Principles of Microeconomics-II
L3: Externalities
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What do markets do?

Our discussion until now has limited us to single markets – and the payoffs of agents operating inside these markets.
Markets –

- allocate resources
- which are traded within the market.
- $\Longrightarrow$ solve allocation problems that the market sets for itself.

What about the agents outside the market? What about the problems that the market does not set out to solve? What is the case for government intervention in free markets?

Markets Fail!

Markets fail to efficiently allocate resources & individual optimisation (private value = private cost) has unintended consequences.

For example:

1. Leather tanneries find it optimal to dispose effluents in water bodies than process it, which affects the activities of downstream farmers;
2. If I decide to take COVID vaccine, it reduces the risk of infection for people I encounter.

Externalities

Definition

When the actions of an economic agent directly affect someone with whom the agent has not engaged in a market transaction, it creates an externality.

- It is "external" to the market.
- Neither the benefit nor the cost are internalised by the economic agent.
- This impact on the agent outside the market is uncompensated i.e. there are missing markets.

Externalities

1. Positive Externalities impose direct benefits on agents outside the market $\Longrightarrow$ benefits are not internalised $\Longrightarrow$ Social Benefit $>$ Private Benefit
2. Negative Externalities: impose direct harm on agents outside the market $\Longrightarrow$ costs are not internalised $\Longrightarrow$ Social Cost $>$ Private Cost

Negative Externalities

Social Cost = Internal Cost + External Cost. Negative Externalities lead to over-production as compared to what is socially desirable.

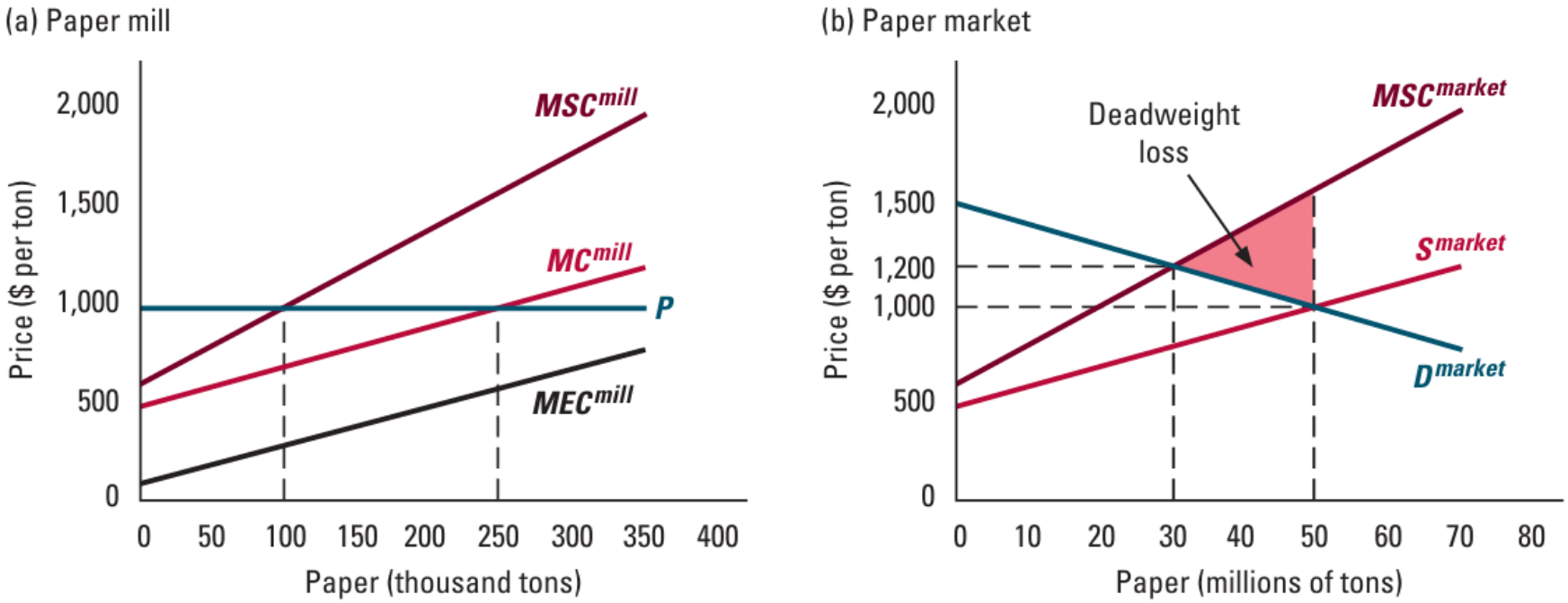

Figure: Negative externality imposed by paper mills. *Source:* Figure 20.1, Bernheim & Whinston (2009)

Positive Externalities

Social Benefit = Internal Benefit + External Benefit. Positive Externalities lead to under-provision as compared to what is socially desirable.

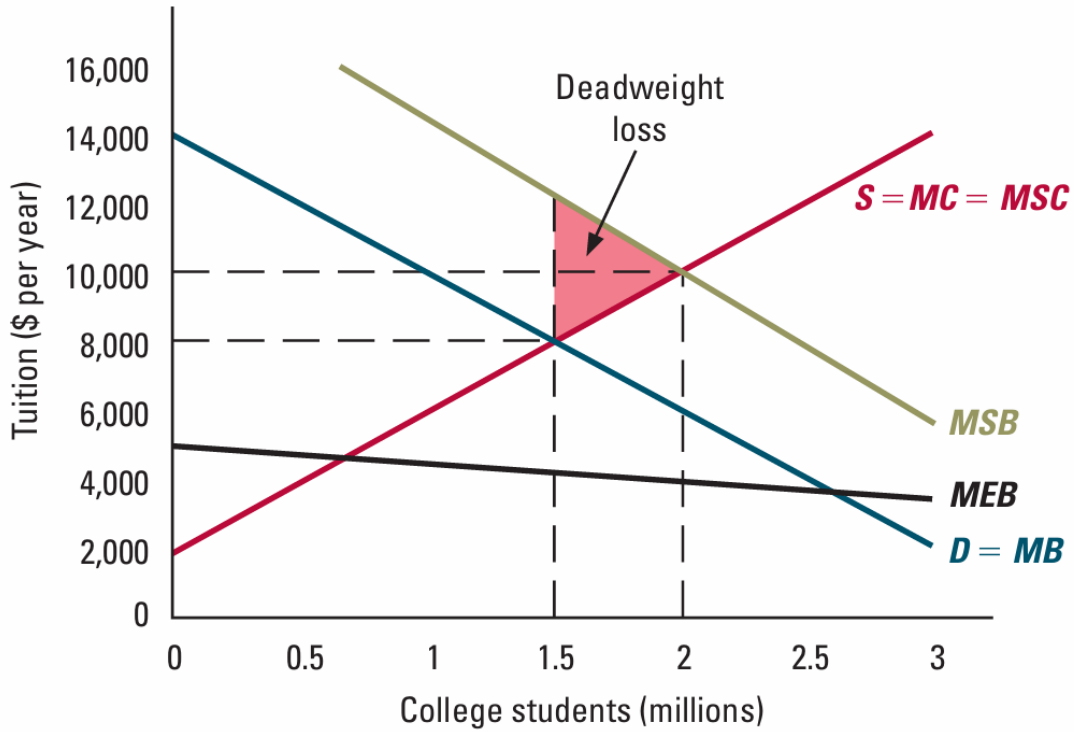

Figure: Positive externalities from a college education. *Source:* Figure 20.1, Bernheim & Whinston (2009)

An Example

There are 200 paper mills in a perfectly competitive market.

Given:

Each firm's $MC = 500 + 2Q$
Each firm's $MEC = 100 + 2Q$
Market demand $Q^D = 1,50,000 - 100P$

- Compute the competitive market equilbrium.
- Compute the efficient level of production that internalises the external cost imposed by the paper mills.

From Bernheim and Whinston (2009)

The Pertinence of Market Structure

The above two implications hold in the case of a perfectly competitive market. Both social and private optima were derived from the equality of demand and marginal cost.

It is not just perfectly competitive firms that impose externalities!

Negative Externalities imposed by a Monopoly

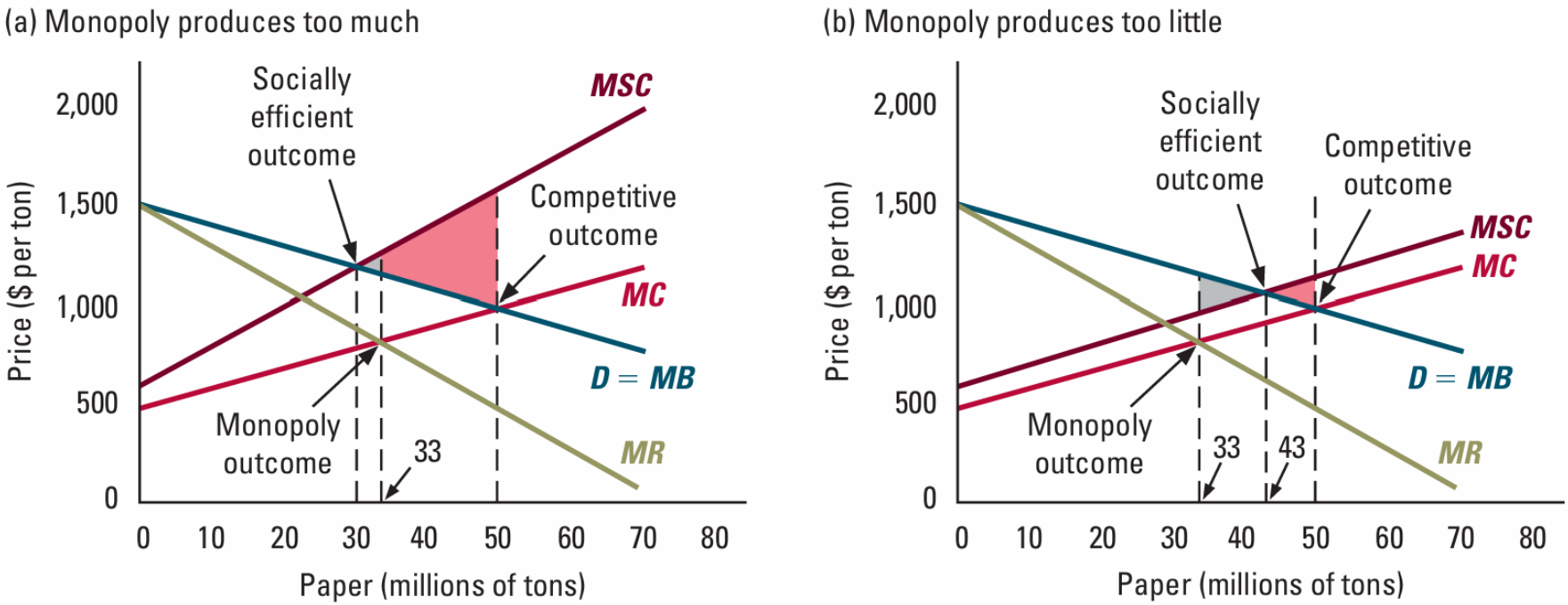

Figure: Both under- and over-production in the case of a monopolist imposing a negative externality. *Source:* Bernheim & Whinston (2009)

Remedying Market Failure

1. Market-Based Policies (for example, imposing a tax on every gallon of effluents a firm releases in a river).
2. Regulation (for example, all purchases of cars include a mandated extra cost to avoid harmful emissions).

Remedying Market Failure: Property Rights

Definition

Property rights are enforceable claims on a good or resource.

Suppose a mill releases effluents in a river, which affect a downstream farmer using river water for irrigating his crop. Polluting the water is free for the mill, abatement is costly. The polluted water is bad for the farmer's output.

- Mill has property rights $\implies$ it has a right to pollute.
- Farmer has property rights $\implies$ he has a right to clean water.

Remedying Market Failure: Negotiation

When and how might private players negotiate with each other to resolve the market failure imposed by externalities?

Assume:

1. Property rights are well-defined.
2. Perfect information between parties.
3. There are no transaction costs.

Transaction Costs: The cost of accumulation information, drawing up a contract, hiring third-party enforcers, etc.

The Coase Theroem

Theorem

If bargaining is frictionless (i.e. in the absence of transaction costs), then regardless of how property rights are assigned, voluntary agreements between private parties will remedy market failure.

It does not matter if the mill or the farmer are assigned property rights!

Where could the Coase Theorem not work?

- Bargaining is not always possible! Can I buy the right to clean air from a crop-residue burning farmer? No!
- Property rights may not be clearly defined. There may be disputes!
- Private players may have limited information.
- Contract enforcement is difficult. Monitoring and ensuring compliance are costly & difficult when the rule of law is not robust.

$\Longrightarrow$ Non-zero Transaction Costs! Private solutions may not always work.

Remedying Market Failure: Regulation

- Command and control!
- Rather than bans – setting limits!
- For example, BS-VI norms set PM 2.5 emissions to 20-40 micrograms per cubic meter for passenger vehicles.

Regulation: Emission Standards

These are quantity controls: a legal limit on the amount of pollution that can be produced from a particular activity. How are these standards set?

- Pollution abatement is expensive $\iff$ firm benefits from polluting: (Marginal Benefit from Polluting/Marginal Cost of Abatement);
- Pollution is costly to others: (Marginal Social Cost).

Regulation requires the social planner knowing the firm's cost of abatement structure!

Regulation: Emission Standards

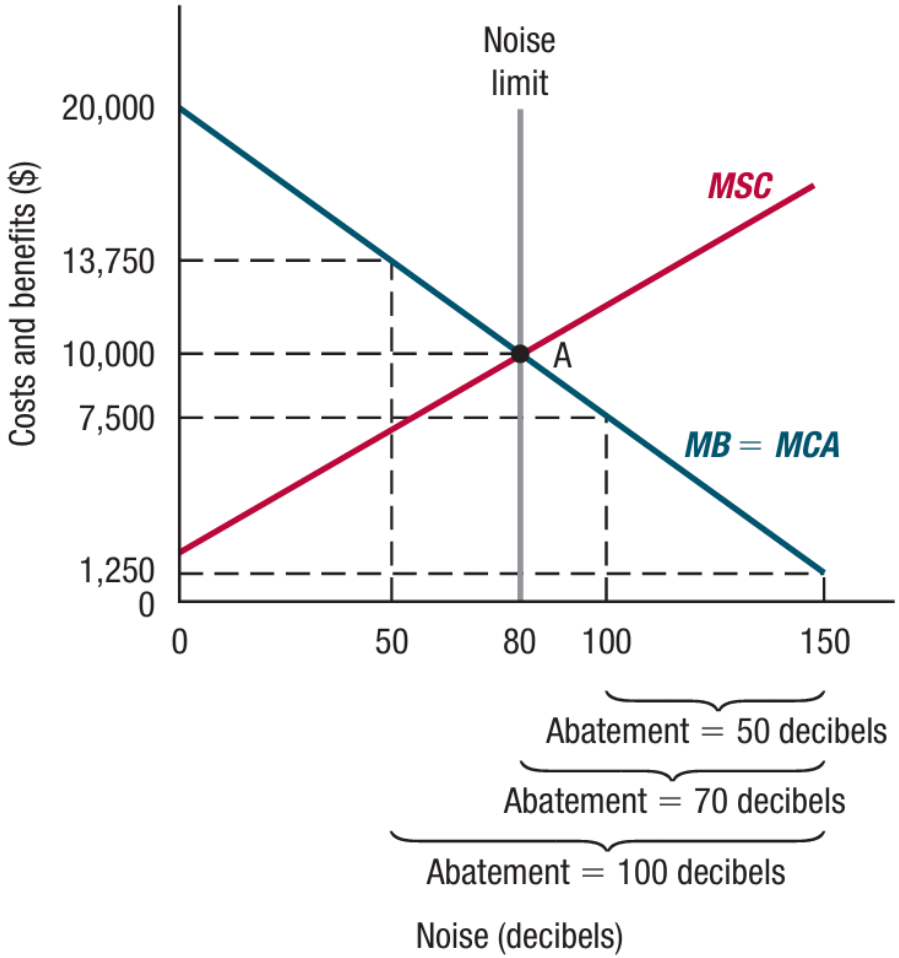

Figure: Regulating Airplane Noise. *Source:* Figure 20.4, Bernheim & Whinston (2009)

Remedying Market Failure: Incentives

Negative externalities fail to internalise external costs. What if incentives could be modified to do so?

For example, what if the government could impose a tax on the paper mill's "right to pollute" the river?

- Tax negative externalities.
- Subsidise positive externalities

Remedying Market Failure: Pigouvian Taxation

The Pigouvian Tax is equal to the external cost (MSC) imposed by a negative externality. This sets the marginal cost of the "right to pollute".

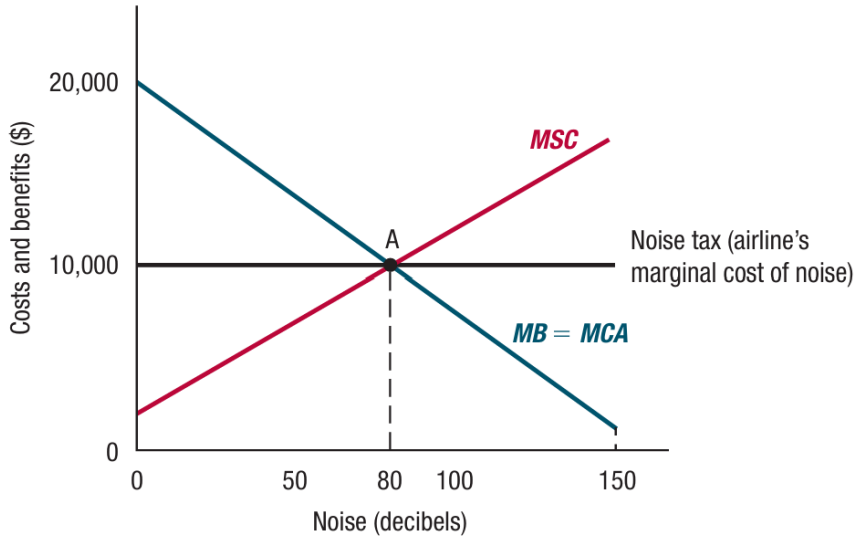

Figure: Pigouvian Tax. *Source:* Fig 20.5, Bernheim & Whinston (2009)

Same outcome as regulation, but government raises revenue!

Remedying Market Failure: Pigouvian Taxation

Your roommate likes loud music, but that distracts you from your microeconomics problem sets (that's bad!). Let D be the sound in decibels. All nominal values are in \$.

Given:
$B = 0.53 - 0.002D^2$ (Your roommate's benefit from music).
$MB = 0.53 - 0.004D$
$C = AD + 0.001D^2$ (Your cost from her music.)
$MC = A + 0.002D$
Say $A = 0.05$

Compute:

1. The socially efficient level of noise.
2. The optimum Pigouvian Tax.
3. The goverment's tax revenue.

Remedying Market Failure: Tradable Permits

- Also called a cap-and-trade system or emission trading system (ETS).
- There is a GHG ETS under the UNFCCC mandate. In a country, each firm is given one emission unit (say, for carbon dioxide), and the total cap on emission units = total number of firms.
- Once the cap is set, the government distributes permits to trade to firms, who can trade under within the cap.
- For example, if Firm A wants to only pollute half an emission unit of CO_2, it can sell to Firm B the right to pollute an extra half unit.
- Total emissions remain the same.

When different private entities have different abatement costs that the government cannot accurately observe, such cap-and-trade systems operate efficiently. (Schmalensee & Stavins, 2017)

Remedying Market Failure: Tradable Permits

Setting a cap is equivalent to ensuring an inelatic supply curve for the "right to pollute".

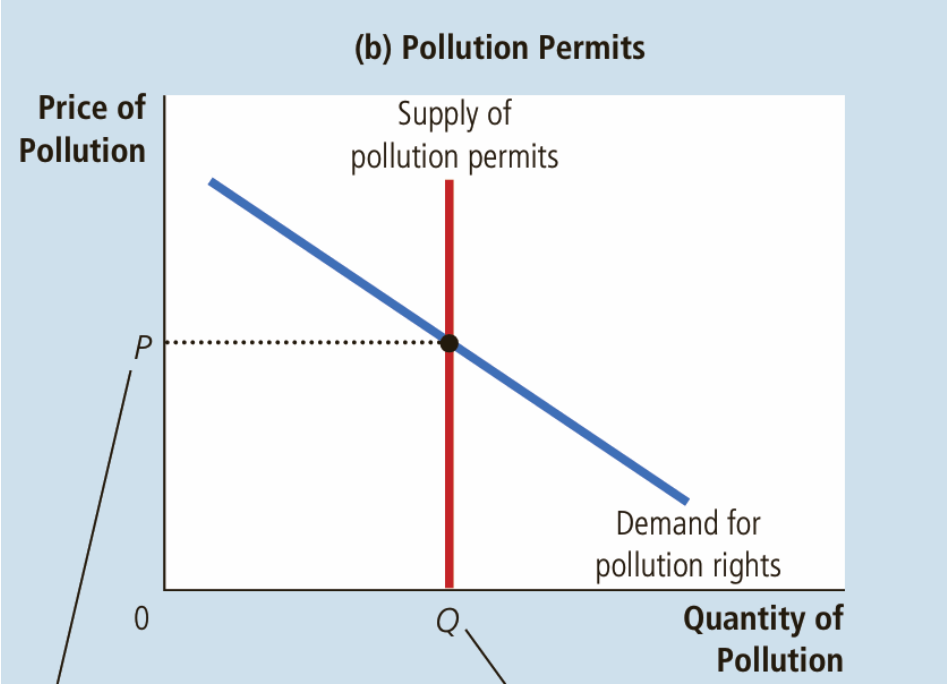

Figure: Tradable Permits. *Source:* Chapter 10, Mankiw (2018).

Remedying Market Failure: Liability Rules

- Legally mandating that the party causing external harm is liable to pay compensation to all affected parties.
- Internalising the external costs by making the firm's MC = MSC in the form of compensatory payments.

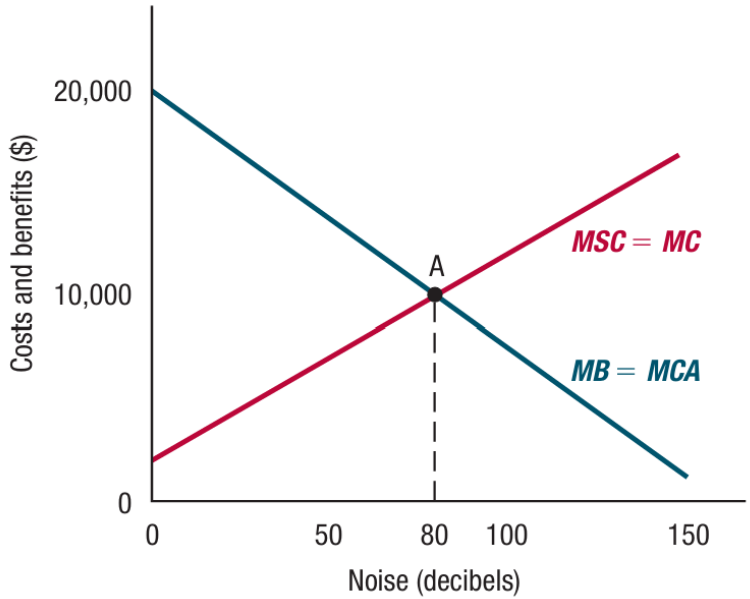

Figure: Liability Rules. *Source:* Fig 20.6, Bernheim & Whinston (2009)

Policy Design

It is difficult for a farmer to move his agriculture away from a nearby river or for someone to escape acid rain, but it is relatively easier for people to move their residence away from noise.

People actively make decisions to distance themselves from negative externalities by comparing costs and benefits: Is it cheaper for society to relocate from the airport or abate noise?

- Shifting residence away from loud airports.
- Petitioning to change roommates.
- If a neighbouring farm is depleting the water table, shifting to drip irrigation.

When is abatement efficient?

The Costs of Improper Policy Design

Without financial compensation, if sound < 90 dB, live near airport else live far from airport $\implies$ different MSC curves.

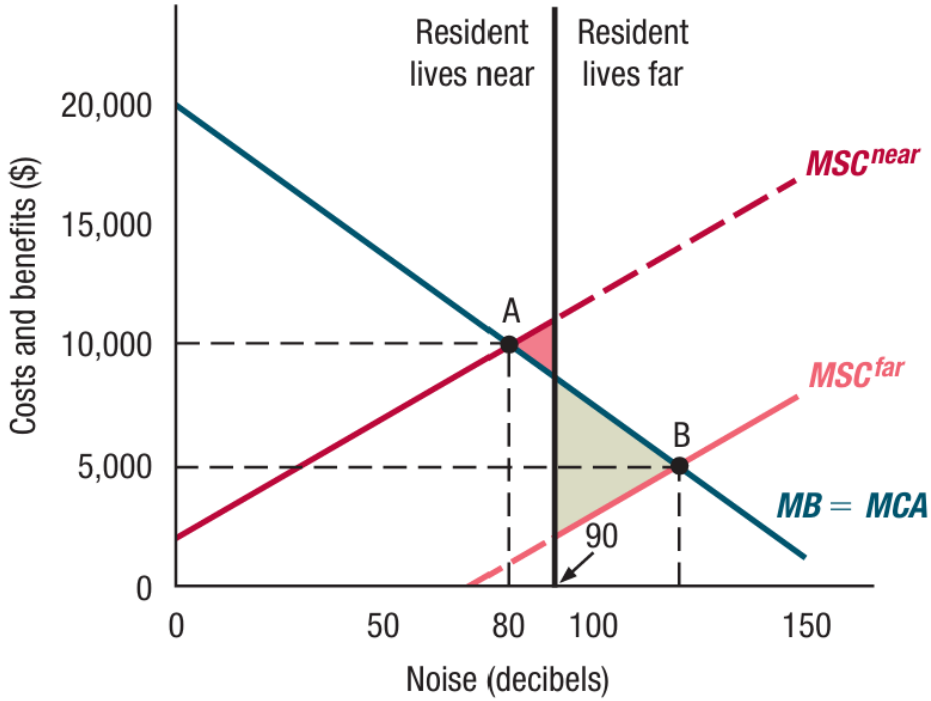

Figure: Improper Policy Design. *Source:* Figure 20.7, Bernheim & Whinston (2009)

Emission Standards v/s Pigouvian Taxation

- In all cases, there is a negatively sloping demand for pollution/marginal benefit from polluting line.
- In case of a Pigouvian Tax, the socially efficient outcome is reached by setting a price of polluting which impacts firms' cost structure and therefore, incentives. This is a Price Control.
- In case of Emission Standards, the state mandates how much firms can pollute. This is a Quantity Control.

Comparing Competing Approaches to Policy

- Change incentives or regulating quantities?
- Outcomes of both approaches equivalent when there is perfect information.
- When there is a margin of error, which policy is better?
- A function of the relative slopes of the MCA and MSC curves.

Comparing Competing Approaches to Policy: Policy Errors

1. When MSC is steeper than MCA, errors in quantity controls lead to lower losses than equivalent errors in setting the tax rate.
2. When MCA is steeper than MSC, price controls lead to lower losses from error.

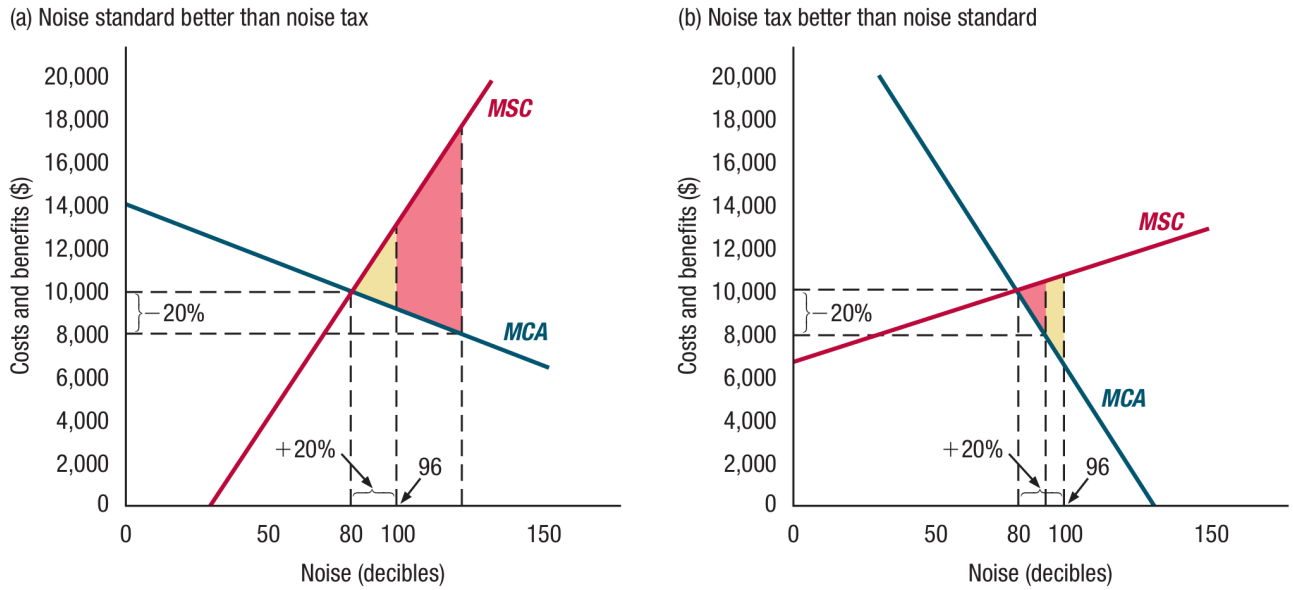

Figure: Comparing Policy. *Source:* Figure 20.8, Bernheim & Whinston (2009)

Comparing Competing Approaches to Policy: > 1 Firm

Even without complete information, pigouvian taxes can lead to lower total abatement costs than quantity controls for a given total amount of pollution.

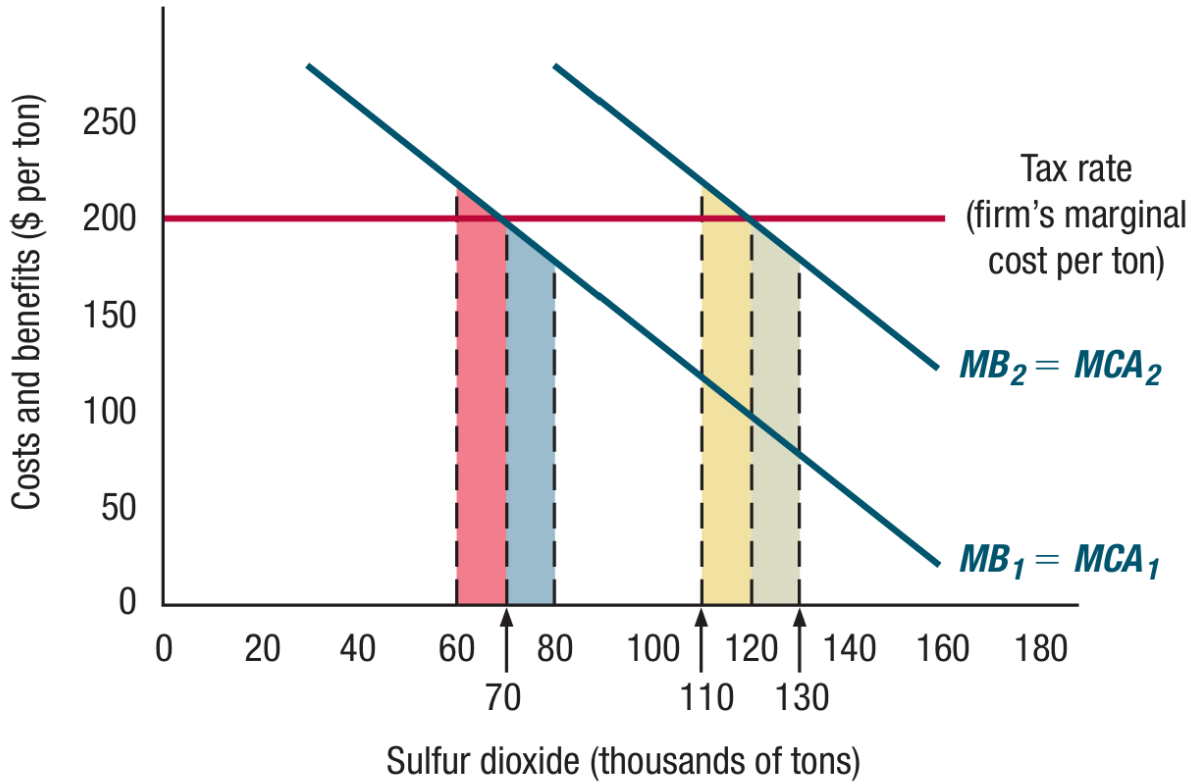

Figure: Minimising Total Abatement Costs. *Source:* Figure 20.9, Bernheim & Whinston (2009)

Comparing Competing Approaches to Policy: Relative Flexibility

- Implementing controls is context-specific! Some things are easier to regulate/ban and other things are easier to tax.
- Most policy involves hybrid approaches.
- Tradable permits are one example of a hybrid approach.
- Application: Positive externalities from education.

Application: Education and Pigouvian Subsidies

- College education can be incentivised by a pigouvian subsidy on tuition.
- Basic education, on the other hand, is better made compulsory.

Common Property Resources

- Commons: used by more than one person, non-excludable.
- Tragedy of the Commons
- Lake, pastures, groundwater tables
- Private incentives lead to overuse $\implies$ a negative externality.

Recap!

1. In perfectly competitive markets, negative externalities lead to over-provision of a "bad" and positive externalities lead to under-provision of a "good".
2. This is because some costs/benefits imposed on people outside the market are not internalised.
3. The degree of under/over-provision is a function of market structure.
4. Regulation: Emission standards (Quantity Controls), Pigouvian Taxation, Liability Rules (Price Controls), Hybrid Methods (Tradable Permits).
5. Regulation Design: Policy choice depends on errors due to information gaps, existence of more than 1 firm, relative flexibility of controls.
6. Common Property Resources.

CA Assignment: Problems and Applications. Chapter 10, Mankiw (2018). Problems 1-9. Chapter 20, Bernheim & Whinston (2009).