PUBLIC POLICIES: AN INTRODUCTION

LESSON OBJECTIVES

01

Define and Analyze Efficiency of Command-and-Control Policies

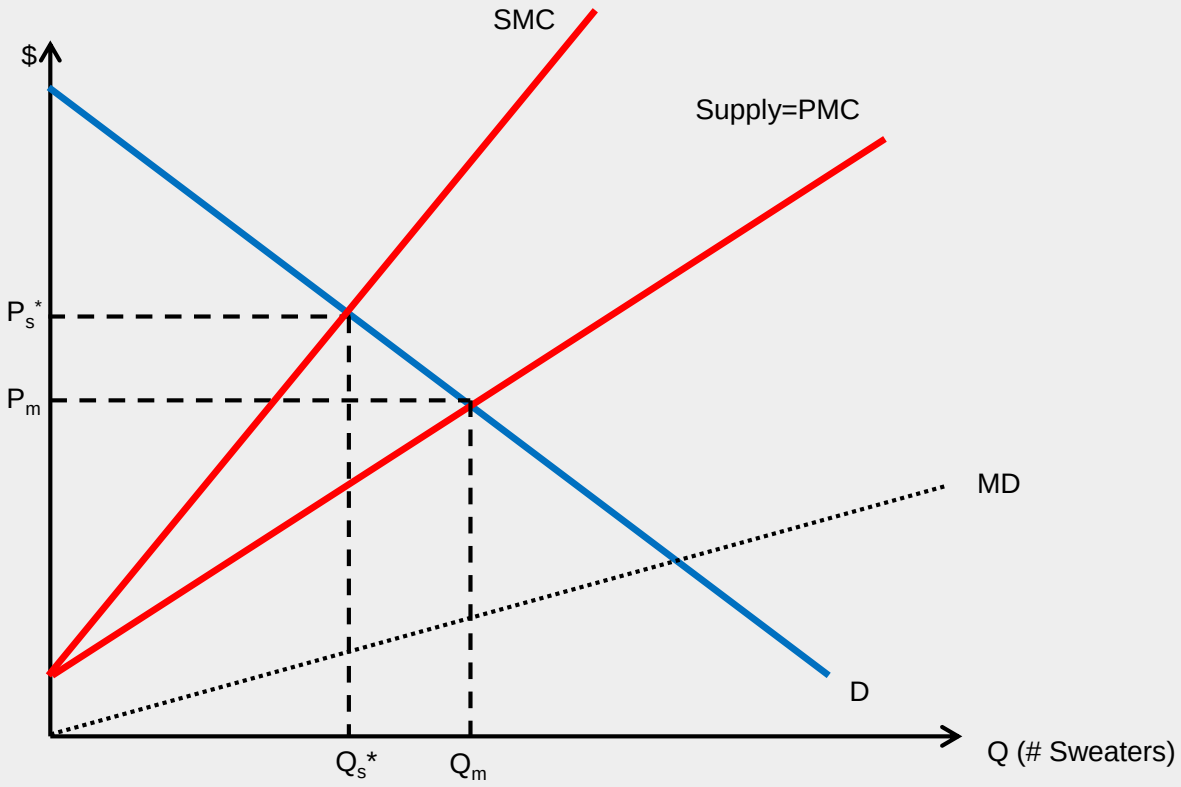
02

Define and Analyze Efficiency of Pigouvian Tax Policies

03

Define and Analyze Efficiency of Tradeable Permit Policies

EFFICIENT VS MARKET EQUILIBRIUM



HOW CAN WE ADDRESS INEFFICIENT OUTCOMES FROM EXTERNALITIES?

Private solutions:

- Coase Theorem
- Social Pressure

Public solutions:

- Standards
- Taxes
- Permits

PUBLIC SOLUTIONS:
STANDARDS
TAXES
PERMITS

We will formally analyze each of the three major policy approaches to address externalities

Each policy is evaluated on its **efficiency** and on **implementation strengths and weaknesses**.

Today we will focus on the **efficiency** of each policy.

HOW TO EVALUATE THE EFFICIENCY OF PUBLIC POLICIES

Efficiency of a policy depends on two factors:

I) How do we "set the goal correctly?"
- What is the optimal level of pollution?

II) Does the policy achieve the optimal level of pollution at least cost?
- Efficient polices must be cost-effective

01

COMMAND-AND-CONTROL POLICY

WHAT IS COMMAND-AND-CONTROL POLICY?

COMMAND-AND-CONTROL

Also referred to as the *prescriptive* or *standards* approach

Two types:

1. Technology Standard:
   - Requires firms (polluters) to use a particular abatement technology
2. Performance Standard:
   - Requires firms to emit no more than "X" amount
   - May be X units per time period (100 ton of NOx/year)
   - Or can be specified as a rate (X unit per unit of fuel consumed)

STANDARDS EXAMPLES

Technology standards:

Clean Air Act (CAA)
Requires new power plants to install scrubber technology to reduce SO_2

Catalytic Convertor:
Requires new cars to have a catalytic convertor to reduce pollutants

Performance standards:

Mercury and air toxin standards (MATS):
Sets a maximum allowable pollutants

Cafe standards:
Requires fleet to meet emissions standard

ARE STANDARDS EFFICIENT

I. HOW DO WE "SET THE GOAL CORRECTLY?"

What is the goal?

- Efficiency

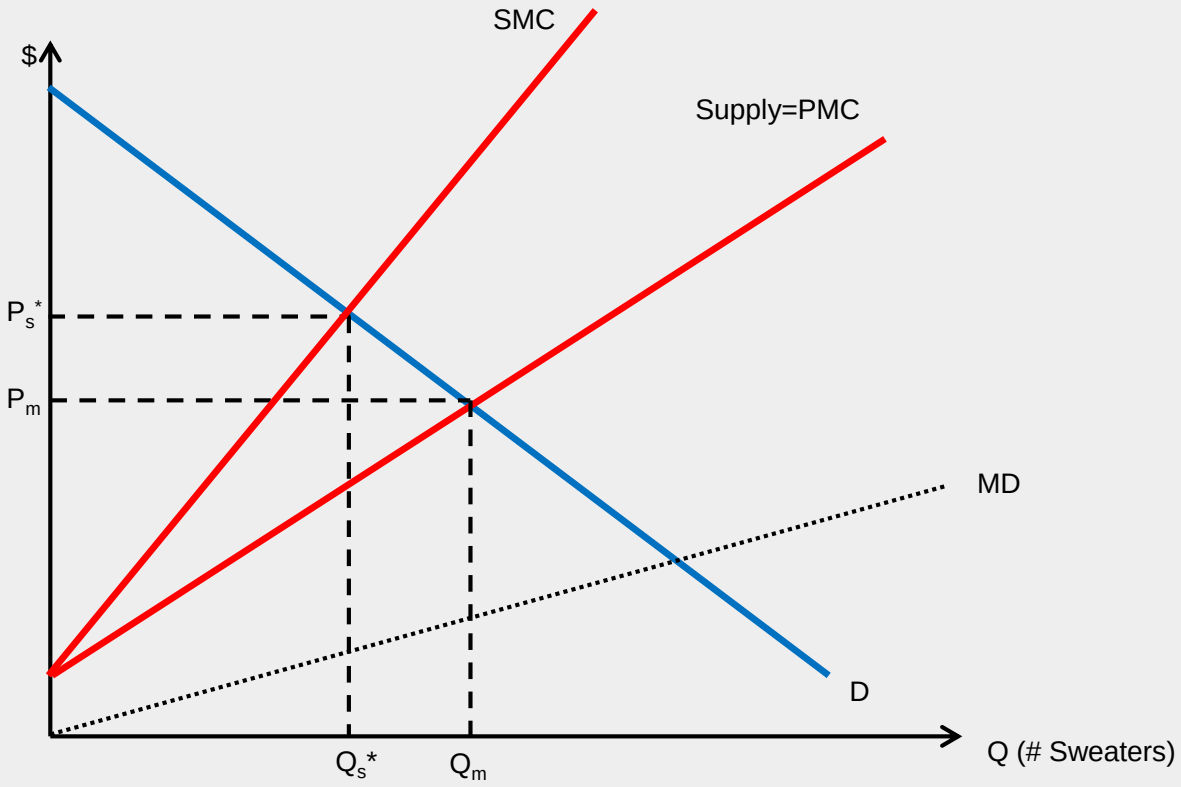
How does command-and-control achieve the goal?

- Setting (or limiting) quantities

Difficulty:

- How to find the efficient quantity

EFFICIENT VS MARKET EQUILIBRIUM



2. DO STANDARDS ACHIEVE THE OPTIMAL LEVEL OF POLLUTION AT LEAST COST?

To answer this question, let's consider the following example…

Consider 15 firms that produce electricity.

- 10 new firms
- 5 old firms

Let's assume they are identical in every way except their pollution and abatement costs

- Pollution:
  - New firms: 10 tons/firm
  - Old firms: 20 tons/firm
- Abatement costs:
  - New firms: $50/ton
  - Old firms: $100/ton

EFFICIENCY OF STANDARDS

Setup:

- 10 new firms, 5 old firms
- New firms: pollute 10 tons/firm (100 tons total), abatement cost of $50/ton
- Old firms: pollute 20 tons/firm (100 tons total), abatement cost of $100/ton

Let's say economists agree the efficient level of pollution is 100 tons.

What is the least-cost way of achieving 100 tons pollution?

- New firms reduce to 0 and old firms do nothing
- Total Cost = 100 x $50 = $5,000

To know the cheapest possible reduction, the policymaker must know every firm's abatement costs and tailor pollution reduction for each firm!

EFFICIENCY OF STANDARDS

Setup:
- 10 new firms, 5 old firms
- New firms: pollute 10 tons/firm (100 tons total), abatement cost of $50/ton
- Old firms: pollute 20 tons/firm (100 tons total), abatement cost of $100/ton

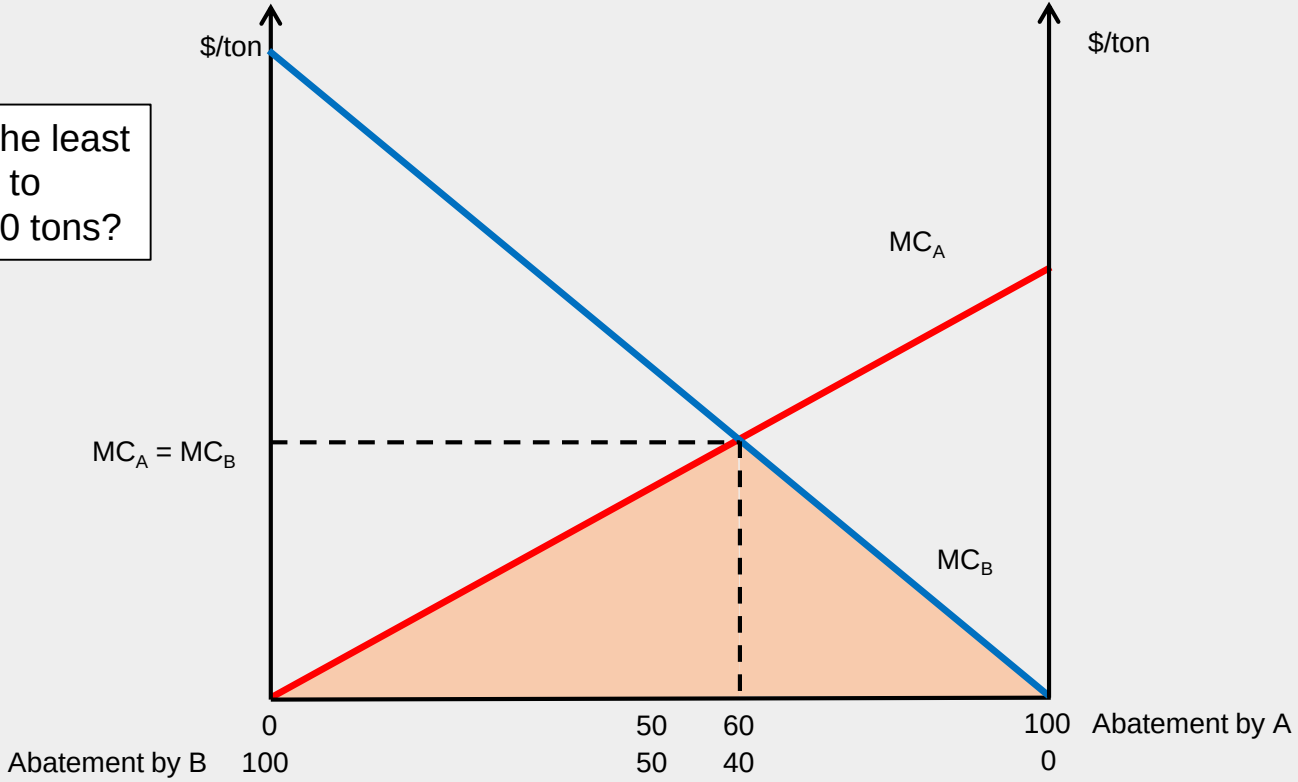
Due to fairness and regulatory burden, standards are typically uniformly imposed on all sources of pollution.

What if all firms were required to reduce emissions by 50% (100 tons pollution)?
- New firms reduce to 5 tons/firm and old firms reduce to 10 tons/firm
- Total Cost = 50 x $50 + 50 x $100 = $7,500

When applied uniformly, standards are no longer an efficient policy!
- No longer achieve at lowest cost

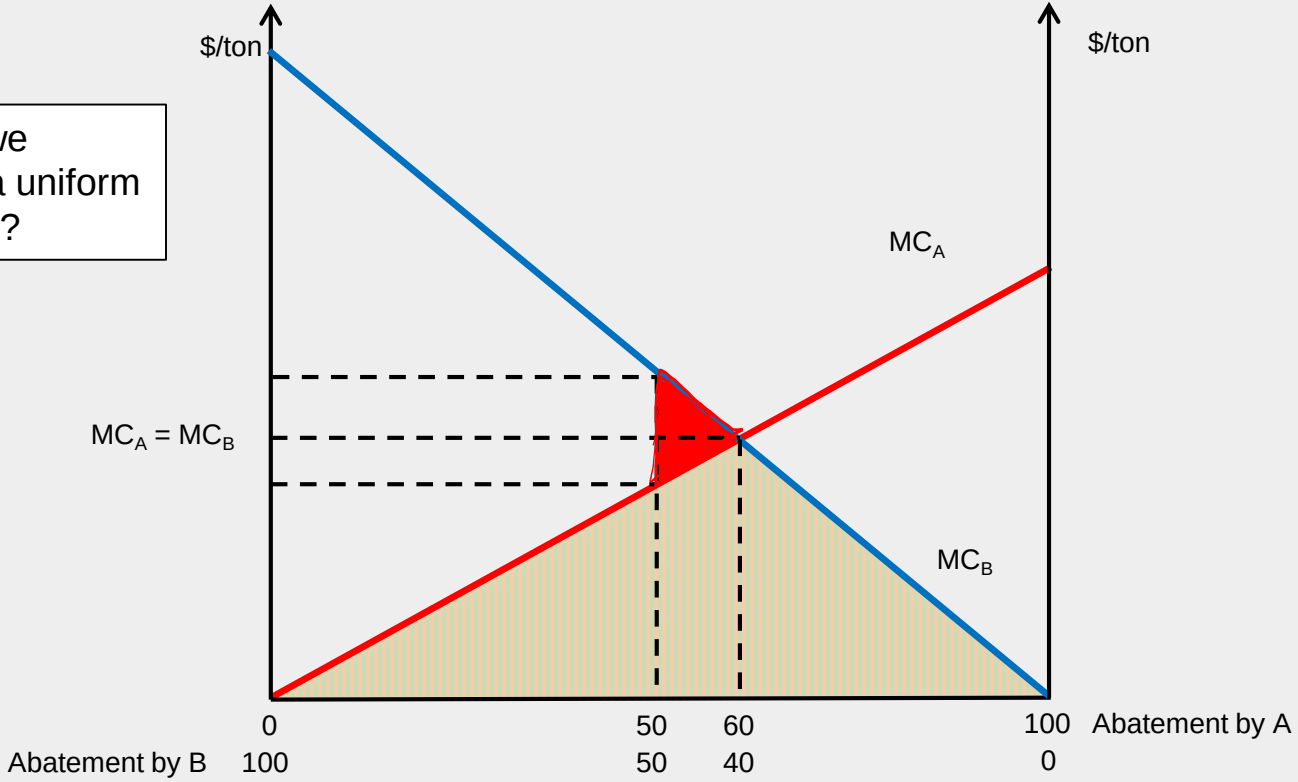
EFFICIENCY OF STANDARDS

What is the least cost way to abate 100 tons?



EFFICIENCY OF STANDARDS

What if we applied a uniform standard?



RELATING TO THE EQUIMARGINAL PRINCIPLE

Recall the Equimarginal principle (EMP)

- Efficient point is where the MB of Abatement = MC of Abatement

In the context of firms reducing pollution, the EMP is:

The least-cost reduction of pollution occurs when each firm reduces pollution to a point that its MC of abating the last unit of pollution is the same as all other firms.

The efficient outcome for each firm will be where MC(firm 1) = MC (firm 2) = MC (firm 3)… and so on.

If marginal costs vary, optimal abatement levels will vary across firms

- Costs are equal, not abatement

PROBLEM

A uniform standard is only efficient if all firms are identical in their abatement costs.

- The more dissimilar, the larger the inefficiencies.

SOLUTIONS?

Why not apply tailored standards?

To implement efficient standard, policymakers would need to know the true costs.

- Will firms reveal this willingly? What are their incentives?

What about using firm (plant) characteristics to tailor the standard?

- Vintage differentiated regulation

VINTAGE DIFFERENTIATED REGULATION

This is commonly used in environmental standards regulation.

- E.g. Clean Water Act, Clean Air Act, energy efficiency standards

Most common approach is grandfathering

- Exemptions for those established (built) prior to a given date face relaxed or no regulation

DOES IT WORK?

Can be more cost-effective than uniform standard.

Possibly fairer.

What happens to incentives?

- What happens to firms' decisions to build new or replace old plants?

Costs of replacement increase, lowering incentive to replace older, less efficient, higher polluting plants.

- Counters goal of regulation

COMMAND-AND-CONTROL TAKEAWAY

Pros:

- Sure to achieve the desired level of pollution (if enforcement is 100%)
- Can be reasonably efficient if all the agents (polluters) are similar in their costs

Cons:

- If costs vary across firms, C&C is not likely to be cost-effective (and thus not efficient even if policy goal is set correctly)

PROBLEM

Standards are a popular approach, but it is clear they are rarely a cost-effective approach

SOLUTION?

What other approaches could we use?

How about market-based approaches?

MARKET-BASED POLICIES

MARKET-BASED POLICIES

Externality problems arise because of incomplete markets

Can we use markets to restore market efficiency?

Three ways to do this:

- Assigning property rights
- Get the prices right (tax)
- Filling the missing demand (permits)

02

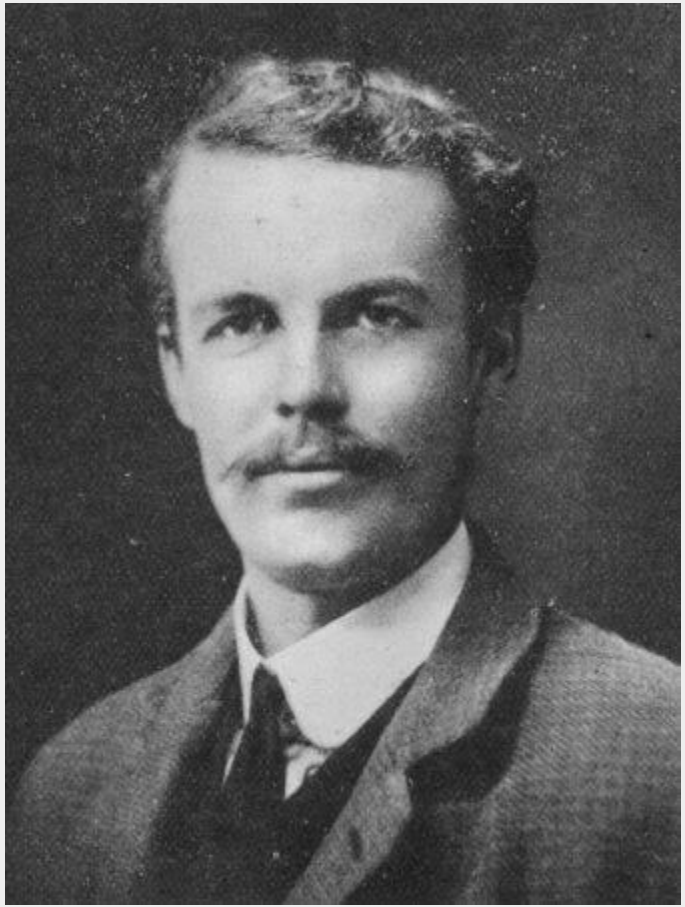
PIGOUVIAN TAXES

A BRIEF HISTORY...

In 1920, Pigou released *The Economics of Welfare*

Challenged the thinking of Adam Smith, arguing a need for government intervention in some instances to achieve efficient outcomes

He argued that profit maximizing firms would not internalize their external social costs.



I. HOW DO WE "SET THE GOAL CORRECTLY?"

What is the goal?

- Efficiency

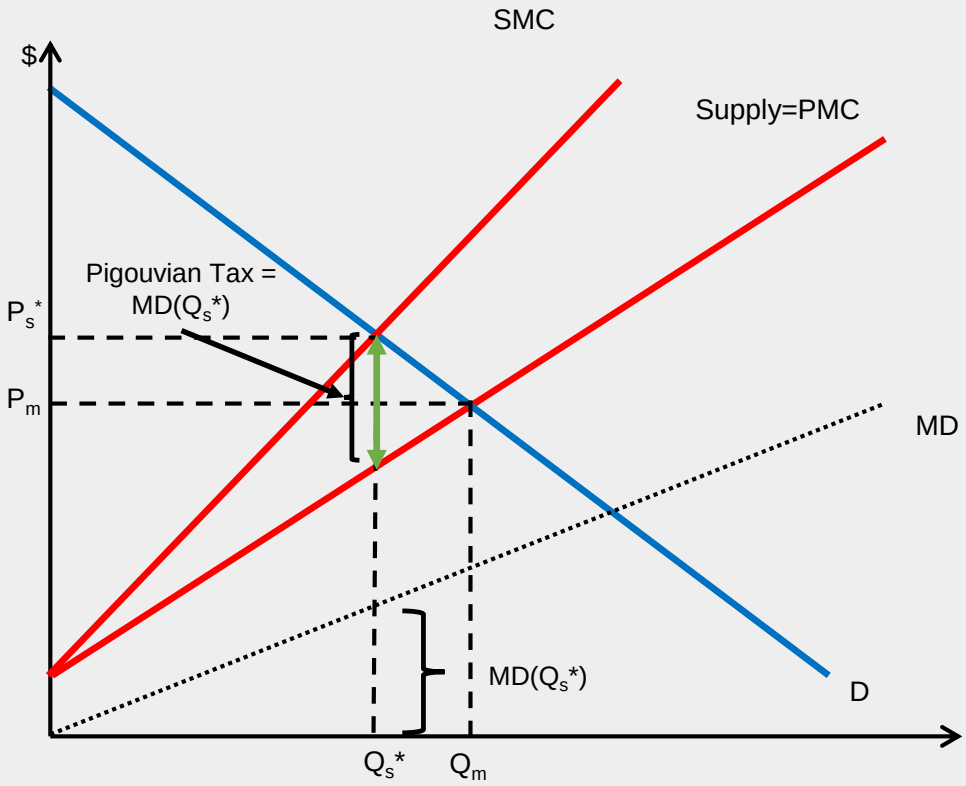
How do Pigouvian taxes achieve the goal?

- Setting prices

Difficulty:

- What is the optimal price?

HOW DO WE "SET THE GOAL CORRECTLY?"



How do we get the prices right?

What size would the tax need to be?

GETTING THE PRICES RIGHT

Pigouvian Tax

Set tax rate equal to the marginal external cost at the efficient quantity

Outcome

With a tax equal to MD(Q^*), the firm faces the *true* cost of production.

New market equilibrium is at the efficient point!

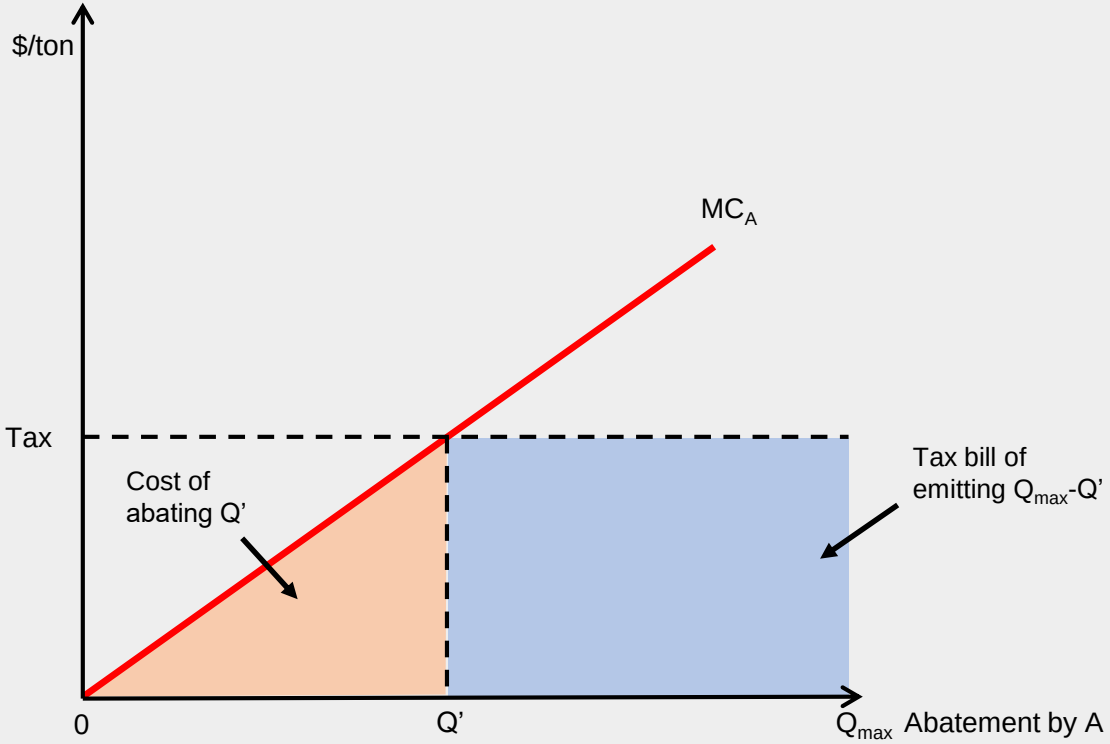
2. DO PIGOUVIAN TAXES ACHIEVE THE OPTIMAL LEVEL OF POLLUTION AT LEAST COST?

COST EFFECTIVENESS

How much will firm A abate?

What is the cost of abatement?

What is the tax bill?



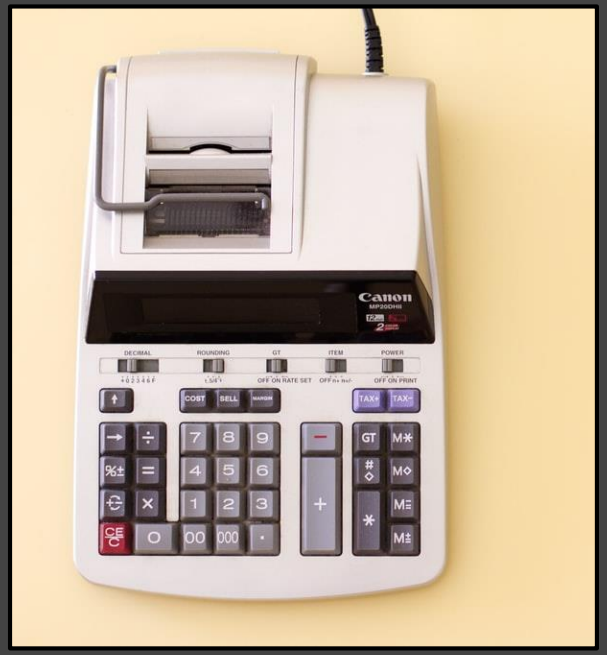
COST EFFECTIVENESS

In response to the tax, Firm A abates Q' such that the marginal cost of abatement equals the tax.

If the firm abated more, or less, the cost of compliance would be higher.

- Just like a cost minimizing firm produces up to the point MC=P

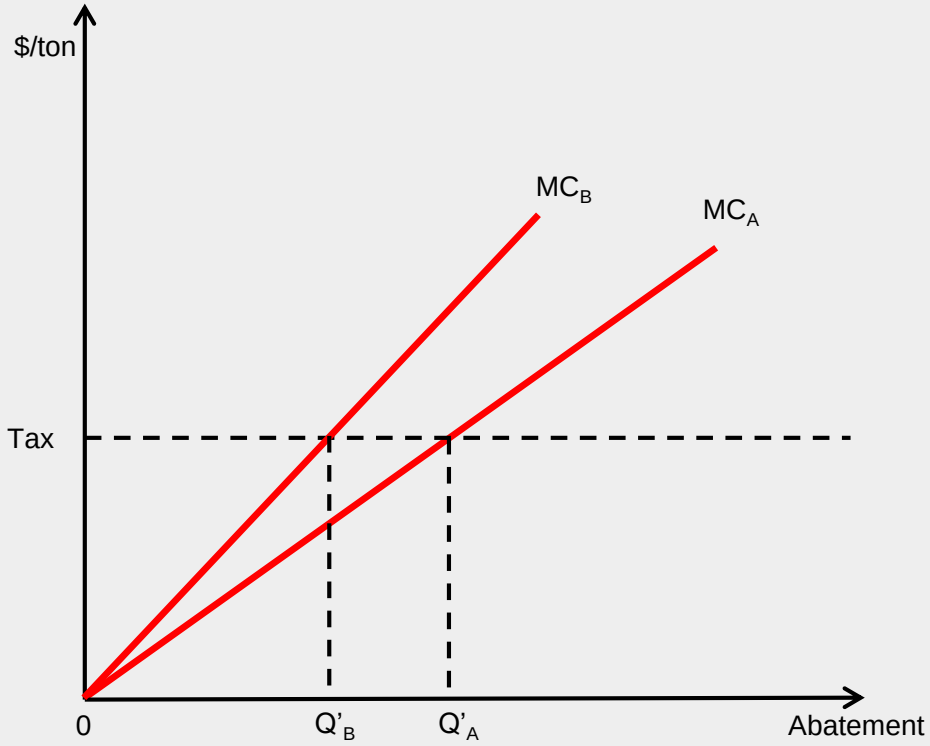
What would happen if there was another firm, Firm B?



COST EFFECTIVENESS

How much will firm A abate?

How much will firm B abate?



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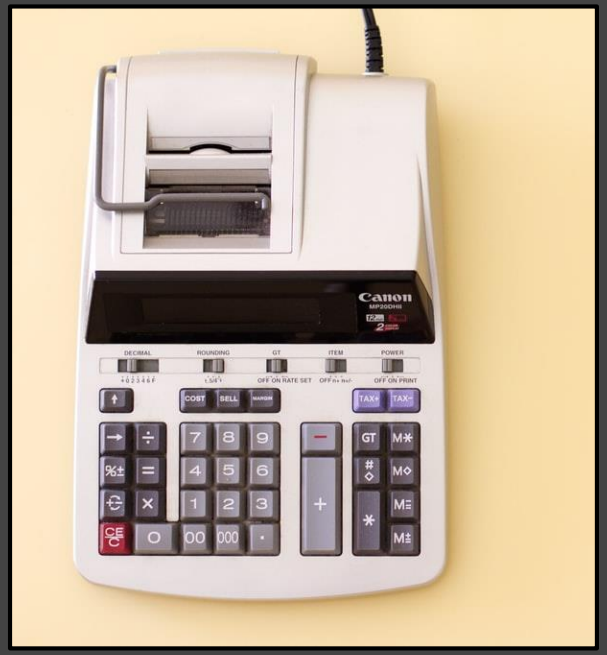
If the firm abated more, or less, the cost of compliance would be higher.

- Just like a cost minimizing firm produces up to the point MC=P

What would happen if there was another firm, Firm B?

- Also abates to point where MC of abatement equals the tax.
- Quantity of abatement may be different for the two firms!

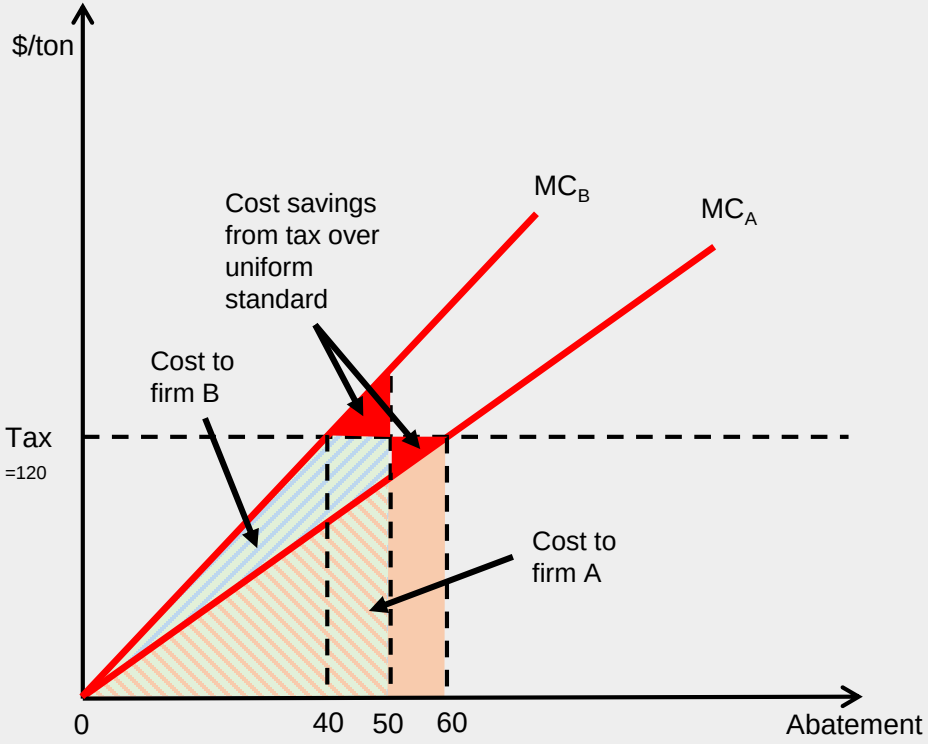


COST EFFECTIVENESS

How do the cost of taxes compare to a uniform standard?

What is the cost of abating 100 with a tax?

What is the cost of abating 100 with a uniform standard?



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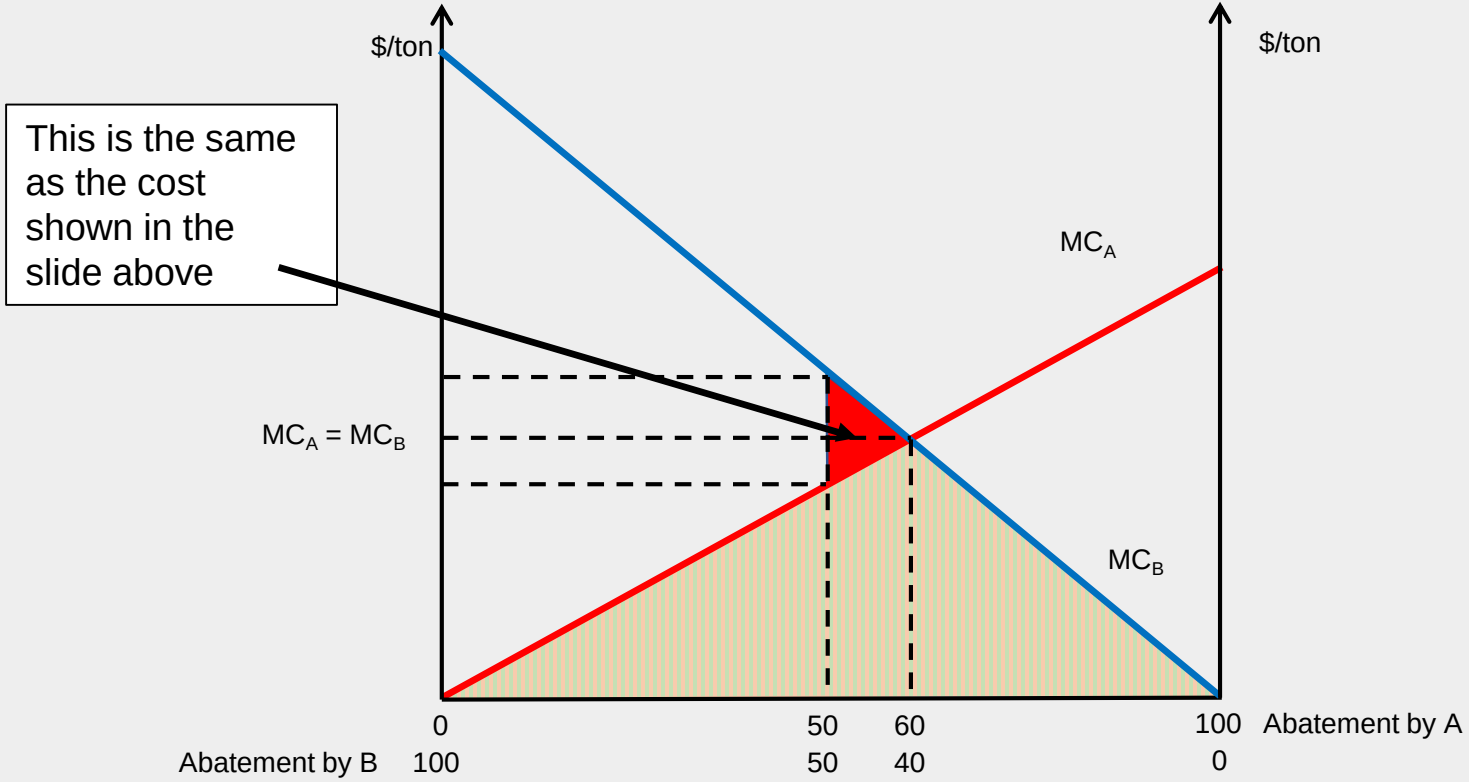


2. DOES THE POLICY ACHIEVE THE OPTIMAL LEVEL OF POLLUTION AT LEAST COST?

Intuition:
Suppose firms faced a new policy that imposed a tax on emissions. What will firms do in response?

When MC<tax rate, firms will reduce emissions (abate) rather than pay tax on that unit

When MC>tax rate, firms will pay the tax and emit that unit

So, they will reduce emissions until MC=tax rate!

Pigouvian taxes are efficient *if* policymakers correctly set the tax rate.

PROBLEM

But what if we don't know the optimal price of pollution?

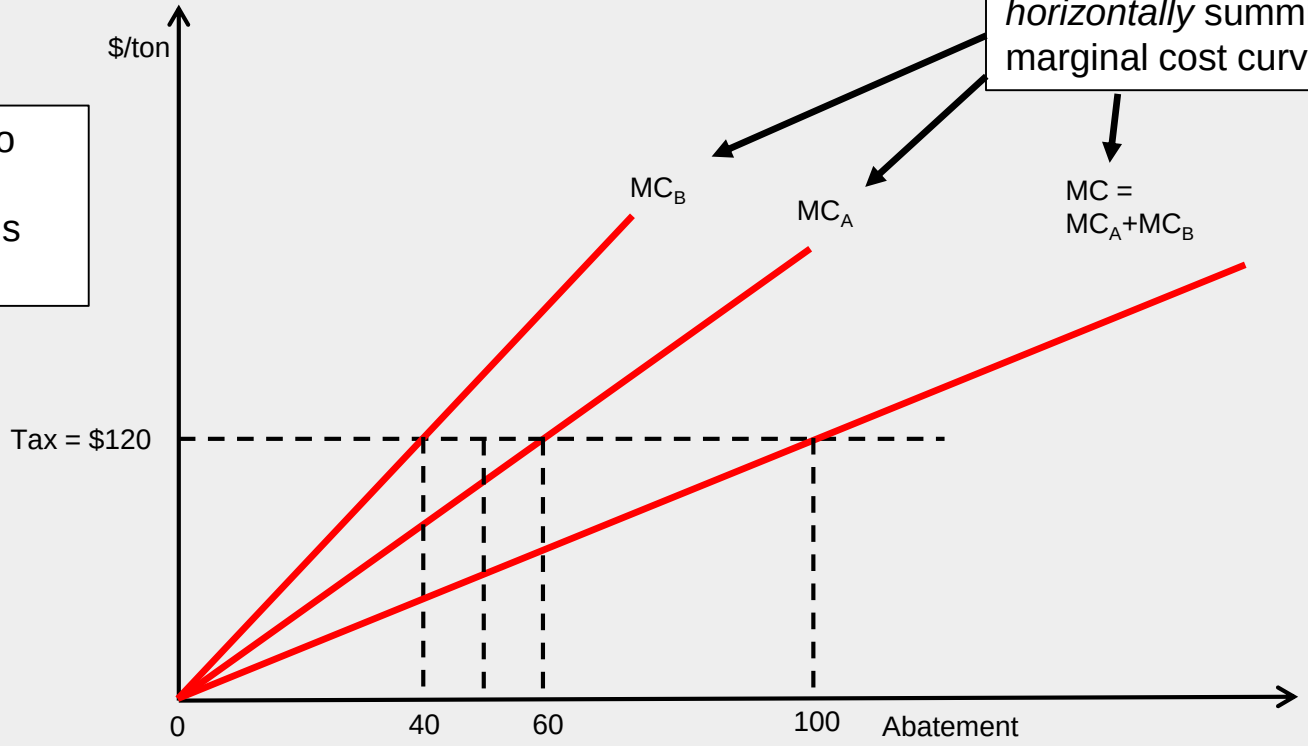
What if instead we know (or have set a goal at) a quantity of abatement Q'.

How do we set the tax to achieve that level of abatement?

SOCIAL AGGREGATE COST CURVE

Have to get social aggregate cost curve by *horizontally* summing marginal cost curves

Say we want to abate Q=100. What tax rate is needed?



IS THERE ANOTHER MARKET-BASED POLICY WE COULD USE?

ATTENDANCE ACTIVITY

Say the US and China were the only countries and policymakers wanted design an intervention for climate change for 2025.

What is the optimal tax?
What are the abatement costs?
What are the gains over a uniform standard?

Costs (in tCO_2)
$MC_{China} = 3.38x10^{-8}Q$
$MC_{USA} = 1.56x10^{-7}Q$
$SMC = 2.78x10^{-8}Q$

Benefits
$MB = \$40/tCO_2$

(Sources: POLES EnerData and EPA)

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Optimal tax?
MD is $40/ton, so optimal tax is $40/ton

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Abatement Cost for Tax
China: $\$40 = 3.38 \times 10^{-8} Q$
-> $Q = 1.18 \times 10^{9}$
-> $TAC = 1/2 \times 40 \times 1.18 \times 10^{9} = \$23.6$ Billion

USA: $\$40 = 1.56 \times 10^{-7} Q$
-> $Q = 2.56 \times 10^{8}$
-> $TAC = 1/2 \times 40 \times 2.56 \times 10^{8} = \$5.1$ Billion

Total: 28.7

ATTENDANCE ACTIVITY

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$SMC = 2.78x10^{-8}Q$

Benefits
$MB = \$40/tCO_2$

(Sources: POLES EnerData and EPA)

Abatement Cost for Standard
China:
-> $Q = 7.18x10^8$
-> $MC(Q) = \$24$
-> $TAC = 1/2x24x7.18x10^8 = \$8.6$ Billion

USA:
-> $Q = 7.18x10^8$
-> $MC(Q) = \$112$
-> $TAC = 1/2x112x7.18x10^8 = \$40.2$ Billion

Total: $48.8 Billion

FILLING THE MISSING DEMAND: TRADEABLE PERMITS

PROBLEM

Pigouvian taxes are a cost-effective approach to achieving efficiency. However, if the goal is to reduce emissions by a given amount, knowledge of the cost curves is still needed.

Example: Reduce emissions to keep greenhouse gases below concentration of 550ppm

SOLUTION

Is there a market-based, cost effective mechanism that can be set based on quantity targets?

Yes! They are called tradeable permits.

03

TRADEABLE PERMITS

HOW PERMITS WORK

To achieve an efficient outcome ("fill the demand") policymakers distribute permits for pollution

- A sheet of paper that says your firm can emit X tons of pollution
- If you admit more than you are allowed, you are fined

There are different ways of initially distributing permits

- Grandfathering, auction, etc.
- This matters for individual firms, but we will see that it doesn't matter for market-level outcomes

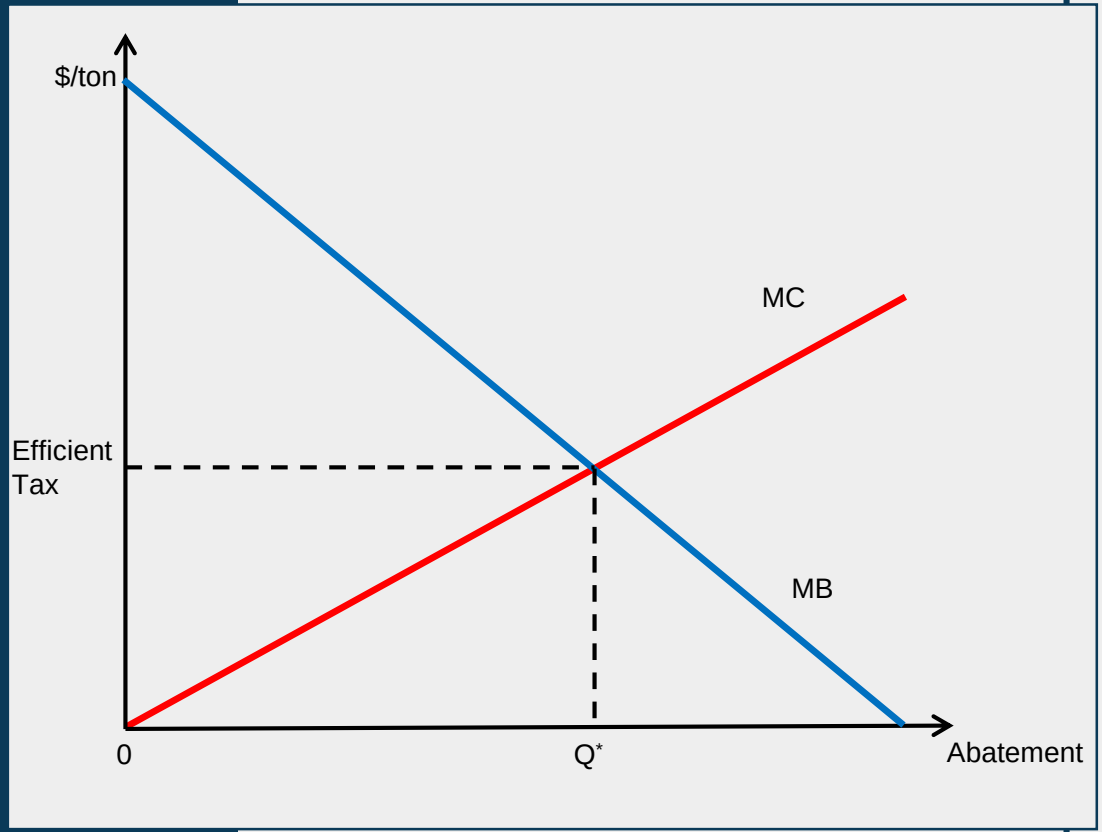
The key to permits is that they are **tradeable**

I. HOW DO WE “SET THE GOAL CORRECTLY?”

To achieve the goal of efficiency, policymakers will need information on both the marginal benefit curve and the marginal cost curve.

- This can be prohibitive

Given this information, policymakers can distribute Q^* permits and let the market sort it out.



2. DOES THE POLICY ACHIEVE THE OPTIMAL LEVEL OF POLLUTION AT LEAST COST?

SIMPLE EXAMPLE

Setup:

- Firm has the shown MC of abatement
- Firm is given 70 permits
- Firm must "clean up" 30 remaining tons
- How can the firm do this at the lowest cost?
- Cost of abating is 0.5x30x30=$450

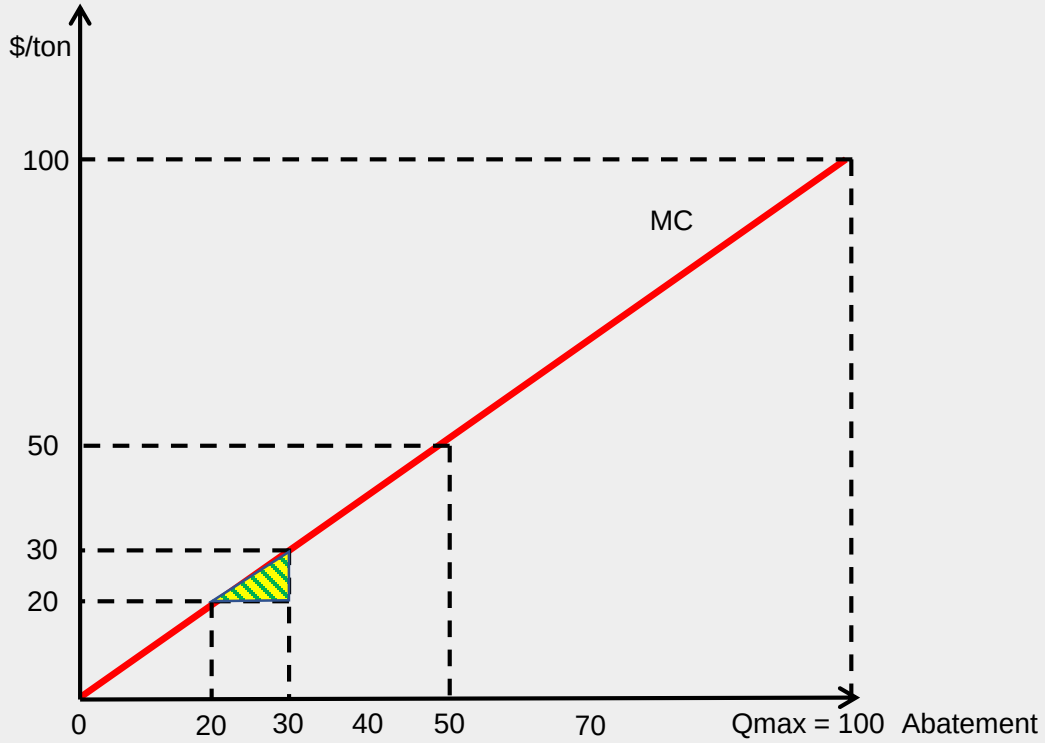
Scenario 1:

Cost of permits is $20

What will the firm do?

The firm will buy 10 more permits and abate 20 tons

Cost = 0.5x20x20+20x10
= 200+200=400



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- How can the firm do this at the lowest cost?
- Cost of abating is 0.5x30x30=$450

Scenario 2:

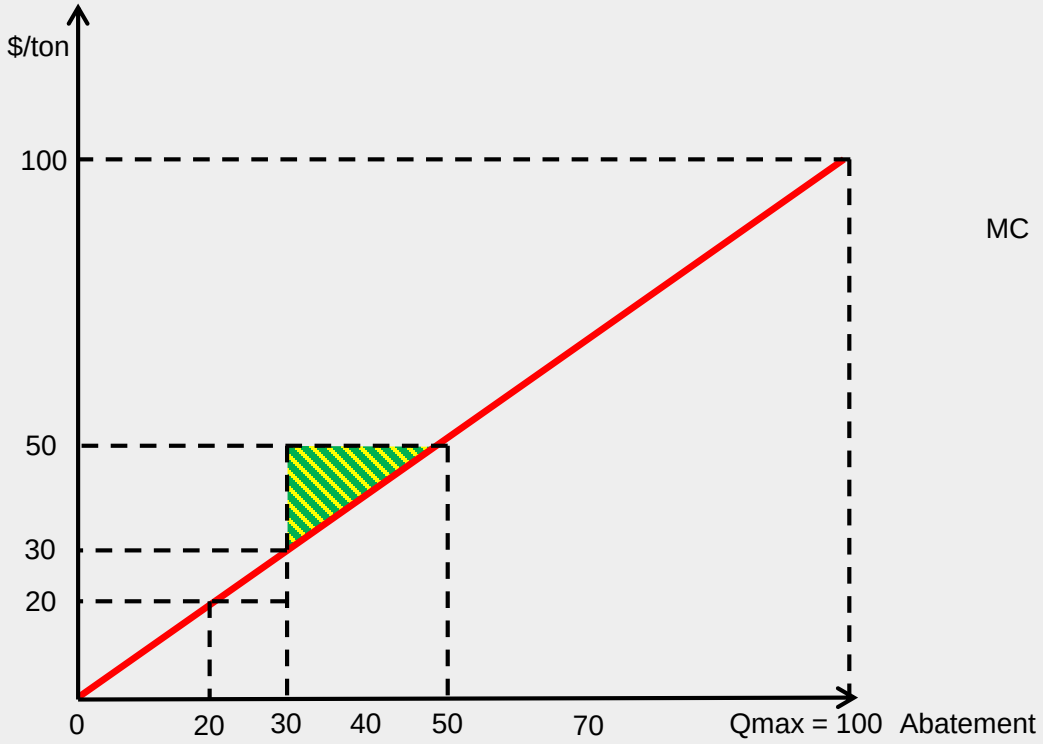
Cost of permits is $50

What will the firm do?

The firm will sell 20 permits and abate 50 tons

Cost = 0.5x50x50-20x50

= 2,500-1,000=$250



SIMPLE EXAMPLE (TWO FIRMS)

Setup:

- Two firms with the shown MC of abatement
- Each firm is given 50 permits
- Firm must "clean up" 50 remaining tons
- What will each firm do?

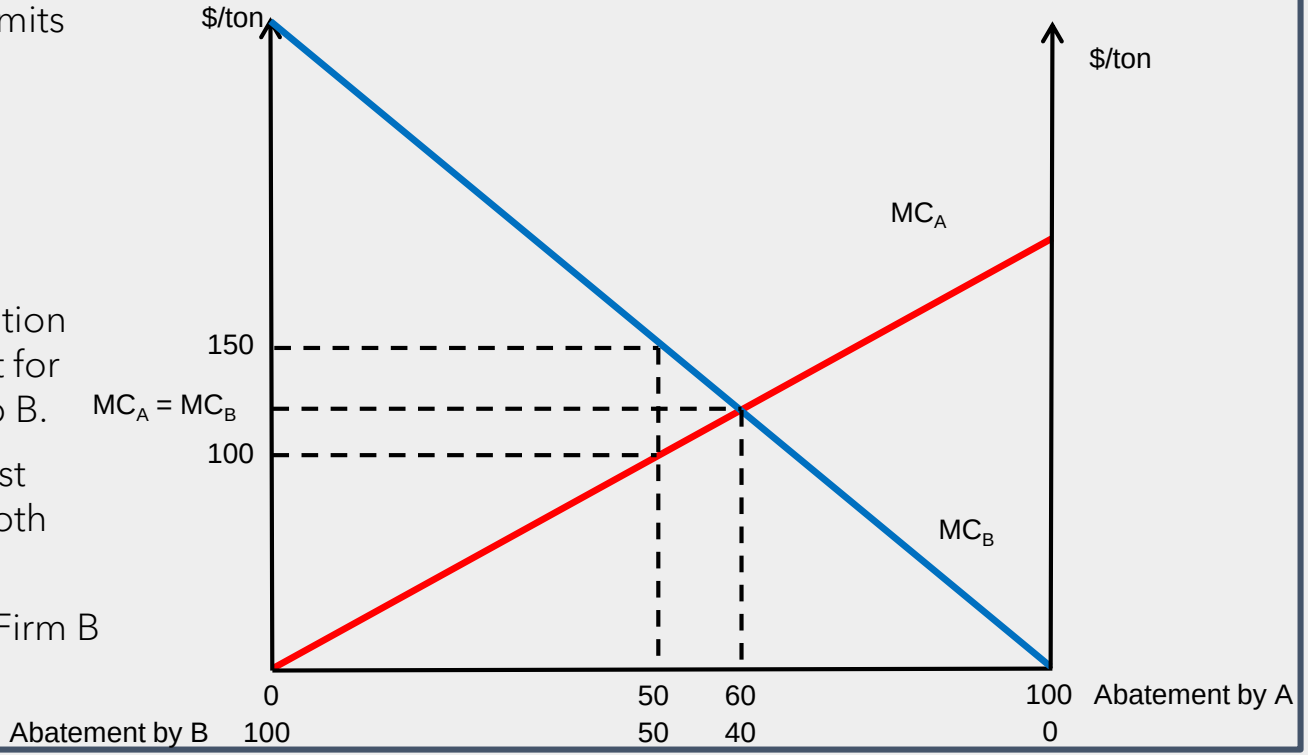
Outcome:

$MC_A < MC_B$ at initial allocation
So, firm A can sell a permit for any price \$100<P<\$150 to B.

The *gains from trade* persist until the MC is equal for both firms.

Firm A sells 10 permits to Firm B

This is the efficient point!



2. DOES THE POLICY ACHIEVE THE OPTIMAL LEVEL OF POLLUTION AT LEAST COST?

We saw in both examples that firms reach the efficient outcome in a cost-effective way.

- The key was the ability to trade permits

The process shown extends to any number of firms…

Firms will trade permits until all marginal costs of abatement equate

- If the permit price is above the marginal cost of abatement, firm will sell permits
- If the permit price is below the marginal cost of abatement, firm will buy permits

Independent of the initial distribution of permits, the market will redistribute permits to reach efficient abatement in a cost-effective way.

- This is Coase theorem!
- Distribution does matter for firm costs

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