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Lecture 13:
Externalities and Public Goods

December 5, 2023

Course Administration

1. Apologies for my absence last week!

Course Administration

1. Apologies for my absence last week!
2. Today's problem set is the last one
3. Final
   - Last year's final is posted
   - Review session Dec. 8, 7 to 8:30, Bell 107

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   - mine
   - school's: https://gwu.smartevals.com

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   - mine
   - school's: https://gwu.smartevals.com
5. Any questions?

Ripped from the Headlines

| | Afternoon |
Finder	Presenter
Tara	Jared
Arizona	Hannah

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Today

Externalities

1. Defining externalities
2. Fixing externalities
3. (skip) Coase Theorem

Today

Externalities

1. Defining externalities
2. Fixing externalities
3. (skip) Coase Theorem

Public Goods

1. Defining public goods
2. Optimal provision of public goods
3. Equilibrium provision of public goods
4. Public provision of public goods

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Defining Externalities

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Externality Definition

Externality $\equiv$ cost or benefit accruing to party not involved in economic transaction

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Externality Definition

Externality $\equiv$ cost or benefit accruing to party not involved in economic transaction

- Positive externality $\equiv$ benefit accruing to party not involved in economic transaction

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- Positive externality $\equiv$ benefit accruing to party not involved in economic transaction
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Externality Definition

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Examples, please.

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In a World Without Externalities

Demand measures private marginal benefit

- equal to social marginal benefit

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In a World Without Externalities

Demand measures private marginal benefit

- equal to social marginal benefit

Supply measures private marginal cost

- equal to social marginal cost

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In a Market Without Externalities
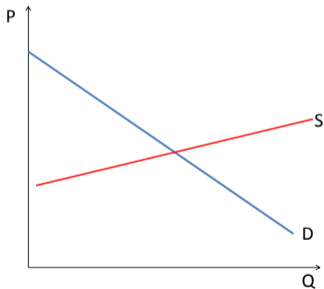
- **If** private demand =
  private marginal benefit =
  social marginal benefit

- **And** Private supply =
  private marginal cost =
  social marginal cost

- **Then** market equilibrium maximizes social welfare, which is total surplus

- Provides goods to consumer at lowest possible cost

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In a Market With Externalities

Assume a negative externality

- $\implies$ Social marginal cost $\neq$ private marginal cost
- $\implies$ Social marginal cost $=$ private marginal cost $+$ external marginal cost

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What Does a Negative Externality Do to Market Supply?

Where Are the Private Market P and Q?

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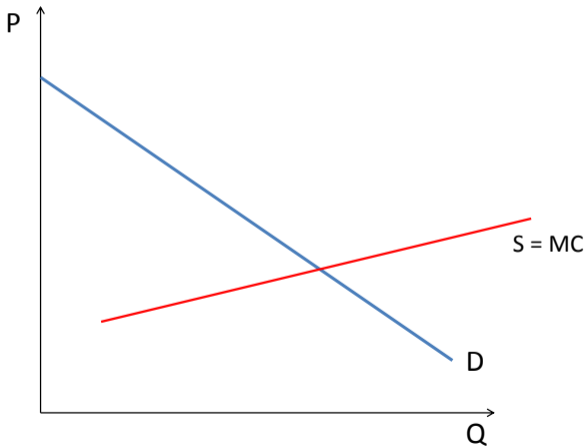
What Does a Negative Externality Do to Market Supply?

Where is the Social Marginal Cost?

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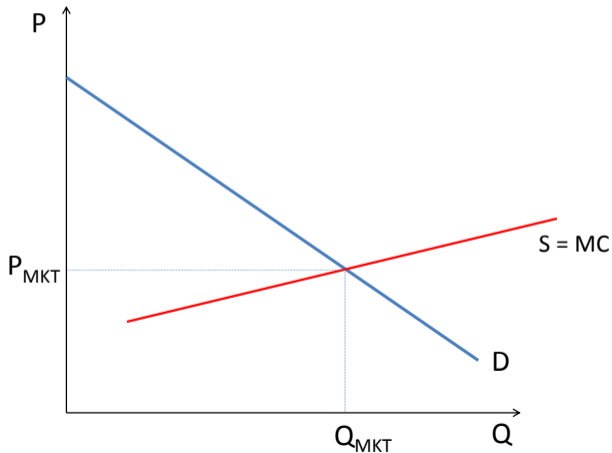
What Does a Negative Externality Do to Market Supply?

What are the Socially Optimal P and Q?

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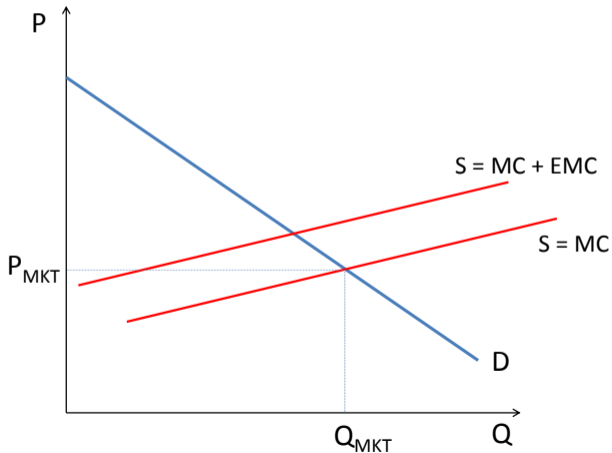
What Does a Negative Externality Do to Market Supply?

What is the Vertical Distance Between the Supply Curves?
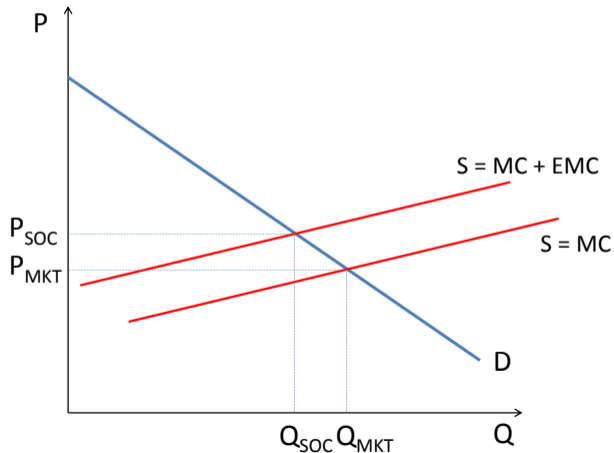
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What Does a Negative Externality Do to Market Supply?

Where is the Deadweight Loss?

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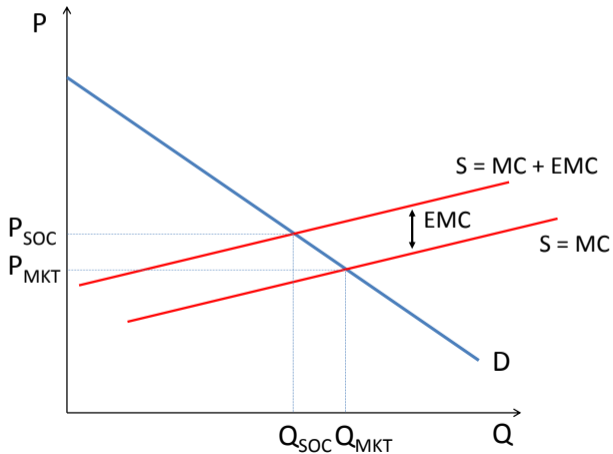
What Does a Negative Externality Do to Market Supply?

Too Much Production, at Too Low a Price

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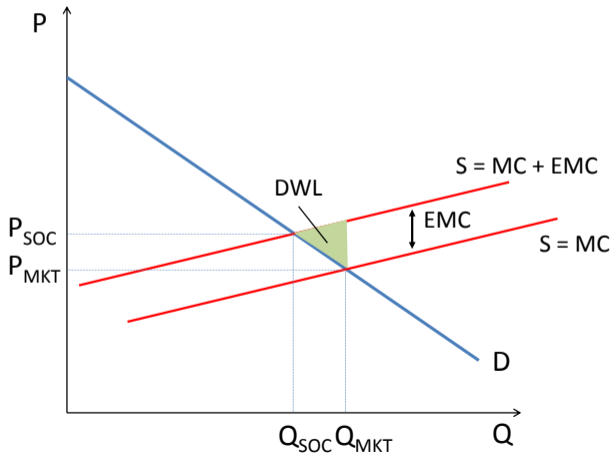
In a Market With Externalities

Assume a positive externality

- $\implies$ Social marginal benefit $\neq$ private marginal benefit
- $\implies$ Social marginal benefit $=$ private marginal benefit $+$ external marginal benefit

What does this mean for the relationship between market equilibrium P_{MKT} and Q_{MKT} and socially optimal P_{SOC} and Q_{SOC}?
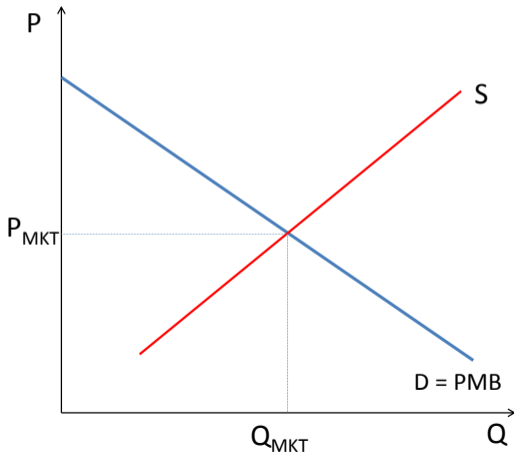
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Positive Externalities

Where Are Market Equilibrium P and Q?

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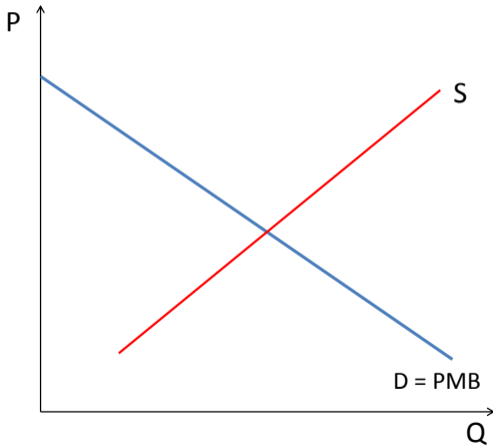
Positive Externalities

Where is the Social Marginal Benefit Curve?

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Positive Externalities

What are the Socially Optimal P and Q?

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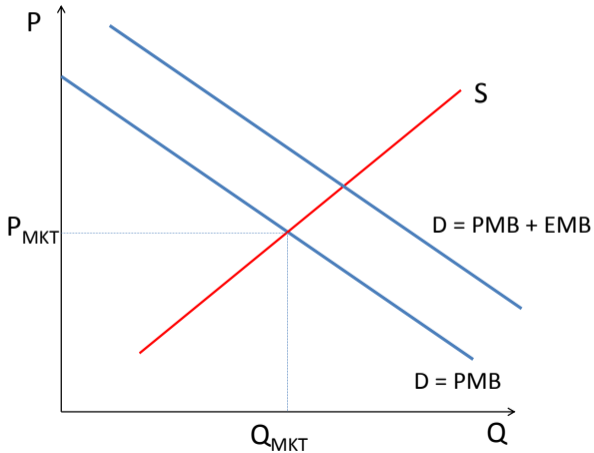
Positive Externalities

What is the Vertical Difference Between the Demand Curves?

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Positive Externalities

Where is the Deadweight Loss?

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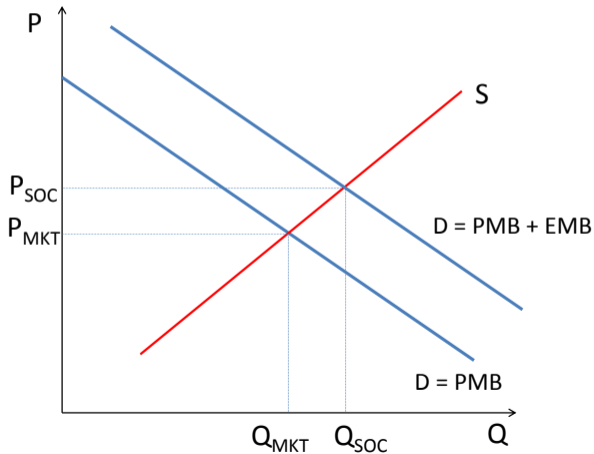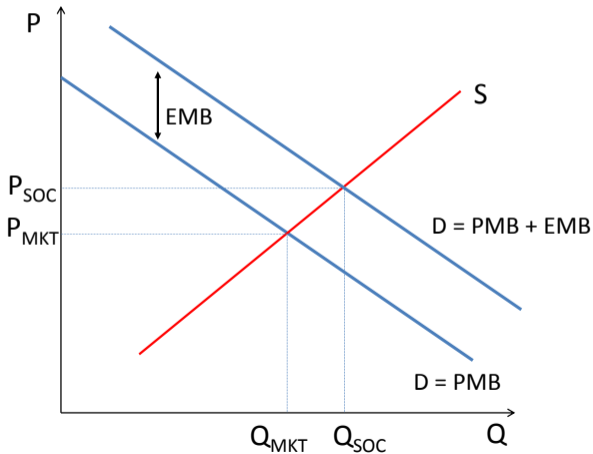
Positive Externalities
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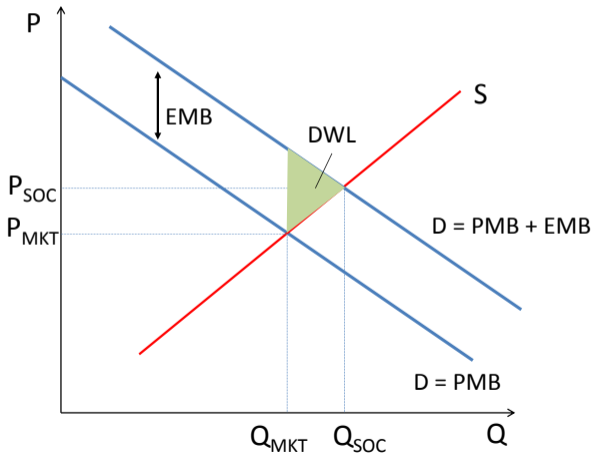
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Bottom Line

- Externalities cause a "market failure"
- This is defined as when market doesn't produce the efficient outcome

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Bottom Line

- Externalities cause a "market failure"
- This is defined as when market doesn't produce the efficient outcome
- What can we do?

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Fixing Externalities

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Before Fix, Note that Optimal Level of Negative Externality is Not Zero

- What is the optimal level of pollution?
    - Where costs of pollution equal benefits of pollution

Before Fix, Note that Optimal Level of Negative Externality is Not Zero

- What is the optimal level of pollution?
    - Where costs of pollution equal benefits of pollution
- What are benefits of pollution?
    - Ex: Air bags.

Before Fix, Note that Optimal Level of Negative Externality is Not Zero

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  - Ex: AirPods.

Before Fix, Note that Optimal Level of Negative Externality is Not Zero

- What is the optimal level of pollution?
  - Where costs of pollution equal benefits of pollution
- What are benefits of pollution?
  - Ex: Air bags. Production is dirty, application saves lives
  - Ex: AirPods. Production and consumption use plastic, allow solo enjoyment

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Getting to the Socially Optimal P and Q

Three methods

1. Change prices
2. Change quantities
3. (skip) Tradeable permits

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1. Using Taxes and Subsidies to Return to the Efficient Point

- Suppose we know the external marginal cost
- Charge a tax equal to the external marginal cost
- This returns us to the socially optimal equilibrium outcome
- Called a Pigouvian tax
- Requires that you (the policymaker) know the cost exactly
- Can redistribute tax revenues to those harmed by policy

Policy relevant? See Citizens' Climate Lobby's proposal for a carbon fee.

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To Be Clear

Before tax

- private marginal cost $= MC$
- social marginal cost $= MC + EMC$

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To Be Clear

Before tax

- private marginal cost $= MC$
- social marginal cost $= MC + EMC$

After tax, $T = EMC$

- private marginal cost $= MC + T$
- social marginal cost $= MC + EMC$

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1a. Correcting for a Negative Externality

Private and Social Supply Before a Tax

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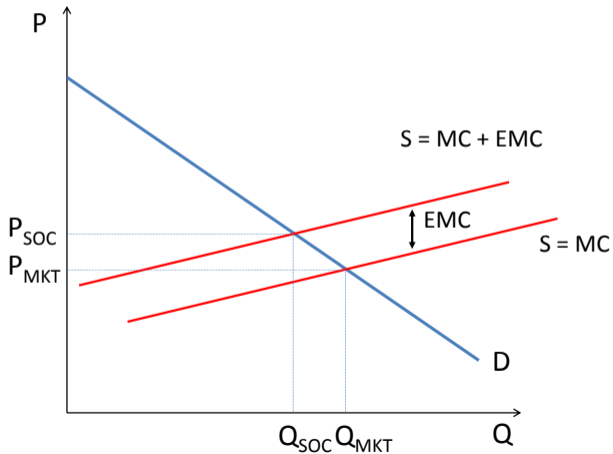
1a. Correcting for a Negative Externality

After the Tax, Private Supply = Social Supply

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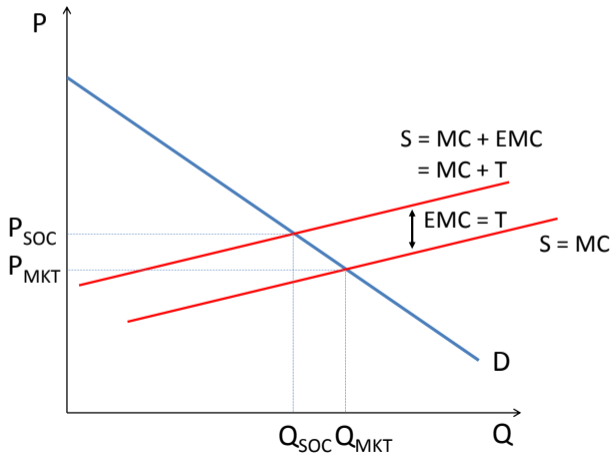
1b. Correcting for a Positive Externality

Private and Social Demand Before a Subsidy

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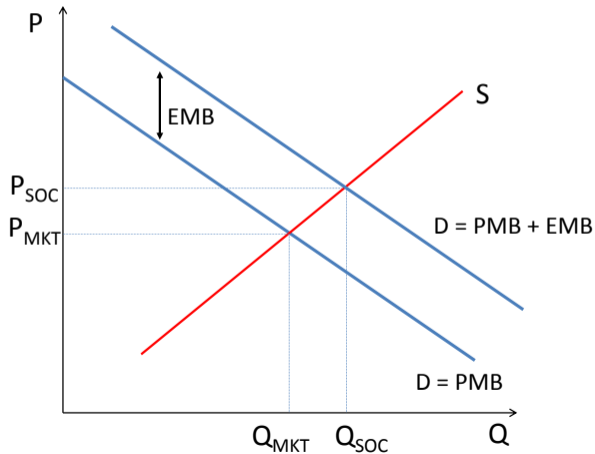
1b. Correcting for a Positive Externality

After the Subsidy, Private Demand = Social Demand

How About Assign a Quota?

What could go wrong?

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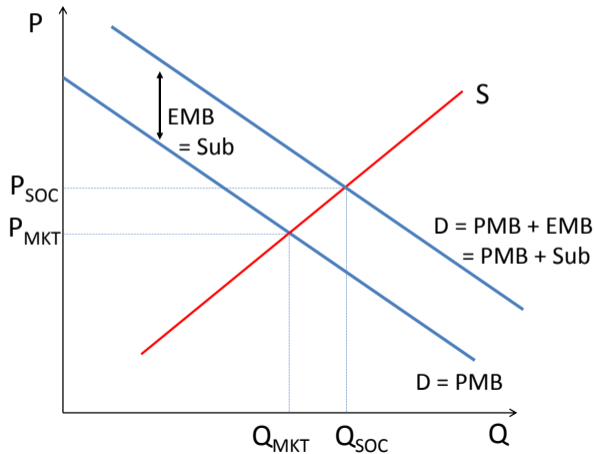
How About Assign a Quota?

What could go wrong?

1. May be hard to know optimal market output level
2. Tricky to assign by firm
   - Even if optimal market output is known, policy must assign quotas by firm
   - To assign quotas by cost of reduction, you need to know firm-specific costs
3. All costs and benefits are borne by market participants; no tax revenues to redistribute

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Try It Yourself: Negative Externalities

Suppose that leather is sold in a perfectly competitive industry. The industry short-run supply curve (marginal cost curve) is $P = MC = 3Q$, where Q is measured in millions of hides per year. The demand for leather hides is given by $Q = 60/7 - P/7$.

1. Find the equilibrium market price and quantity.

2. Suppose that the leather tanning releases bad stuff into waterways. The external marginal cost is $4/hide. Calculate the socially optimal level of output and price for the tanning industry.

3. What tax should you charge to the socially optimal equilibrium?

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Leather Production and Negative Externalities

1. Need to set supply = demand. Note that for demand, $P = 60 - 7Q$. Let supply = demand, $3Q = 60 - 7Q$, or $10Q = 60$, or $Q = 6$, and $P = 3(6) = 18$.

2. $SMC = MC + EMC = 3Q + 4$. Set supply = demand, or $3Q + 4 = 60 - 7Q$, or $Q = 5.6$. Then $P = 3(5.6) + 4 = 20.80$.

3. Set Pigouvian tax equal to external marginal cost

Ripped from Headlines: Externalities

We welcome Hannah

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Defining Public Goods

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Defining Public Goods

- Public goods are both non-rival and non-excludable
  - Non-rival $\equiv$ goods where your consumption does not impact my consumption
  - Non-excludable $\equiv$ goods from which consumption cannot be excluded

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- Pure public goods are rare:

Defining Public Goods

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Defining Public Goods

- Public goods are both non-rival and non-excludable
  - Non-rival $\equiv$ goods where your consumption does not impact my consumption
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- Pure public goods are rare: national defense, perhaps air for breathing.
- Public goods are **not** necessarily publicly provided goods.

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Think of Goods as Lying on a Grid of Public-ness

		Is consumption of good rival?	
		Yes	No
Is consumption	Yes	Private good	Impure public good
excludable?	No	Impure public good	Public good

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Key Aspects in Defining Public Goods, 1 of 2

- Everyone consumes the same quantity, but everyone need not equally value the good

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Key Aspects in Defining Public Goods, 1 of 2

- Everyone consumes the same quantity, but everyone need not equally value the good
  - you all consume the same economics lectures
  - some of you like them more than others

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Key Aspects in Defining Public Goods, 1 of 2

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- Classification as a public good depends on market conditions and technology

Key Aspects in Defining Public Goods, 1 of 2

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    - Think of the first written products: Guttenberg Bible
    - Clearly a private good!
    - But the bible now?

Key Aspects in Defining Public Goods, 1 of 2

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Key Aspects in Defining Public Goods, 1 of 2

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- Classification as a public good depends on market conditions and technology
  - Think of the first written products: Guttenberg Bible
  - Clearly a private good!
  - But the bible now?
- Some goods may be non-rival but excludable and vice versa
  - non-excludable, but rival: road at rush hour
  - non-rival, but excludable: very big park

Key Aspects in Defining Public Goods, 2 of 2

- Things that aren't products may have public good aspects

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Key Aspects in Defining Public Goods, 2 of 2

- Things that aren't products may have public good aspects
  - clean air
  - clean water
  - kindness

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Key Aspects in Defining Public Goods, 2 of 2

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Key Aspects in Defining Public Goods, 2 of 2

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  - construction of the purple line
  - bond issuance

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Key Aspects in Defining Public Goods, 2 of 2

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How do public goods from podcasts fit in this?

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Think of Public Goods

With your neighbors

- Come up with one specific example of each of these types of goods
    1. (mostly) public good
    2. publicly provided private good
    3. private good

- Be ready to explain why

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Optimal Provision of Public Goods

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Using Algebra To Do This
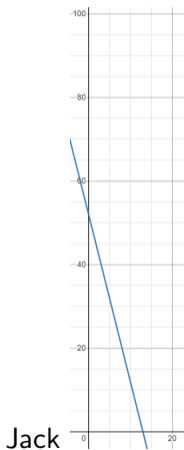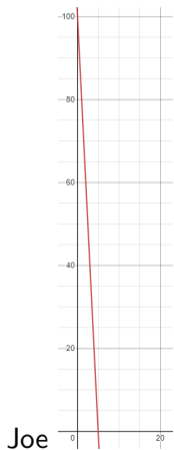
Suppose we have two
demand curves

- $Q_{Joe} = 5 - 0.05P$
- $Q_{Jack} = 13 - 0.25P$

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Joe

Jack

How Do We Add These?

Joe

Jack

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How Do We Add These?

Joe

Jack

w/ 1 J

w/ 2 Js

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Given the two demand curves

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Their sum is a piece-wise linear function. What are the pieces?

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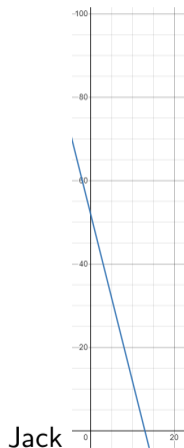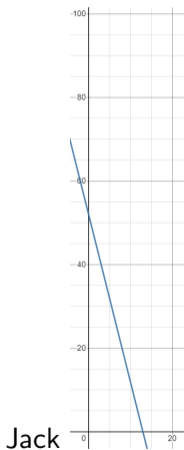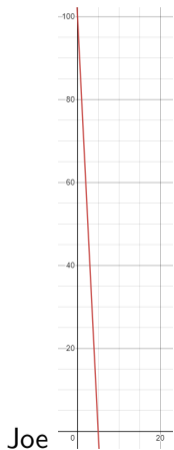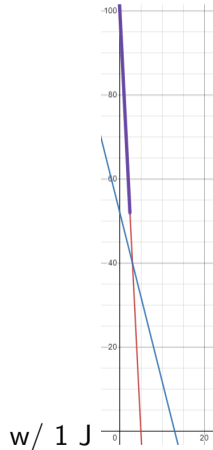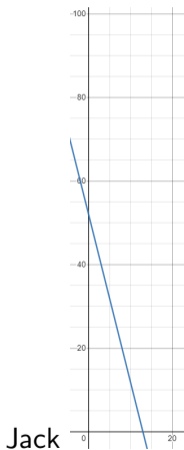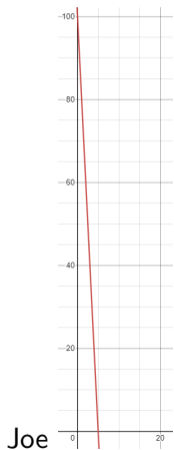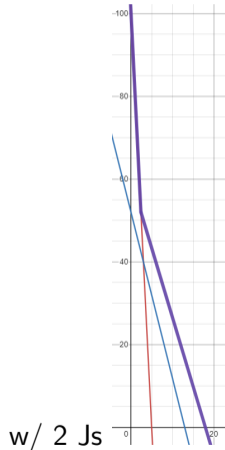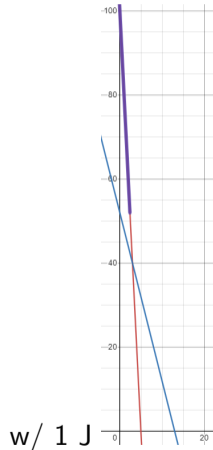
Using Algebra To Do This

Given the two demand curves

- $Q_{Joe} = 5 - 0.05P$
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Their sum is a piece-wise linear function. What are the pieces?

- At $P > \$52$, Jack doesn't want any more
- At $P > \$100$, Joe doesn't want any more

We write this as

$$Q_M = \begin{cases} 18 - 0.3P & \text{if } 0 < P < 52 \\ 5 - 0.05P & \text{if } P > 52 \end{cases}$$

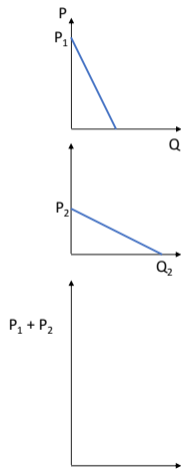Why doesn't this work for public goods?

Optimal Provision of Public Goods?

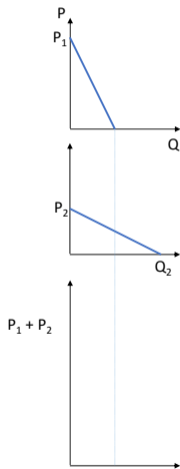## How Much Are Mr. 1 and Mr. 2 Willing to Pay for Fireworks?

Optimal Provision of Public Goods?

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Optimal Provision of Public Goods?

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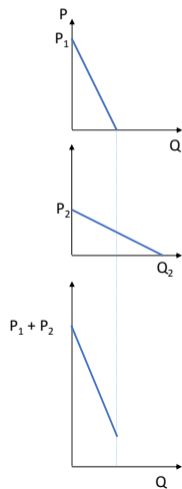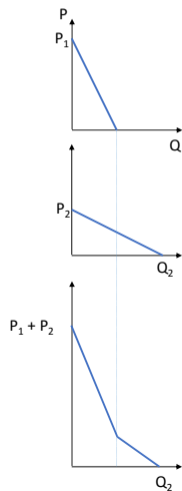## How Much Are Mr. 1 and Mr. 2 Willing to Pay for Fireworks?

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Optimal Provision of Public Goods?

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Adding Market Demand for Public Goods in Math

Big Picture: Add up P at a given quantity, Q.

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Adding Market Demand for Public Goods in Math

Big Picture: Add up P at a given quantity, Q. Step by step:

1. Figure out who is in the market for which **quantities**

- look at maximum willingness to purchase
- you read this from the Q axis
- demand curve with farthest Q intercept has maximum willingness to purchase
- use these bounds to determine where kinks are in demand curve

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2. For each region of quantities, find market demand

- Starting with region with only one market participant
- $\rightarrow$ demand curve is only maximum demander
- For quantities where > 1 person is willing to purchase
- Add Ps
    - write demand curve in terms of P
    - Add $P_M = P_1 + P_2 + \ldots$

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Equilibrium Provision of Public Goods

Is Equilibrium Provision of Public Goods Optimal?

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- Notice that it required us to know an awful lot about what people want

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Bottom line: Equilibrium provision of public goods $<$ optimal provision of public goods

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Why Underprovision?

- People may not truthfully reveal demand due to free rider problem
- People may not know their demand
- To reiterate, two equivalent statements
  - In general, private markets **underprovide** public goods
  - Even goods that a whole group wants and is willing to pay for may not be provided

When Does Private Market Provide Some Public Goods?

- The smaller the group, the more likely the provision
- When one, or a few, members care a lot
- Altruism
- Warm glow

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Public Provision of Public Goods

Can the Government Do Better?

Due to the failure in the private market, one solution is for government to provide public goods.

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- Free-rider problem again: optimal amount of public goods is sum of P given Q
  - Consumers might not know their demand (do you know your demand for missiles?)
  - And consumers have an incentive to underestimate

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  - And consumers have an incentive to underestimate
- Government provision "crowds out" private provision
  - Before the government firework show, you might have bought some of your own. Now you do not. Other examples?
- Costs and benefits hard for government to measure

Recap of Today: Public Goods

Externalities

1. Defining
2. Fixing

Public Goods

1. Defining public goods
2. Optimal provision of public goods
3. Equilibrium provision of public goods
4. Public provision of public goods

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The End

Thank you