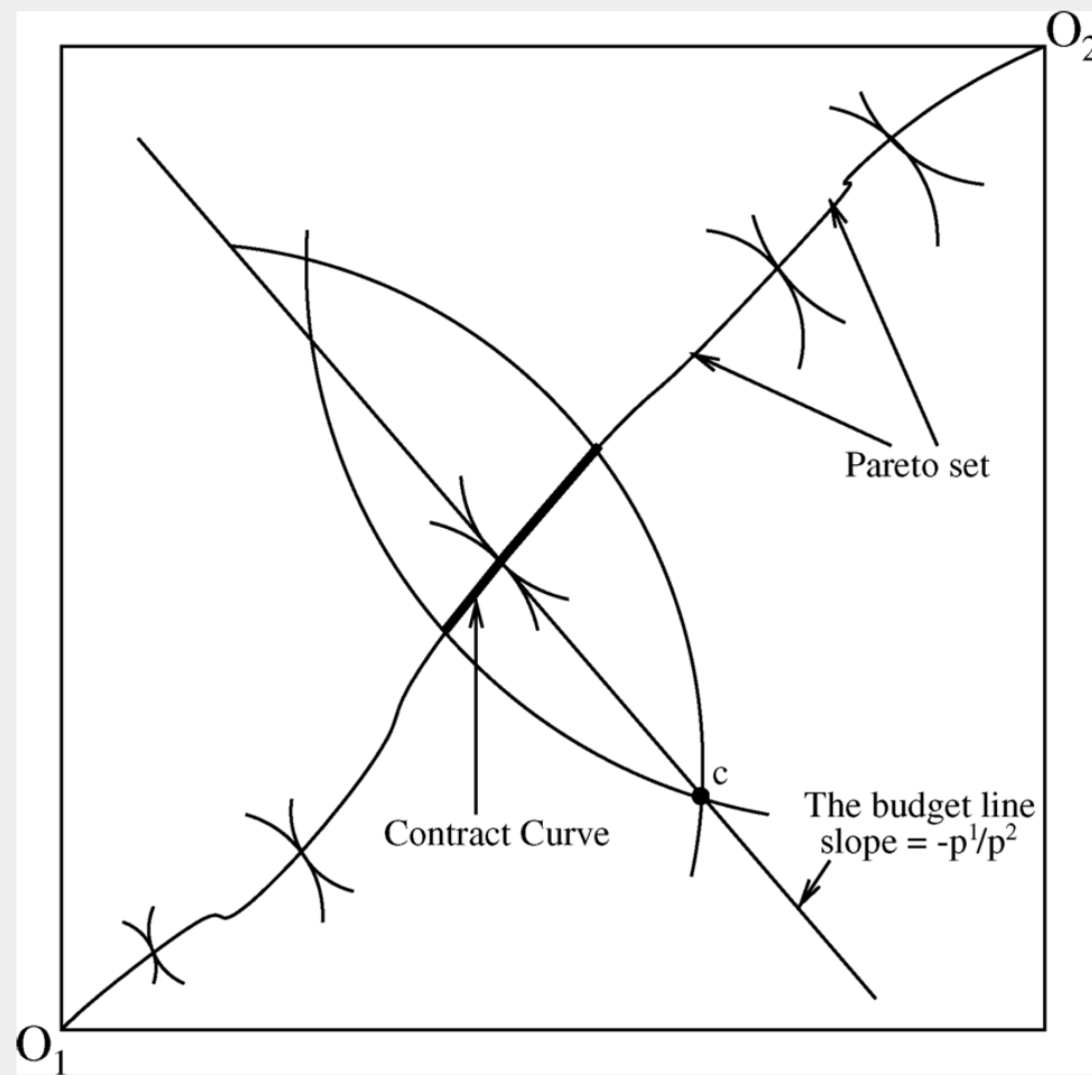
# Why do externalities arise? Edgeworth Box

In a properly functioning market:

- The endowment point is well-established
- A and B can trade X and Y to some Pareto improving point
- They continue trading until they achieve a Pareto optimal allocation
- This allocation lies on the **contract curve**: the line consisting of all Pareto efficient allocations



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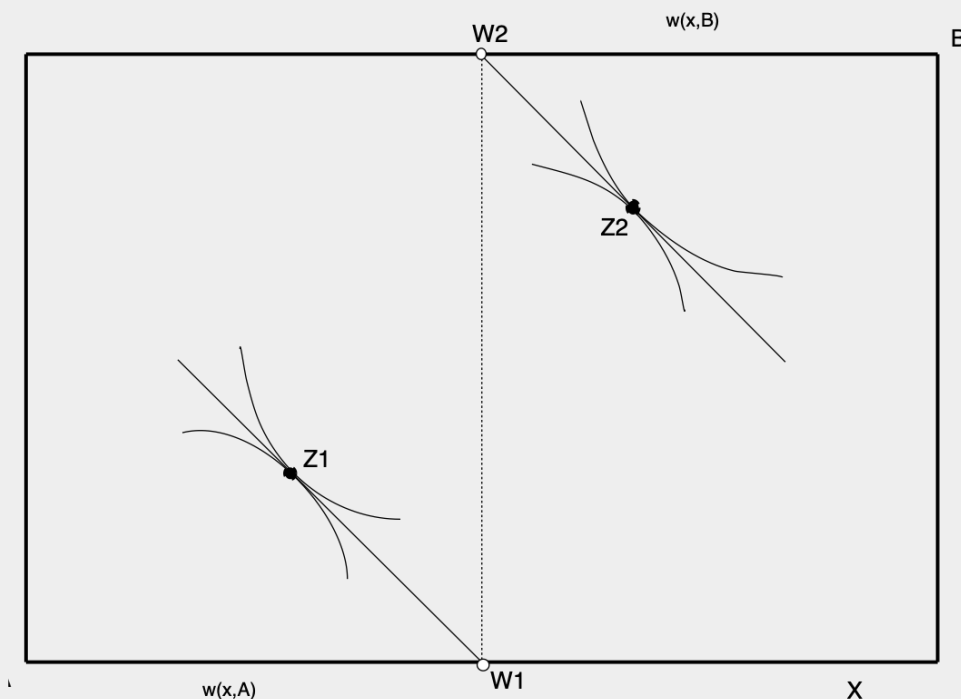
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Suppose both start off with the same quantity of  $X$

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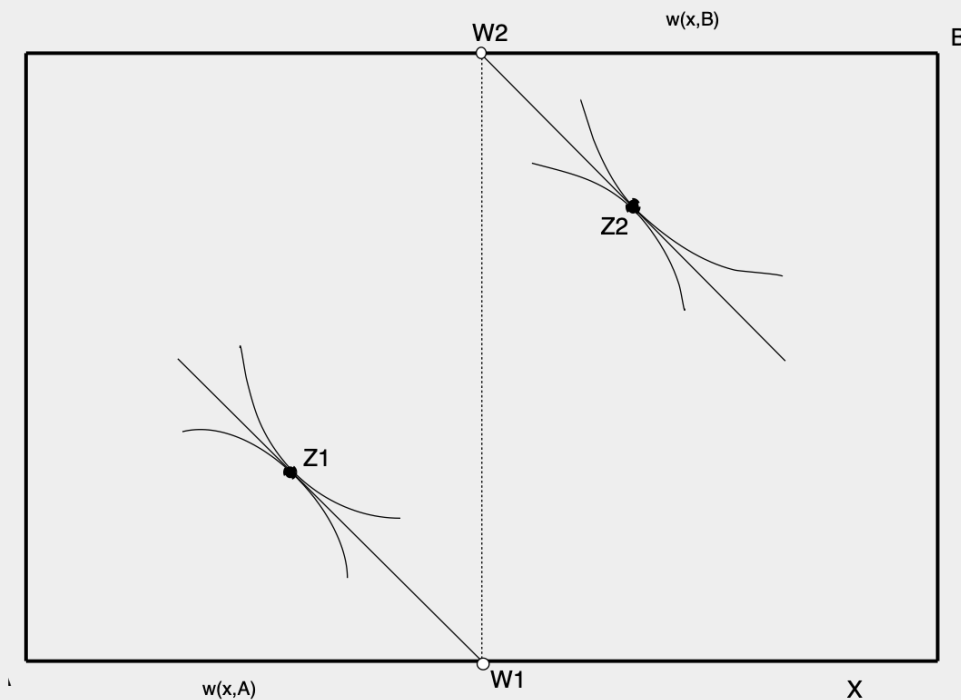


Depending on who has property rights, we either start at:

- $W1$  (B has property rights)
- $W2$  (A has property rights)

Think about why these are where we must start

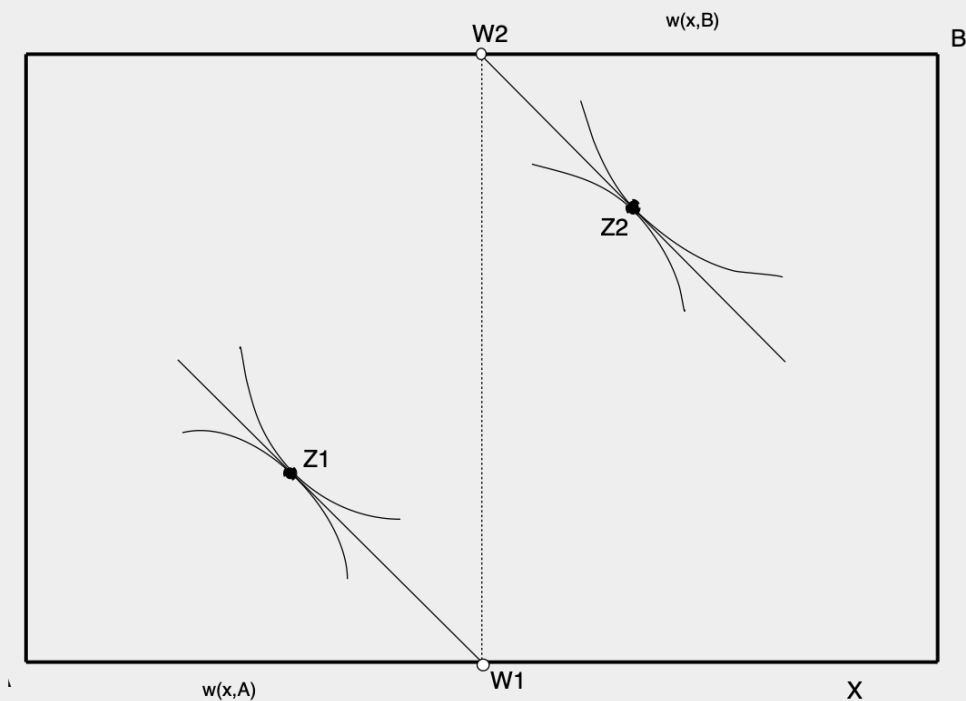
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Suppose we start at  $W1$ , what happens?



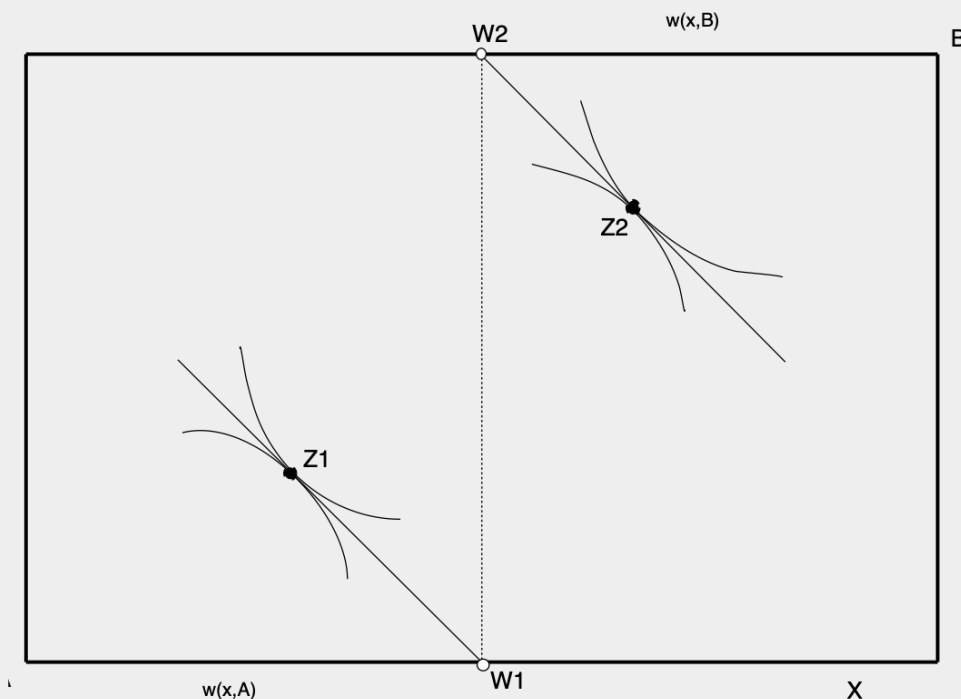
# Why do externalities arise? Edgeworth Box



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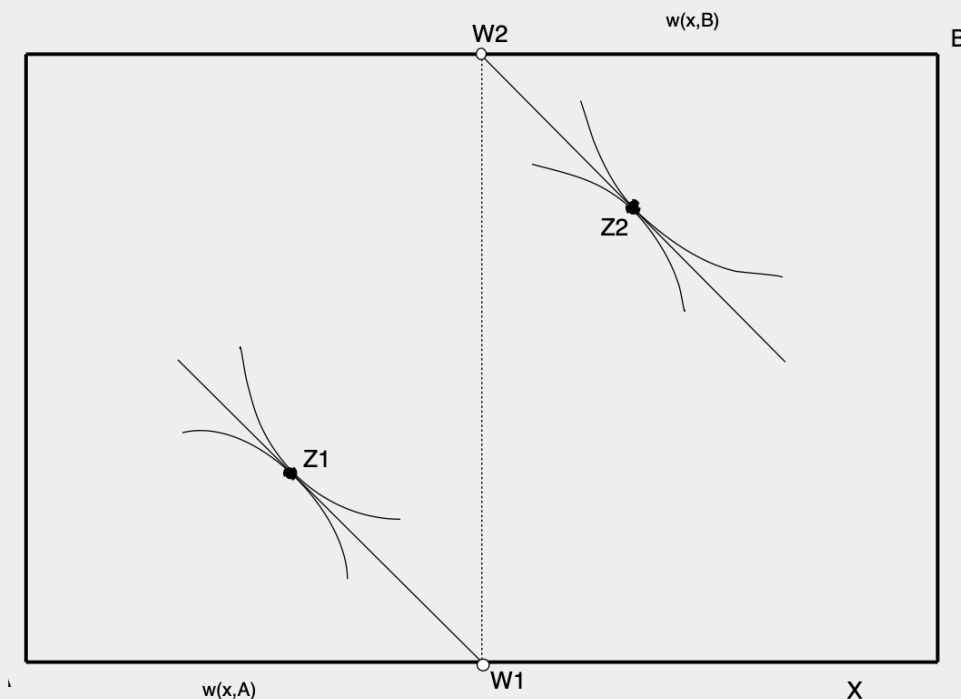


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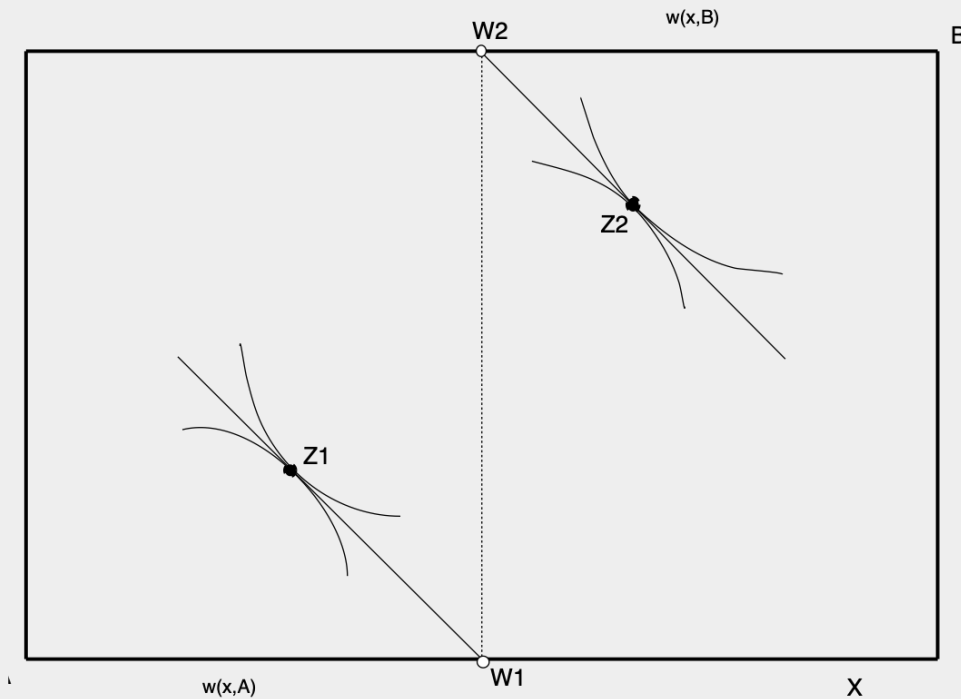
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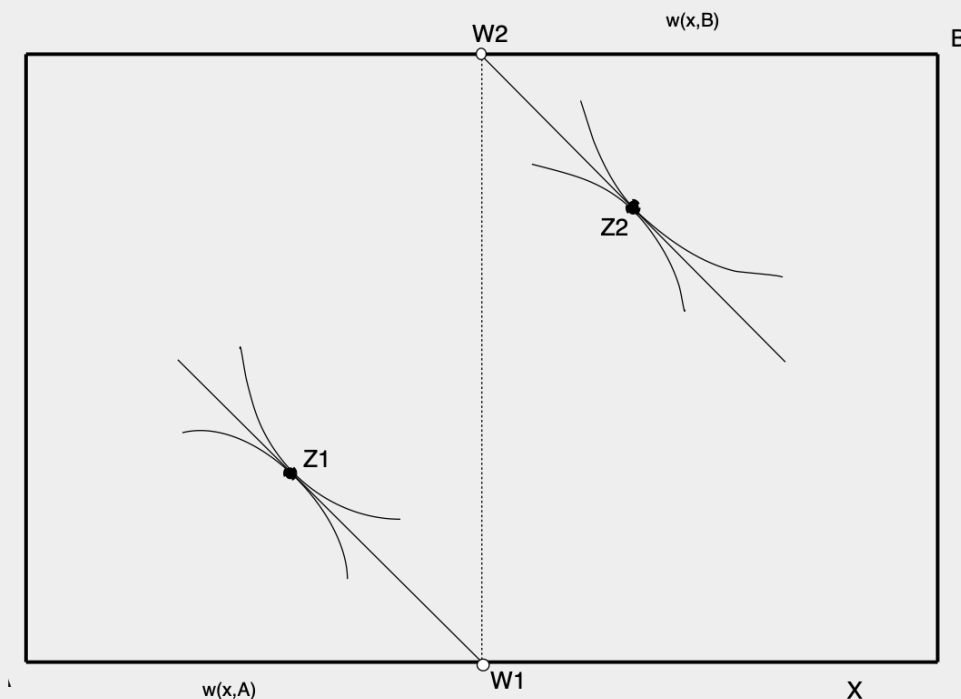
A pays B in units of  $X$ , move to  $Z1$ , Pareto optimum

# Why do externalities arise? Edgeworth Box



Suppose we start at  $W2$ , what happens?

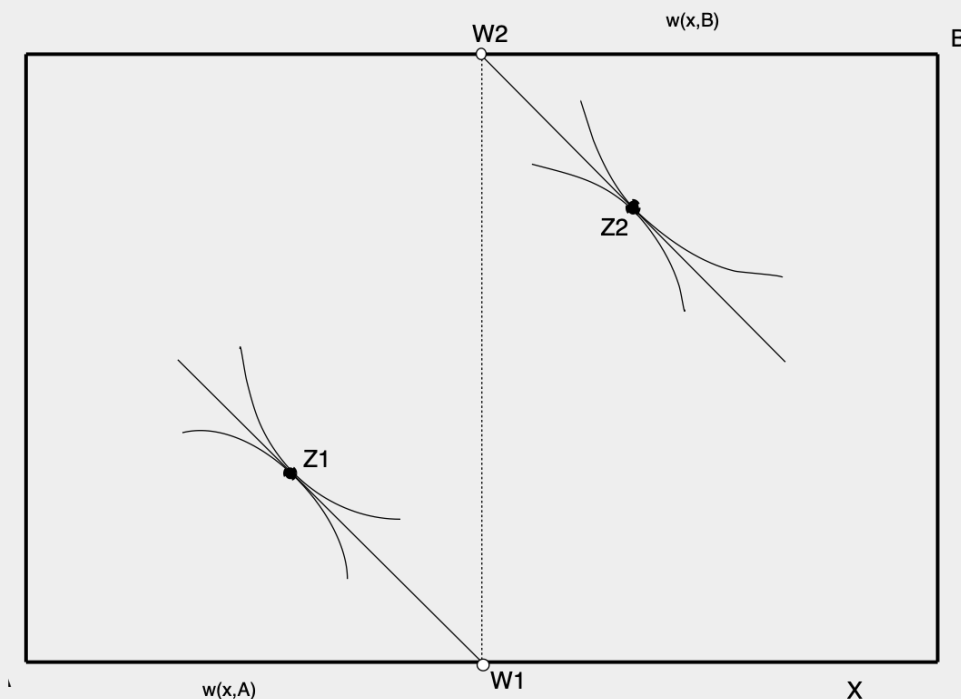
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Suppose we start at  $W2$ , what happens?

B wants to have less Y, but this imposes a cost on A

# Why do externalities arise? Edgeworth Box

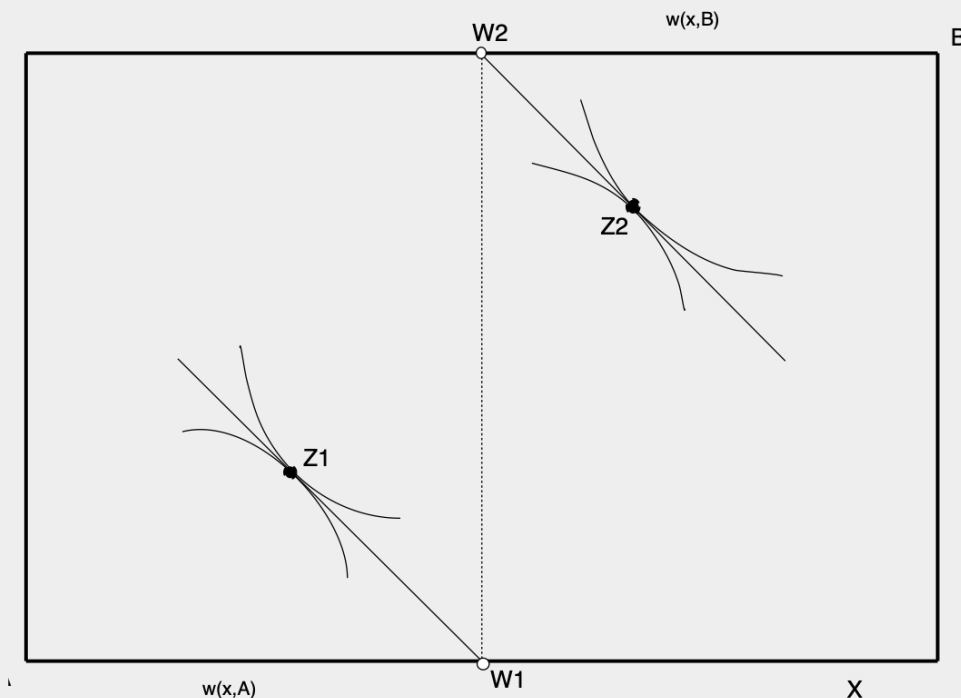


Suppose we start at  $W2$ , what happens?

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In the previous example we were able to achieve the Pareto optimum even with a public good / externality

Why?

1. Property rights were assigned to either A or B
2. Transactions costs were low (didn't have to pay a fee to trade X)

# Property rights and externalities

A solution to many externalities is to just assign property rights and let the market do its thing

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We'll talk about a few ways that we can assign property rights

# Transactions costs and externalities

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Even if they were assigned the property rights, it might be hard for them to bargain

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- Negotiating over how much  $X$  each person gets

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- Takes a lot of time to find something that works for everyone
- Negotiating over how much  $X$  each person gets

The costs of bargaining may exceed the benefits and we end up stuck at  $W_2$



# Transactions costs and externalities

Road noise: drivers implicitly have property rights to noise around roads

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Even if you prefer quiet, you can't negotiate a payment with every loud car that might pass pay

# The free-rider problem

Externalities and public goods/bads often exhibit many of the same features

Both are subject to the **Free-Rider Problem**

A type of market failure that occurs when those who benefit from resources, public goods (such as public roads or hospitals), or services of a communal nature do not pay for them[1] or under-pay

e.g.

- people don't pay their taxes for publicly-provided services
- non-smokers will wait for others to pay in order to reduce smoke

# The provision of public goods

---

# Public goods

How do we efficiently provide public goods?

We know:

- Private goods:  $PMB = PMC \Leftrightarrow SMB = SMC$
- Goods with negative externalities:  $PMB = SMC \Leftrightarrow SMB = SMC$
- goods with positive externalities:  $SMB = PMC \Leftrightarrow SMB = SMC$

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- goods with positive externalities:  $SMB = PMC \Leftrightarrow SMB = SMC$

Suppose we have a public good, e.g. depth of a river for public use

How do we decide the socially efficient depth?

# Public goods

Optimal provision is **always** given by:  $SMB = SMC$

What are the SMB and SMC for a public good?

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What are the SMB and SMC for a public good?

Think about the characteristics of a public good, one of them is critical:

**Non-rival:** multiple people can use the same unit of a good (one person using the river doesn't 'use up' its depth)

This means multiple people can derive benefits from the provision of 1 unit of the good

# Optimal provision of public goods

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e.g. the free market underprovides clean air, national defense, etc

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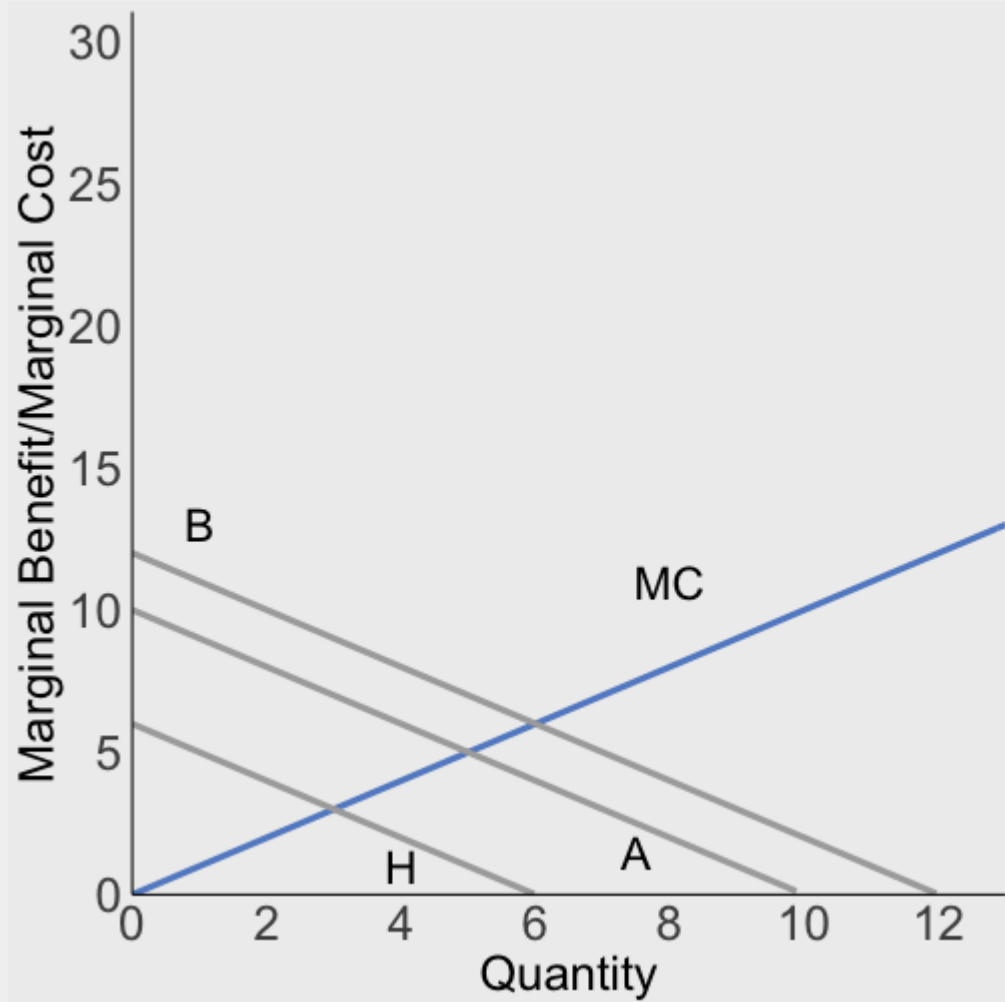
Public goods are non-rival, multiple people can consume each unit

At each quantity, what is the total marginal benefit?

At each quantity, we need to add up PMBs/prices

Public goods: we add demand curves vertically

# Public goods: graphical

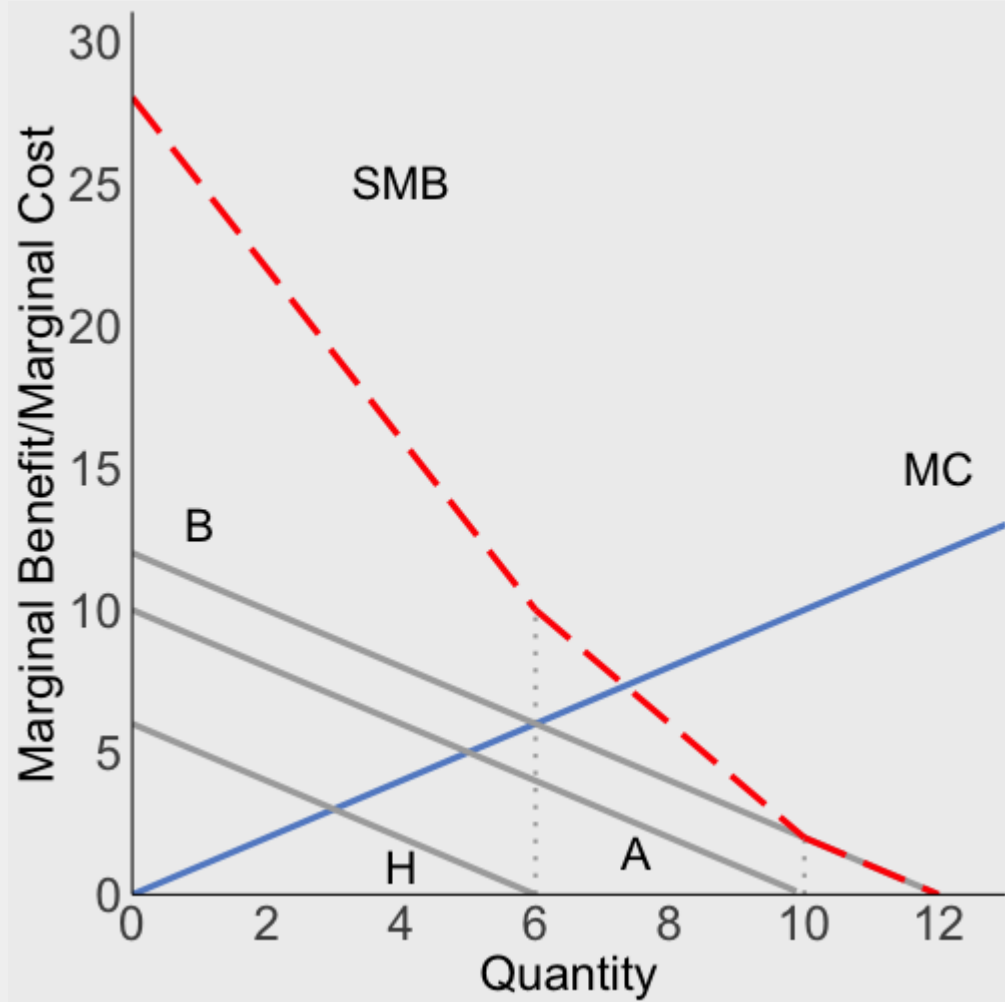


3 different groups: boaters (B), anglers (A), and hikers (H)

Each has a different marginal benefit for water depth:

- Boaters:  $MB = 12 - Q$
- Anglers:  $MB = 10 - Q$
- Hikers:  $MB = 6 - Q$
- MC of provision:  $MC = Q$

# Public goods: graphical

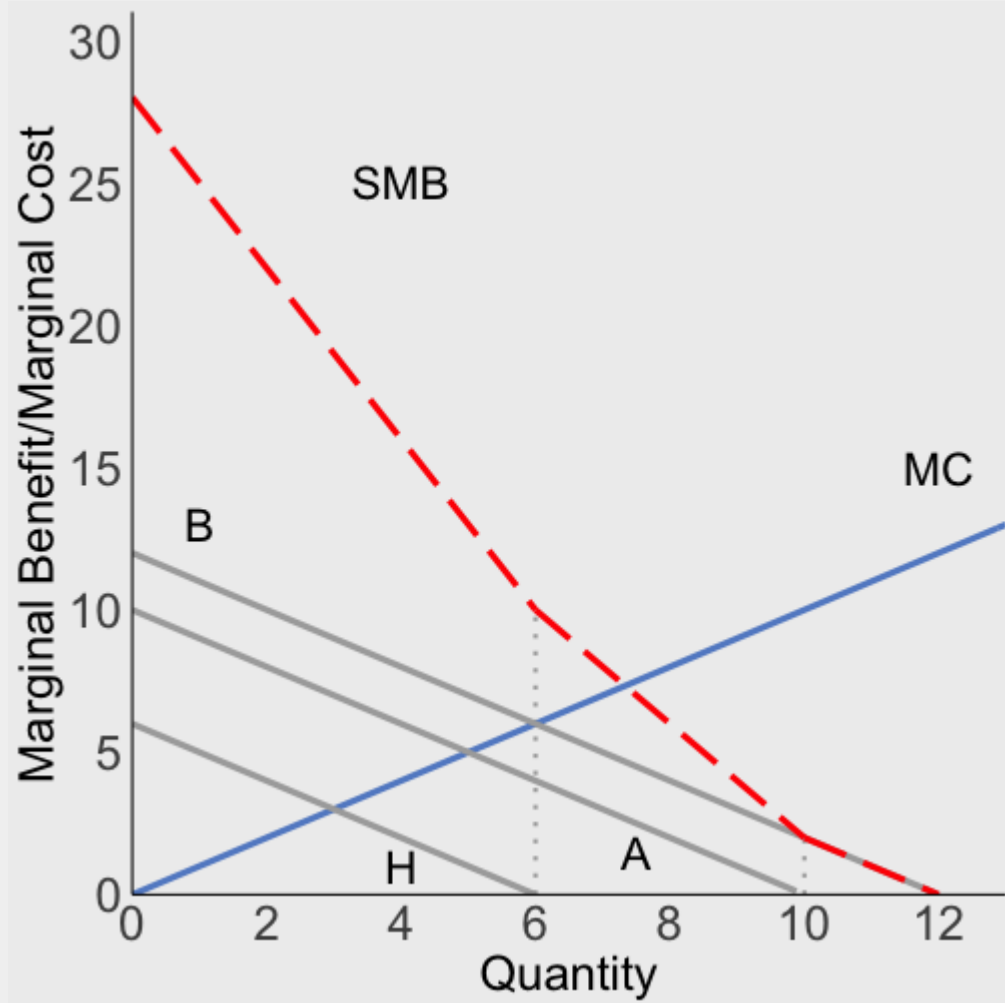


Now we need to aggregate them to get the **social marginal benefit**

We do so by adding up the demand curves vertically:

At each Q, sum the MBs

# Public goods: graphical

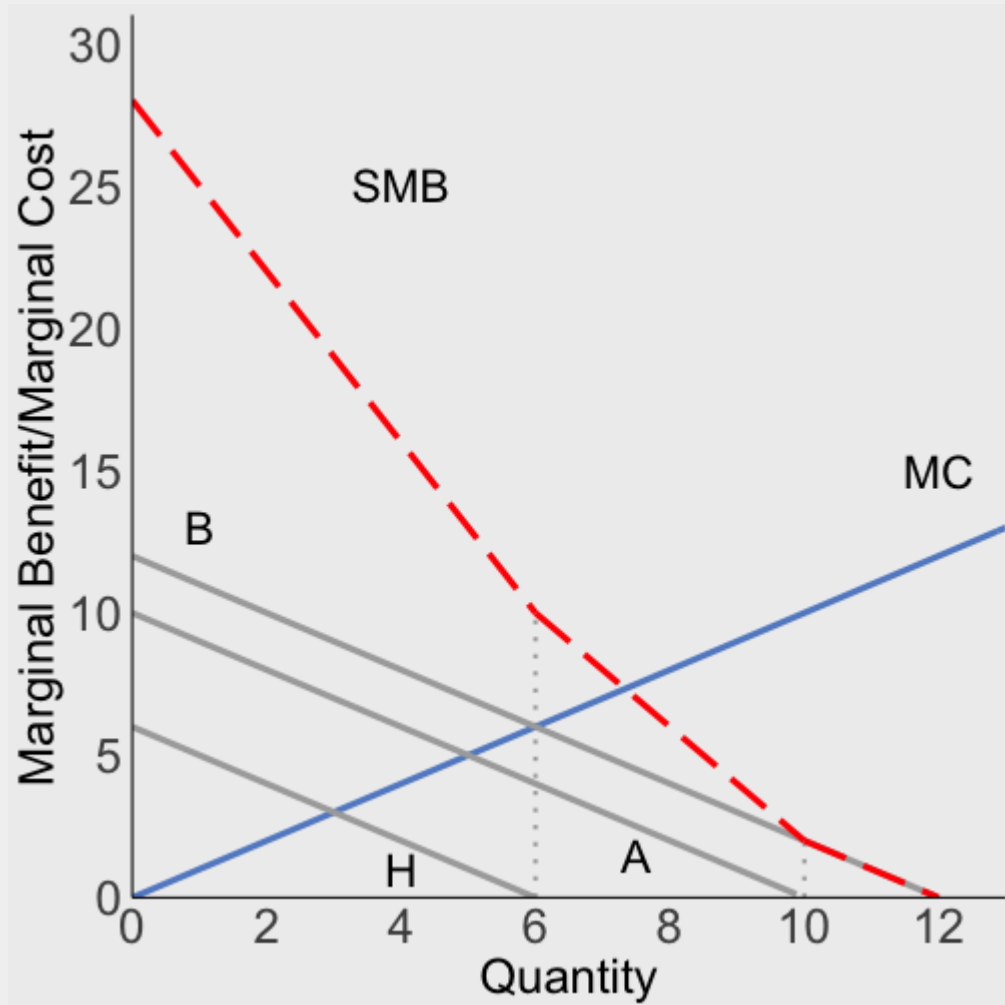


Why is the aggregate demand curve kinked?

Because at each quantity/depth, only certain groups are willing to use the river

Kinks are at the dotted lines, where PMBs hit zero

# Positive externalities: graphical

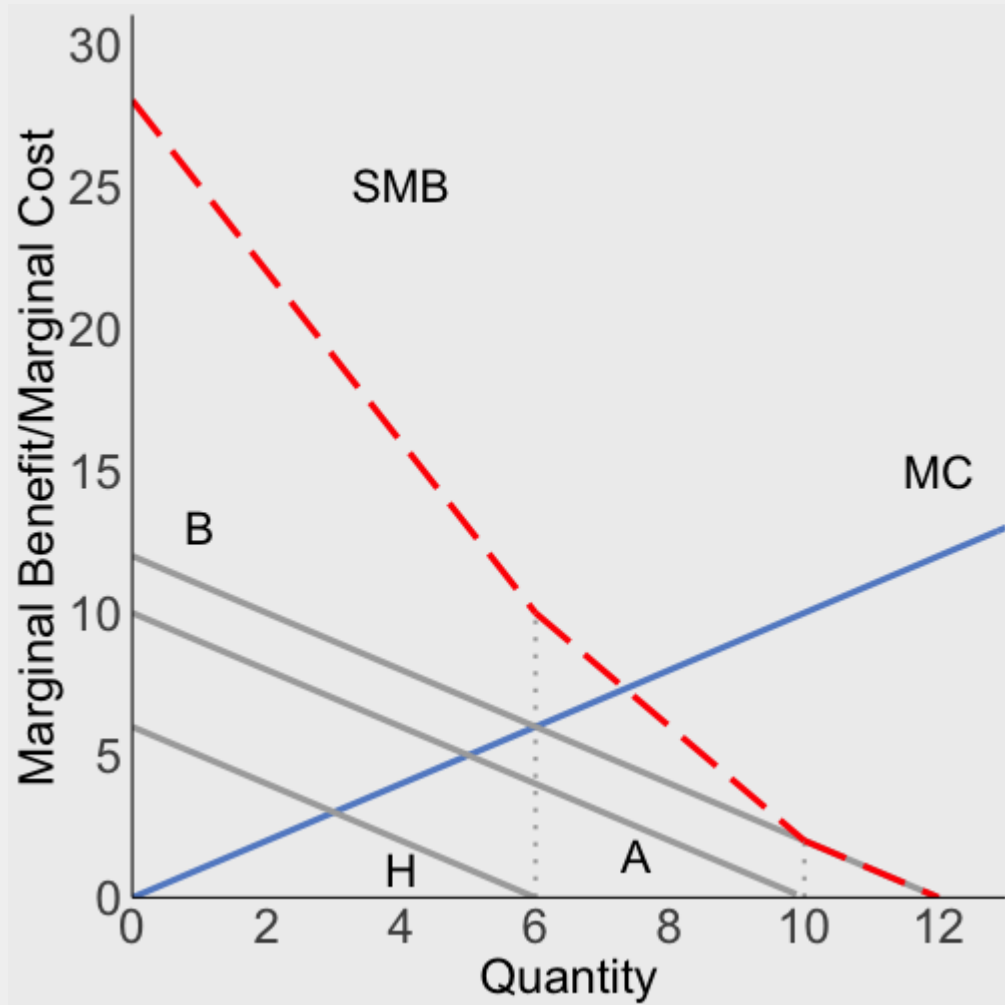


At quantities  $> 10$ , only boaters are willing to pay

At quantities  $> 6$  and  $\leq 10$ , only boaters and anglers are willing to pay

At quantities  $\leq 6$  all groups are willing to pay to use the river

# Positive externalities: graphical



The SMB curve is:

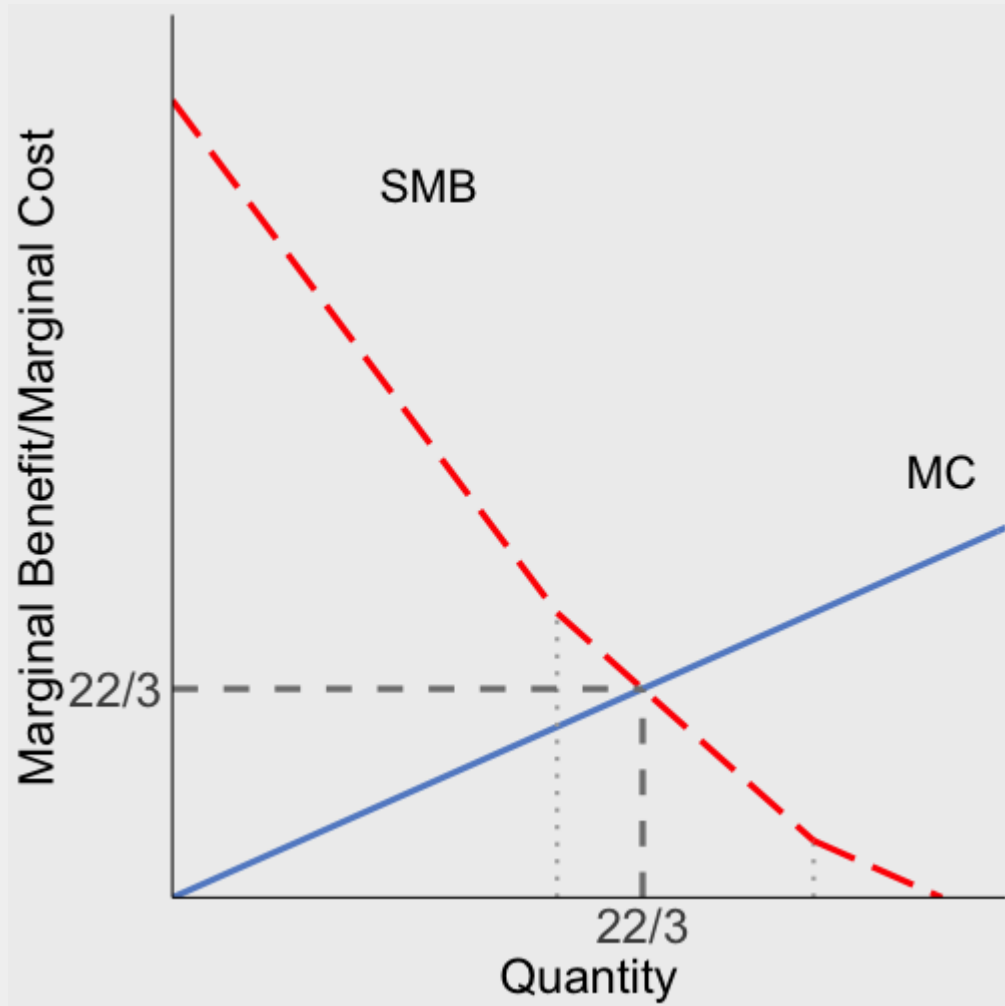
$28 - 3Q$  for  $Q \leq 6$

$22 - 2Q$  for  $6 < Q \leq 10$

$12 - Q$  for  $10 < Q \leq 12$

Summing the PMBs over the relevant range of Q

# Public goods: graphical



The optimal provision of the public good is where the MC curve crosses the SMB curve

This is across the middle segment

$$Q = 22 - 2Q \Rightarrow Q = 22/3$$

The optimal quantity of  $Q = 22/3$  is greater than the quantity any individual group would be willing to purchase



# Public goods financing

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If the government is able to provide the good, how does it finance the cost raising the river depth above zero?

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Since the good is non-rival, this is enough to finance the cost

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It requires perfect information on behalf of the regulator