

# Externalities in Environmental Economics

Lecture Notes on Natural Resource Economics (AEC-608)

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# 1 Introduction to Externalities in Environmental Economics

Externalities are a central concept in environmental economics, representing situations where the actions of an individual or firm affect others for which they are not compensated or charged. These effects, often termed **spill-over effects**, are not reflected in market prices, leading to inefficiencies in resource allocation. In the context of environmental economics, externalities frequently arise from the use or degradation of natural resources, such as air, water, and biodiversity, which are often not privately owned or priced.

**Why Study Externalities?** The environment is a shared resource, and its misuse or overexploitation often imposes costs or benefits on third parties who are not directly involved in the transaction. Understanding externalities is crucial for designing policies that correct market failures and promote sustainable development. This lecture explores the nature, causes, and consequences of externalities, with a focus on pollution as a key example, and examines mechanisms to internalize these external effects.

## 2 Definition and Types of Externalities

### What is an externality?

An **externality** is an indirect cost or benefit to an uninvolved third party resulting from another party's activity. It occurs when the private price equilibrium of a product or service does not reflect the true social costs or benefits, leading to a divergence between private and social outcomes.

### Types of Externalities

Externalities can be classified based on their impact and origin:

- **Negative Externalities:** Costs imposed on third parties not involved in the transaction. Examples include air pollution from factories affecting public health or water pollution from industrial effluents harming aquatic ecosystems .
- **Positive Externalities:** Benefits accrued to third parties without compensation. Examples include the benefits of public parks or research and development spillovers that enhance societal welfare .
- **Production Externalities:** Arise from production activities, such as industrial pollution or noise from manufacturing processes.
- **Consumption Externalities:** Result from consumption behaviors, such as traffic congestion caused by individual drivers or second-hand smoke affecting non-smokers.

### 3 Causes of Externalities

Externalities often emerge due to systemic issues in economic and property systems:

- **Poorly Defined Property Rights:** When ownership of resources like air, water, or wildlife is unclear or unenforceable, individuals or firms may exploit them without bearing the full cost, leading to negative externalities. Conversely, positive externalities may be underprovided due to lack of ownership incentives .
- **Common Pool Resources:** Resources that are rivalrous but non-excludable, such as fisheries or forests, are prone to overuse and degradation (the "tragedy of the commons"), resulting in negative externalities.
- **Market Mechanisms Failing to Price Social Costs/Benefits:** Markets often fail to account for external costs or benefits, as these are not directly borne by producers or consumers, leading to overproduction of harmful goods and underproduction of beneficial ones.

### 4 Consequences: Market and Government Failure

#### Market Failure

Market failure occurs when resources are inefficiently allocated due to imperfections in the market mechanism. Externalities are a primary cause of market failure because:

- **Inefficient Allocation:** Negative externalities lead to overproduction of goods (e.g., pollution-heavy industries), while positive externalities result in underproduction (e.g., clean energy technologies).
- **Divergence from Pareto Optimality:** The competitive equilibrium does not achieve an optimal balance where marginal social benefit equals marginal social cost, resulting in societal welfare loss.
- A good with positive externality is under produced.
- A good with negative externality is over produced.

#### Government Failure

Government intervention to correct externalities can sometimes lead to failure due to:

- **Incomplete Information:** Regulators may lack accurate data on the extent of externalities or the costs of mitigation, leading to ineffective policies.

- **Implementation Challenges:** Policies like taxes or regulations may face resistance, high administrative costs, or enforcement issues, reducing their effectiveness.
- **Policy Misalignment:** Interventions may not align private incentives with social goals, or they may create unintended consequences, such as economic inequity or reduced competitiveness.

## 5 Pollution as a Case of Externality

### Pollution as a Negative Externality

Pollution is a classic example of a negative externality, where the production or consumption of goods imposes uncompensated costs on society. For instance, a factory emitting pollutants into the air or water harms public health, damages ecosystems, and affects property values without the factory bearing these costs.

### Pollution Shirking

**Pollution shirking** refers to the tendency of firms or individuals to avoid responsibility for the environmental damage they cause, often due to the absence of penalties or enforcement. This is because the benefit of a clean environment will be enjoyed by everyone, whereas, the cost of abating the pollution, is entirely on the individual or the firm.

### Key Economic Concepts in Pollution Externalities

- **Marginal Private Cost (MPC):** The cost borne by the producer or consumer for producing or consuming an additional unit of a good or service. This excludes external costs.
- **Marginal External Cost (MEC):** The additional cost imposed on society due to the production or consumption of an extra unit, such as health or environmental damage from pollution. Alternatively, this is also referred to as Marginal Damage Cost
- **Marginal Social Cost (MSC):** The total cost to society, calculated as  $MPC + MEC$ . It reflects the true cost of production or consumption when externalities are considered.
- **Marginal Abatement Cost:** It is the additional cost of reducing the pollution by one unit.
- **Private Optima:** The level of production or consumption that maximizes private benefit, determined where MPC equals marginal private benefit, often leading to overproduction in the case of negative externalities.

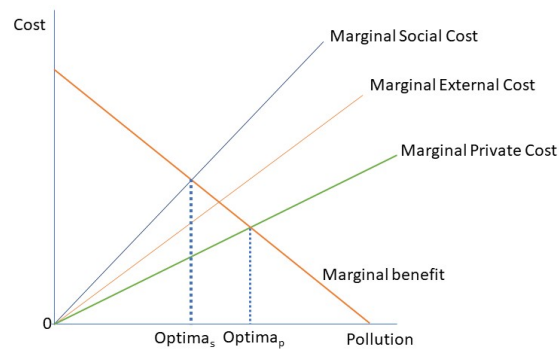


Figure 1: Optimum Pollution using MSC and MB

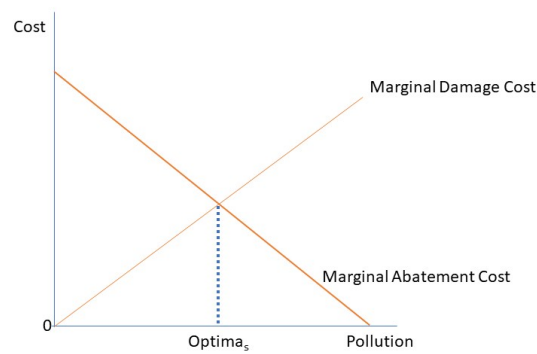


Figure 2: Optimum Pollution using MDC and MAC

- **Social Optima:** The socially desirable level of production or consumption, achieved where MSC equals marginal social benefit, balancing costs and benefits to society.

## Optimum Pollution

**Zero Pollution** is theoretically impossible. According to the laws of the thermodynamics, energy can neither be created nor be destroyed, but only be converted from one form to the other. Every economic activity will involve some transfer of energy, and there will always be some loss of energy to the environment as a waste. In essence, there is no production without pollution. The key question then is, how to achieve optimum pollution?

## 6 Internalizing Externalities: Mechanisms and Limitations

Internalizing externalities involves adjusting market mechanisms or policies to ensure that external costs or benefits are accounted for in decision-making. Below are key approaches used in environmental economics.

### Coase Theorem

**Concept:** Proposed by Ronald Coase, this theorem suggests that if property rights are well-defined and transaction costs are low, parties can negotiate a mutually beneficial solution to externalities without government intervention.

**How It Achieves Internalization:** - If a polluter has the right to pollute, affected parties can pay them to reduce emissions. - If affected parties have the right to clean air, the polluter can compensate them to accept pollution. - The outcome is efficient regardless of initial rights allocation, as long as negotiation is costless.

**Limitations:** - High transaction costs in real-world scenarios, especially with many affected parties, make negotiation impractical. - Power imbalances between parties can lead to unfair outcomes. - Difficulty in defining and enforcing property rights, particularly for common resources.

### Pigouvian Tax

**Concept:** Named after Arthur Pigou, this tax is imposed on activities generating negative externalities, equal to the marginal external cost, to align private costs with social costs.

**Implementation:** The pigovian tax is equivalent to the difference between the Marginal Private Cost and Marginal Social Cost, at the level of Social Optima.

**How It Achieves Internalization:** - By imposing a cost on pollution, it incentivizes firms and individuals to reduce emissions or adopt cleaner technologies. - The tax revenue can be used to mitigate environmental damage or fund public goods. - Shifts the supply curve left, reducing output to the socially optimal level.

**Limitations:** - Difficulty in accurately measuring external costs to set the correct tax rate. - Potential economic burden on firms, possibly affecting competitiveness or leading to job losses. - Requires robust monitoring and enforcement, which can be administratively costly.

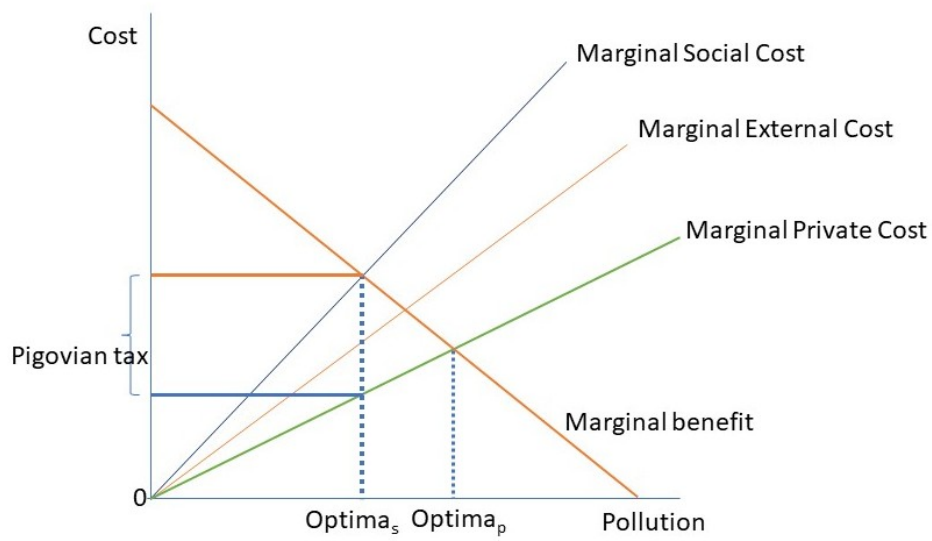


Figure 3: Pigovian taxation

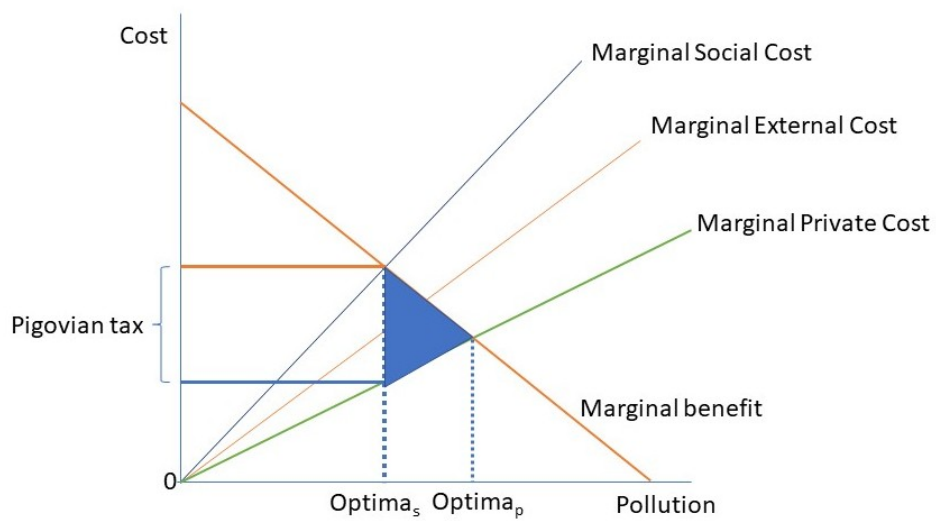


Figure 4: Pigovian taxation- magnitude



## Tradable Permits

**Concept:** A market-based approach where a cap is set on total emissions, and permits to emit are distributed or auctioned. Firms can trade these permits, allowing flexibility in meeting environmental targets.

**How It Achieves Internalization:** - Creates a financial incentive to reduce emissions, as firms with lower abatement costs can sell excess permits to those with higher costs. - Ensures the environmental target (cap) is met at the lowest total cost to society. - Permits flow to their highest-valued use in a competitive market.

**Limitations:** - Initial allocation of permits can be contentious and may not be equitable. - Requires a well-functioning market and regulatory oversight to prevent manipulation or hoarding. - May not address local pollution hotspots if trading leads to concentrated emissions.

## Standards and Regulations

**Concept:** Direct government mandates that set limits on emissions or require specific technologies to control externalities.

**How It Achieves Internalization:** - Enforces a uniform reduction in negative externalities by banning or limiting harmful activities. - Can be tailored to specific industries or pollutants, ensuring compliance through legal penalties. - Provides certainty in environmental outcomes by setting clear targets.

**Limitations:** - Often lacks flexibility, as a one-size-fits-all approach may not be cost-effective for all firms. - High administrative and compliance costs for monitoring and enforcement. - May stifle innovation by mandating specific technologies rather than outcomes.

## 7 Summary Table: Mechanisms for Internalizing Externalities

Table 1: Comparison of Mechanisms for Internalizing Externalities

Mechanism	Type	Key Features / Limitations
Coase Theorem	Market-Based Negotiation	Relies on low transaction costs and defined property rights; impractical for large-scale issues
Pigouvian Tax	Fiscal Policy	Imposes cost on pollution to align private and social costs; challenges in setting accurate rates
Tradable Permits	Market-Based Instrument	Caps emissions, allows trading for cost-efficiency; allocation and local impacts are concerns
Standards/Regulations	Direct Control	Sets mandatory limits or technologies; lacks flexibility, high enforcement costs

## 8 Assignments

1. Identify and describe a real-world example of a negative externality in your local area, and suggest a potential mechanism to internalize it.
2. Compare the effectiveness of Pigouvian taxes and tradable permits in addressing air pollution, considering economic and environmental outcomes.
3. Discuss the challenges of applying the Coase Theorem to global environmental issues like climate change.
4. Write a one-page summary on the concept of the "tragedy of the commons" and its relation to externalities.