

Lecture 15: Policy Design

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Environmental Economics
Econ 4075

Module 4: Economics and Environmental Policy

Previously, we covered tools for evaluating environmental policies. The goal of this module is to apply those tools in an exploration of actual environmental policies.

Roadmap for this module:

- Policy Design
- Market-based Instruments
- Review of Major Environmental Regulations

Part 1: Why Regulate?

Market Failures

Recall market failures discussion from Lecture 2.

- Public goods → little incentive to provide or purchase a good that is nonexcludable and nonrival.
- Externalities → private actions have unintended consequences on individuals not part of the transaction.

Sometimes these problems are described with the metaphor of the **tragedy of the commons** ([Hardin, 1968](#)), where common pool resources are non-excludable, subject to diminishing marginal returns, and eventually depleted.

Collective Action Problems

The tragedy of the commons is a **collective action problem (CAP)**.

- Individually rational agents act in their own best interest and produce a socially sub-optimal outcome.
- The prisoner's dilemma game is one theoretical model for CAPs.

Collective action problems are ubiquitous and diverse: climate change, over-population, grazing areas, water depletion, soil loss, etc.

Solutions to CAPs

CAPs are a tricky problem for some foundational notions in economics (e.g., the invisible hand and the 1st theorem of welfare economics). We still lack a general theory of collective action.

Some solutions:

- 1) The state (i.e., regulatory approach)
- 2) The market (i.e., privatization)
- 3) New institutionalism



[Image source.](#)

“If ruin is to be avoided in a crowded world, people must be responsive to a coercive force outside their individual psyches, a ‘Leviathan’ to use Hobbes's terms.”

- Garrett Hardin

The Regulatory Approach

Two takes on the regulatory approach:

- The **public interest** theory of regulation suggests that government intervenes in the economy to promote the public interest in the face of imperfect information, market power, or externalities.
- The **interest group** theory of regulation suggests that specific industries or interest groups capture government functions for rent-seeking purposes.

Limitations of the Regulatory Approach

Regulatory approach is not a panacea:

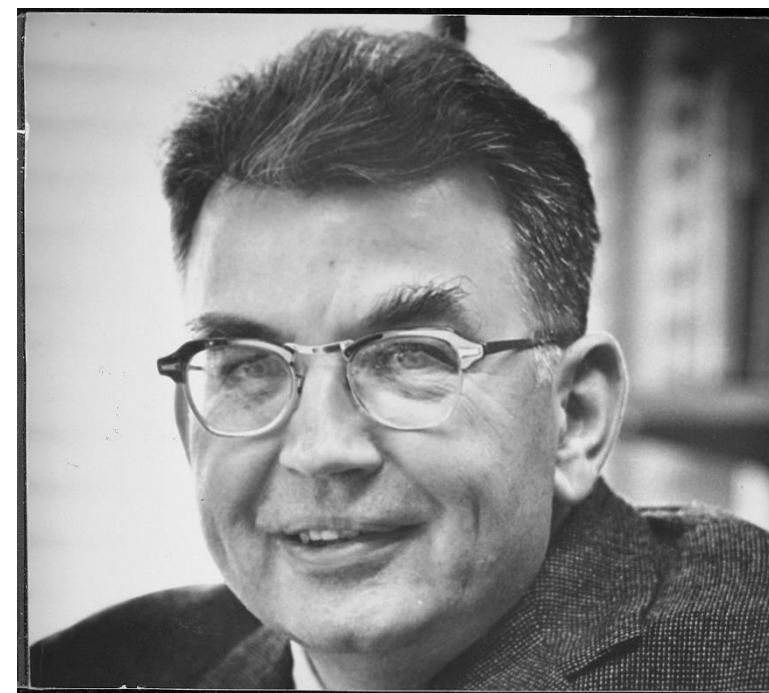
- Lack of complete information
- Costly monitoring
- Corruption
- Coercion
- Political feasibility

Is There a Case for Regulation?

The Coase Theorem

According to the [Coase Theorem](#), assigning property rights can lead to an efficient resolution of externalities *if* transaction costs are minimal regardless of who is assigned the property rights.

- The Coase Theorem suggests an alternative to government regulation of collective action problems.
- The theorem does not speak to equity, only efficiency.



Ronald Coase ([image source](#)).

Transaction Costs

Ronald Coase, The Problem of Social Cost (1960), pg. 16: “The argument has proceeded up to this point on the assumption... that there were no costs involved in carrying out market transactions. This is, of course, a very unrealistic assumption.”

Transaction costs include:

- Discovery costs, legal costs, collective action problem, bargaining costs, compliance/enforcement costs, time, etc.

Coase: “These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost.”

Some Coase Take-Aways

The Coase Theorem is like “economics in a vacuum.” While not directly applicable to most scenarios of interest, it provides some policy implications:

- Because transaction costs are everywhere, the theorem can be a strong argument for government intervention (and privatization in some cases).
- Assigning property rights over environmental goods is one way to mitigate environmental problems efficiently.

Q: Is the Coase Theorem a solution to the Tragedy of the Commons?

A Third Path: Elinor Ostrom's Work

Common-pool resource problems can be addressed without nationalization or privatization. These problems are not all “tragedies” in which the participants cannot avoid disastrous results.

- Policies based on metaphors can be harmful.
- Devising solutions to complex and unique CAPs requires thinking beyond simplistic metaphors and the binary (state vs. market).

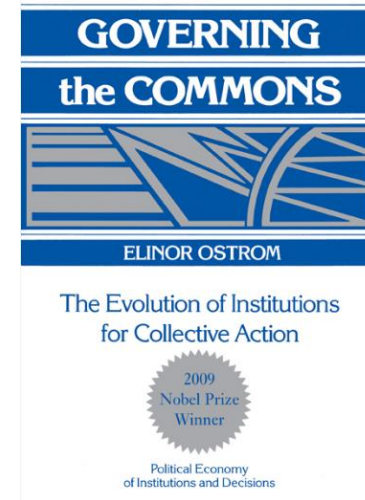


Image source [1](#) and [2](#).

New Institutionalism

New institutionalism studies how agents can voluntarily organize to retain the commons and autonomy over their decision-making. A focus is on identifying successful institutional features.

- L'Huerta irrigation system in Valencia
- Alpine valleys in Switzerland
- Alanya, Turkey inshore fishery
- Many others

See [Ostrom \(1990\)](#) for more.



By Keith Drew  21st February 2022

Invented by the region's Moorish rulers 1,200 years ago, Valencia's irrigation system is now a model for sustainable farming. [Link to article.](#)

Part 2: Regulatory Instruments

Regulatory Instruments

Many regulatory instruments are available and need not be implemented in isolation:

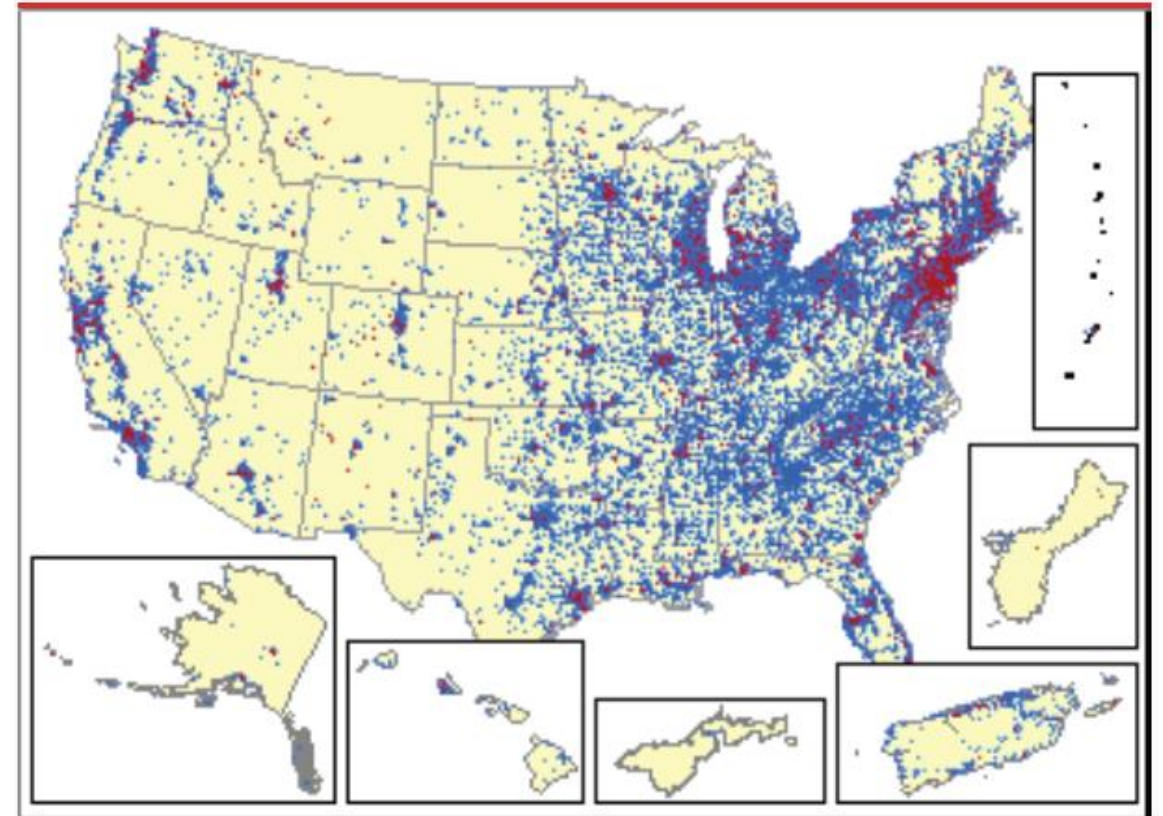
- Information approaches
- Liability approaches
- Prescriptive Regulations
- Emission Taxes or Abatement Subsidies
- Quantity Control and Allowance Trading

Information Approaches: TRI

Information-based approaches help to solve market failures that may arise from information asymmetries. Examples: eco-labeling, environment/sustainability/governance metrics.

The **Toxic Releases Inventory (TRI)** program:

- TRI tracks some facilities that emit pollution into air, land, and water.
- Hundreds of pollutants and their emission quantities by type of release are reported to the program each year.



Note: TRI sites in blue and Superfund sites in red.

Source: [Persico, 2019.](#)

Information Approaches: Behavioral Nudges

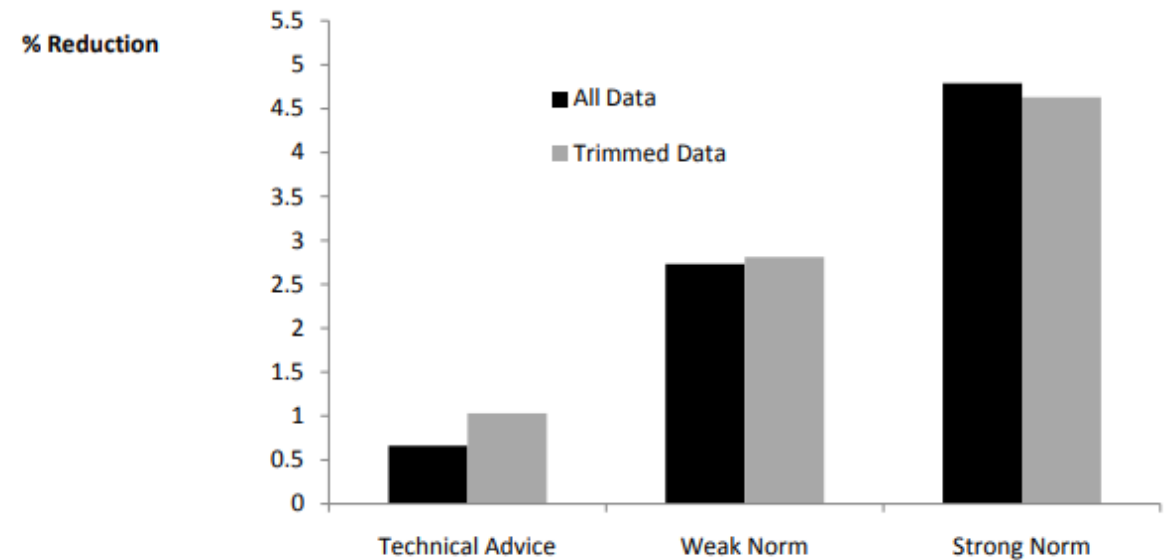
Providing consumers or firms with advice for improving their behavior can elicit conservation behaviors.

In one study, water ratepayers in Atlanta were randomly given:

- Technical advice,
- An appeal to reduce water consumption,
- A comparison to water consumption among peers.

The social comparison effect (c) is roughly the same as the effect of increasing water prices 12 to 15 percent, or \$5 per month for a median user.

Figure 1: Estimated Treatment Effects – All and Trimmed Data



Source: [Ferraro and Price, 2011](#).

Information Approaches: Behavioral Nudges

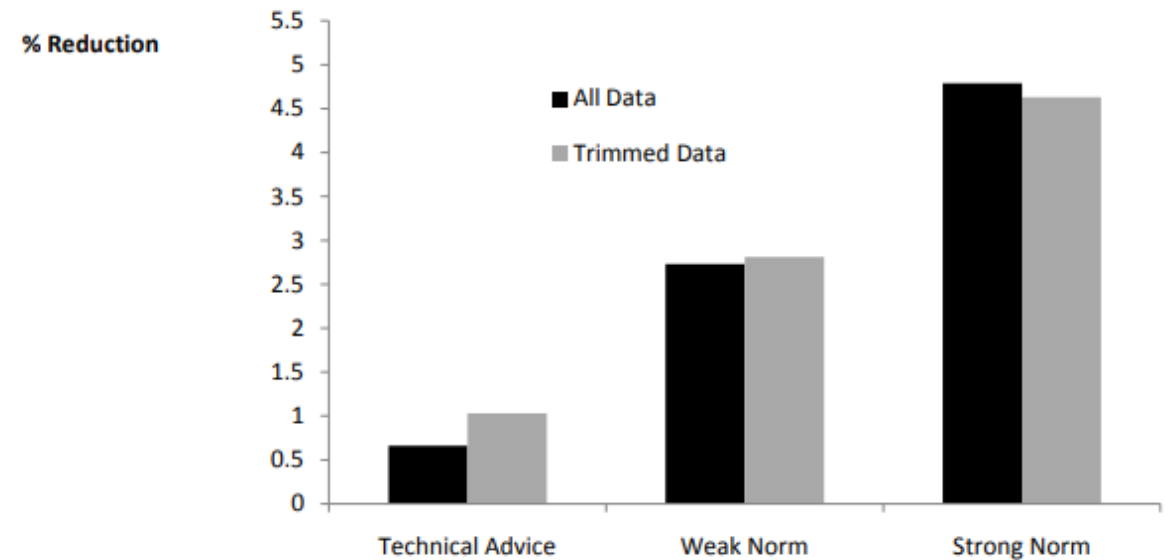
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Figure 1: Estimated Treatment Effects – All and Trimmed Data



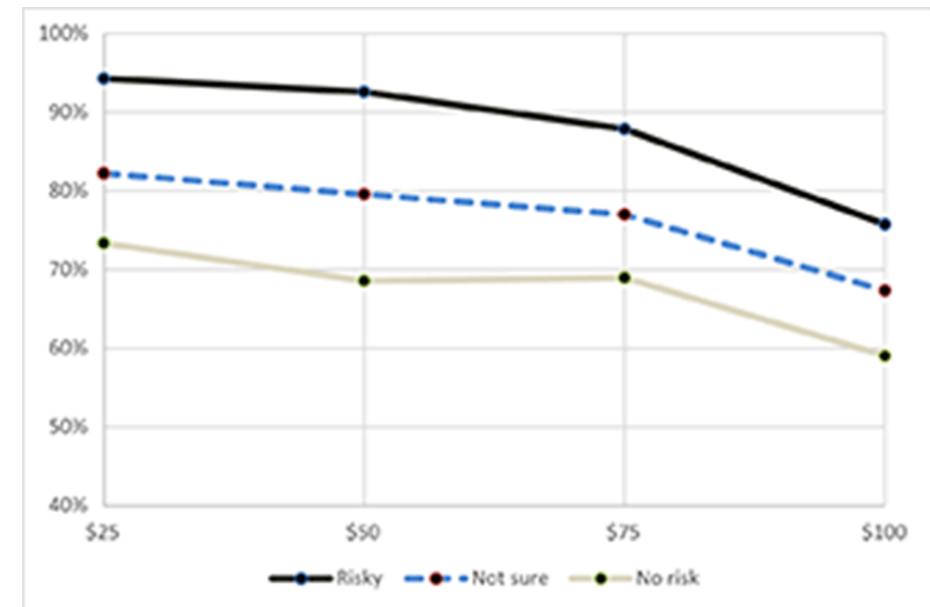
Source: [Ferraro and Price, 2011.](#)

Accessibility: A Pitfall of Information Approaches

Just because information is available does not mean it is *accessible*. Scientific uncertainty is inevitable, and so is our bounded rationality.

- Do typical households use TRI data to make decisions?
- Even where they do, households might exhibit a high willingness to pay to avoid negligible risks.

[Viscusi et al. \(2019\)](#): over-reaction to negligible risks could lead to policies for which there is an inappropriate benefit-cost balance.



Perceptions of risk from a pesticide (atrazine) in drinking water and willingness to pay to avoid the contaminant.

Liability Approaches

Liability rules create incentives for acceptable behavior of firms and facilities by raising the costs of non-compliance or externalizing behavior.

Some examples:

- Legal institutions that compel payment for clean-up (e.g., the Superfund program).
- Deposit refunds (e.g., for recycling car batteries).



Image: The Tenmile Creek Superfund Site in Rimini, Montana. Mine discharge contaminated with heavy metals ([source](#)).

Prescriptive Regulations

Prescriptive regulatory instruments (a.k.a. “Command-and-control” policies) stipulate the outcome or action that a firm or facility must achieve to limit pollution or protect the environment.

Firms often have some flexibility in meeting the requirements.

Prescriptive Regulations

Two common types:

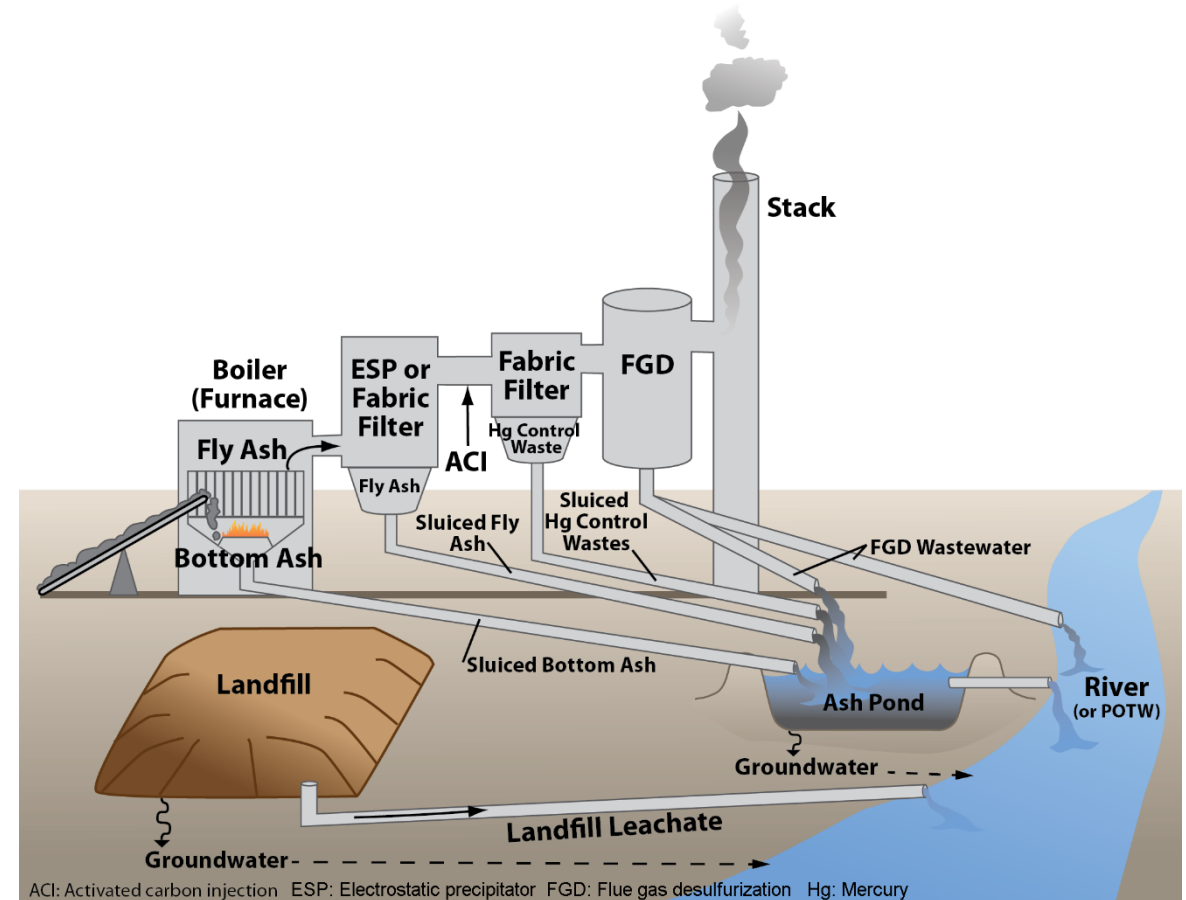
- **Technology-based standards:** a firm must install a specific technology to comply with the regulation.
- **Performance-based standards:** a firm must ensure that pollution emissions meet a designated target emission quantity or rate.

And hybrid **technology-based performance standard**: the regulator picks a target emission quantity that can be achieved through specific technology but does not mandate that the technology is used.

Example Prescriptive Regulations

Real-world examples:

- Clean Water Act's “best available technology economically achievable” for effluent limitation guidelines.
- Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) for chemicals exposure in the workplace.



Note: Most coal ash waste-streams.

Source: [EPA Steam Electric Power Generating Effluent Guidelines](#).

Example Prescriptive Regulations

Another real-world example:

- The Risk Management Program requires risk management plans (RMPs) for facilities handling or storing risky substances.
- Inspired by the Bhopal Union Carbide Chemical plant disastrous release of methyl isocyanate (1984).



Source: [Bhopal: The World's Worst Industrial Disaster, 30 Years Later](#), *The Atlantic*, 2014.

Part 3: Market-Based Regulatory Instruments

Regulatory Instruments

Many regulatory instruments are available and need not be implemented in isolation:

- Information approaches
- Liability approaches
- Prescriptive Regulations
- Emission Taxes or Abatement Subsidies
- Quantity Control and Allowance Trading



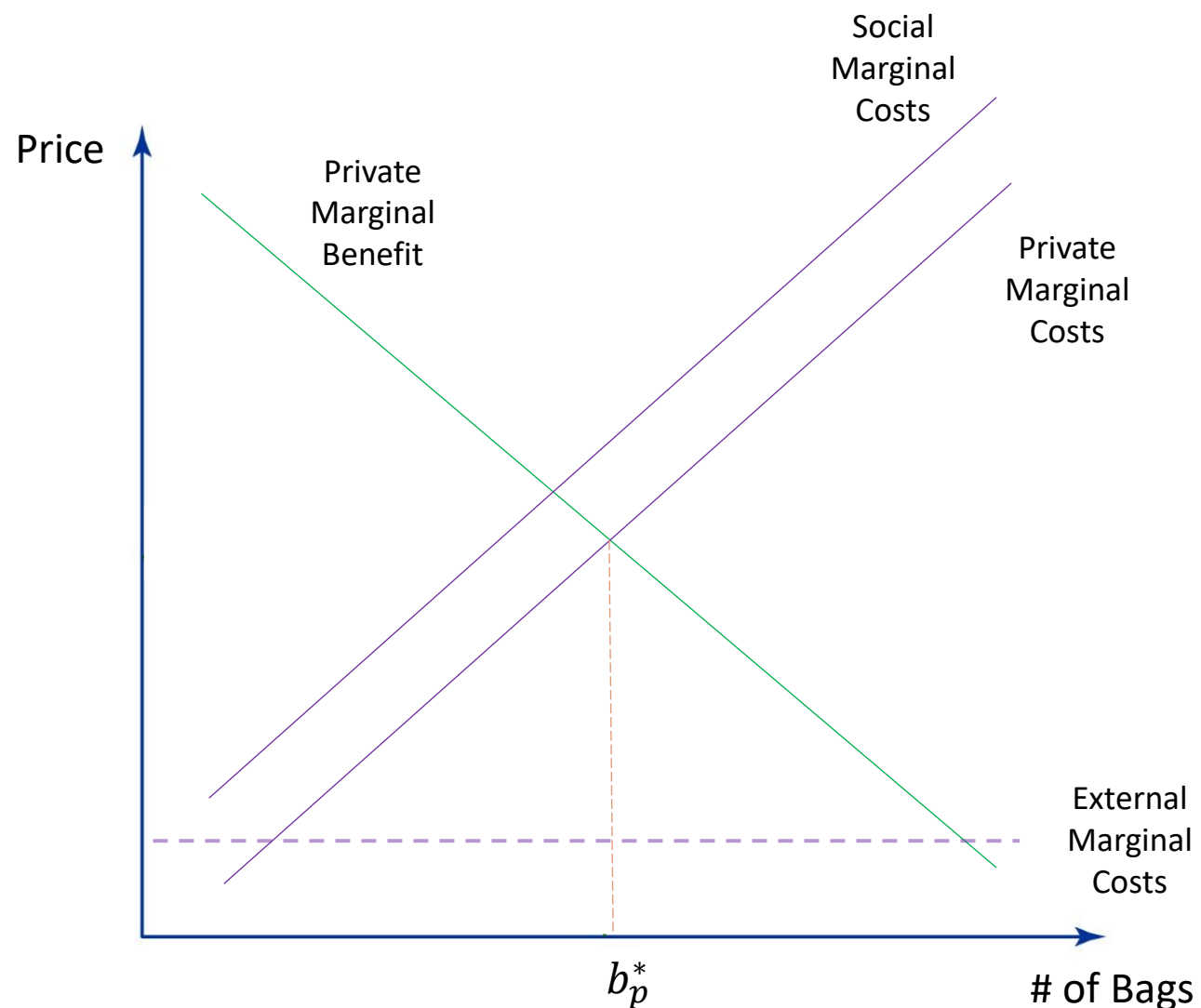
Market-based instruments.

Emissions Taxes

Recall the discussion in lecture 2 regarding plastic bags.

Emissions taxes, a form of Pigouvian tax, charge the polluter for each unit of pollution they emit.

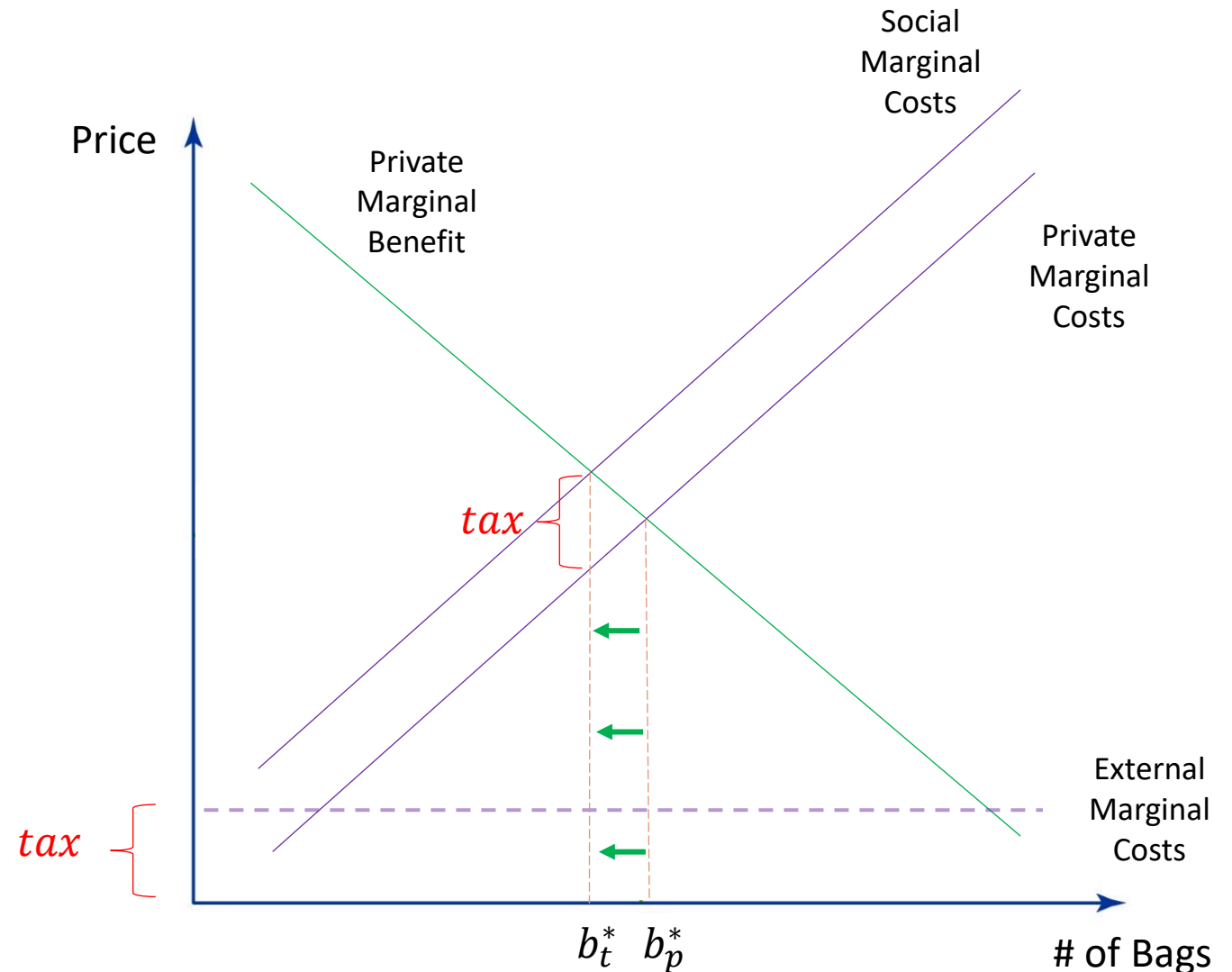
What is the optimal Pigouvian tax?



Emissions Taxes

What is the optimal tax?

- The optimal tax is equal to marginal external costs at the quantity (b_t^*) where the social marginal cost curve intersects the private marginal benefit curve (i.e., the demand curve).

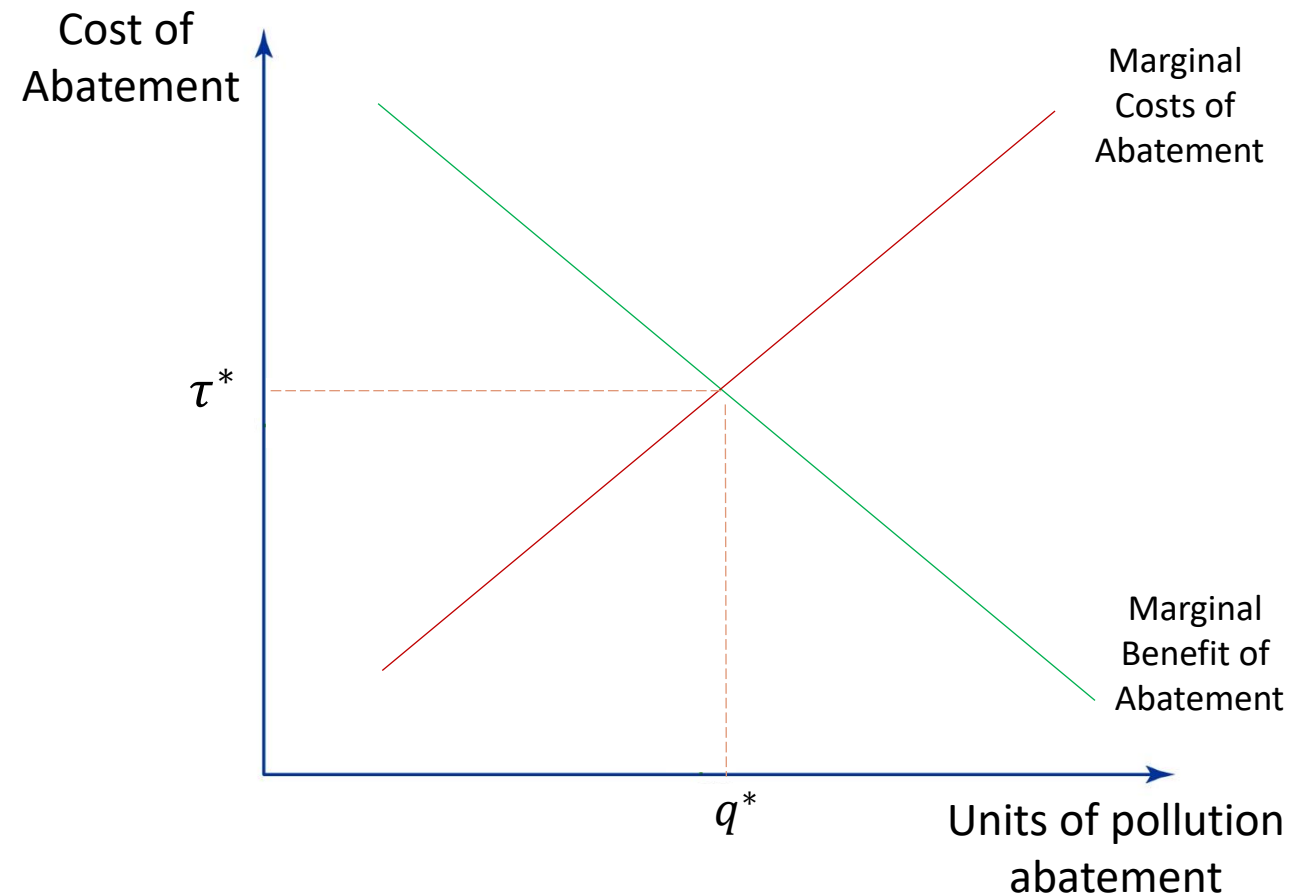


Market for Pollution

A Pigouvian tax mimics the price in a market for pollution where:

- “Demand” is the marginal benefit of abatement (i.e., society’s demand for abatement).
- “Supply” is the marginal cost of abatement.

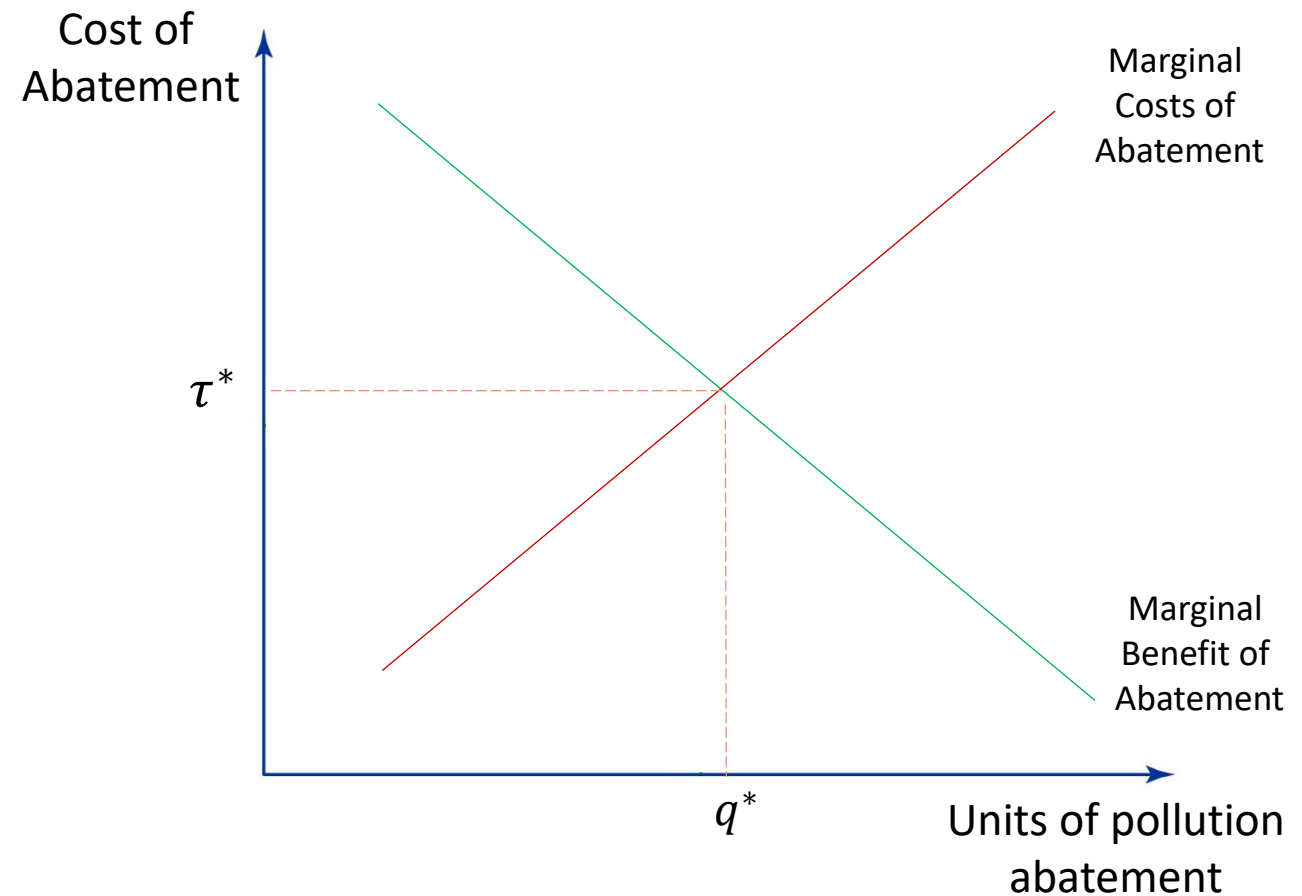
Optimal abatement occurs at the q^* where marginal costs are equal to the tax τ^* , the cost per unit of pollution imposed by the regulator.



Market for Pollution

Why do firms abate up to the quantity q^* associated with τ^* on their supply (MC) curve?

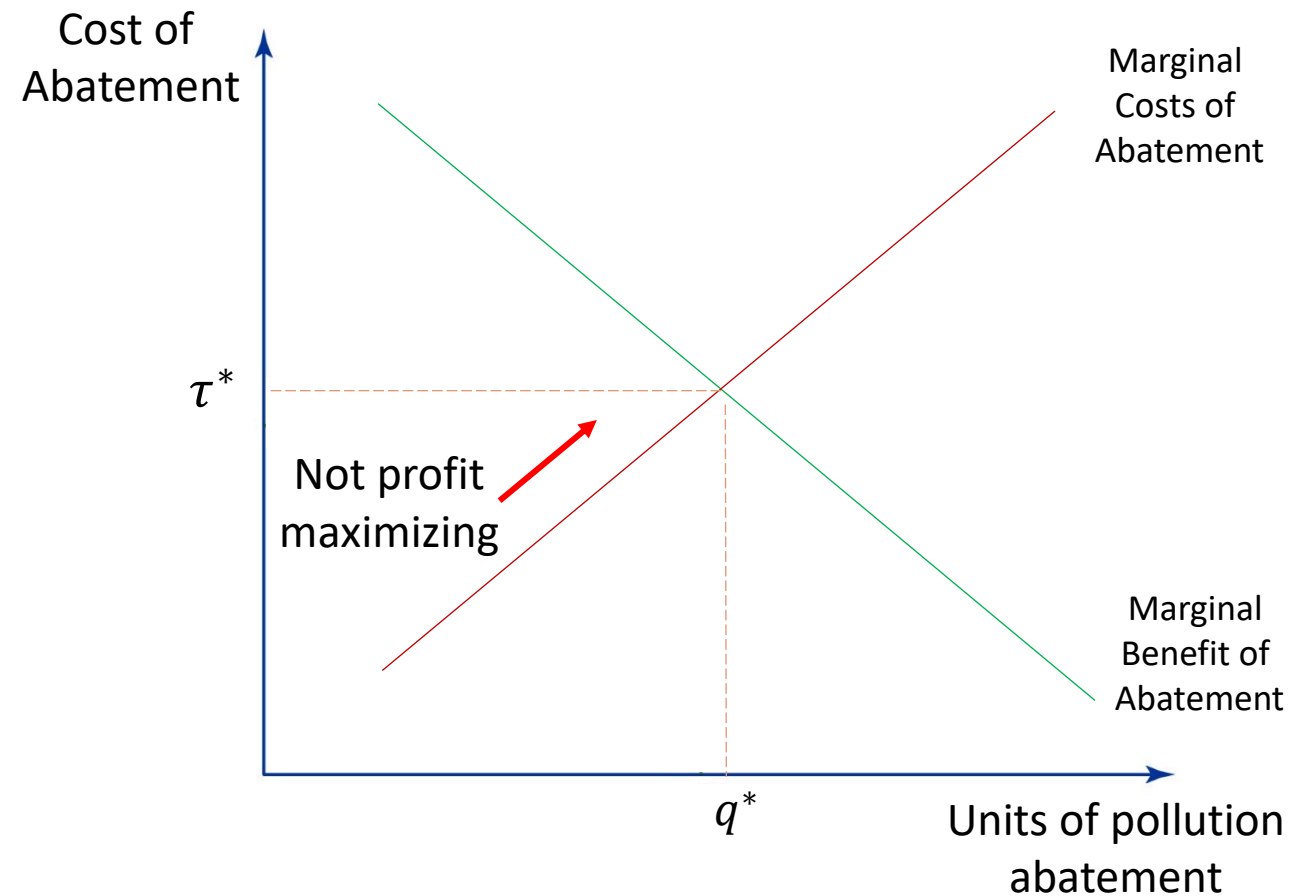
- At quantities of abatement below τ^* , it is cheaper for the firm to abate than to pay the tax.



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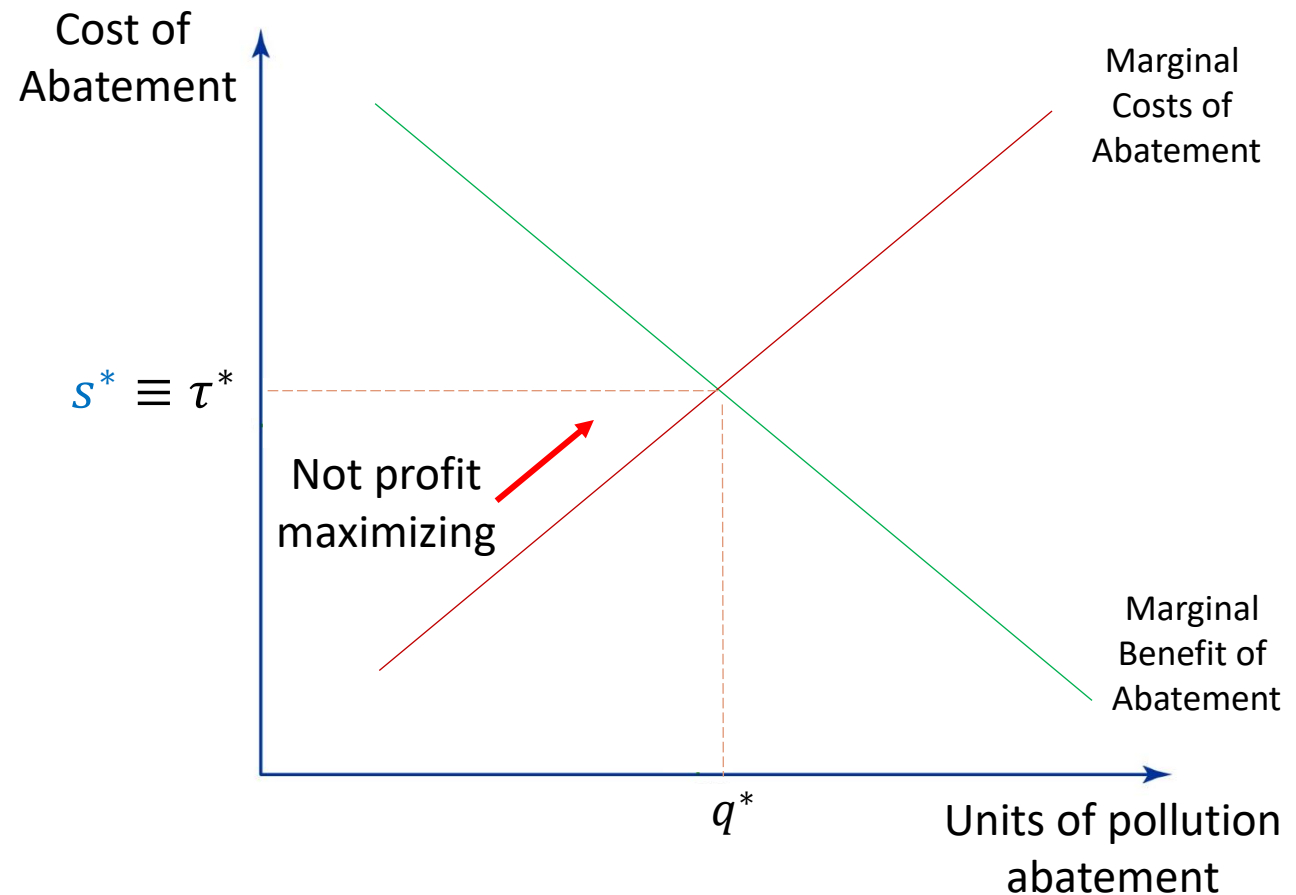


Abatement Subsidies

Note that the socially optimal quantity can be achieved with the same tax or subsidy.

- At quantities of abatement below s^* , the firm makes more for abatement than it costs to abate.

However, taxes and subsidies have very different market impacts for the product associated with the pollutant.



Regulatory Instruments

Many regulatory instruments are available. These need not be implemented in isolation:

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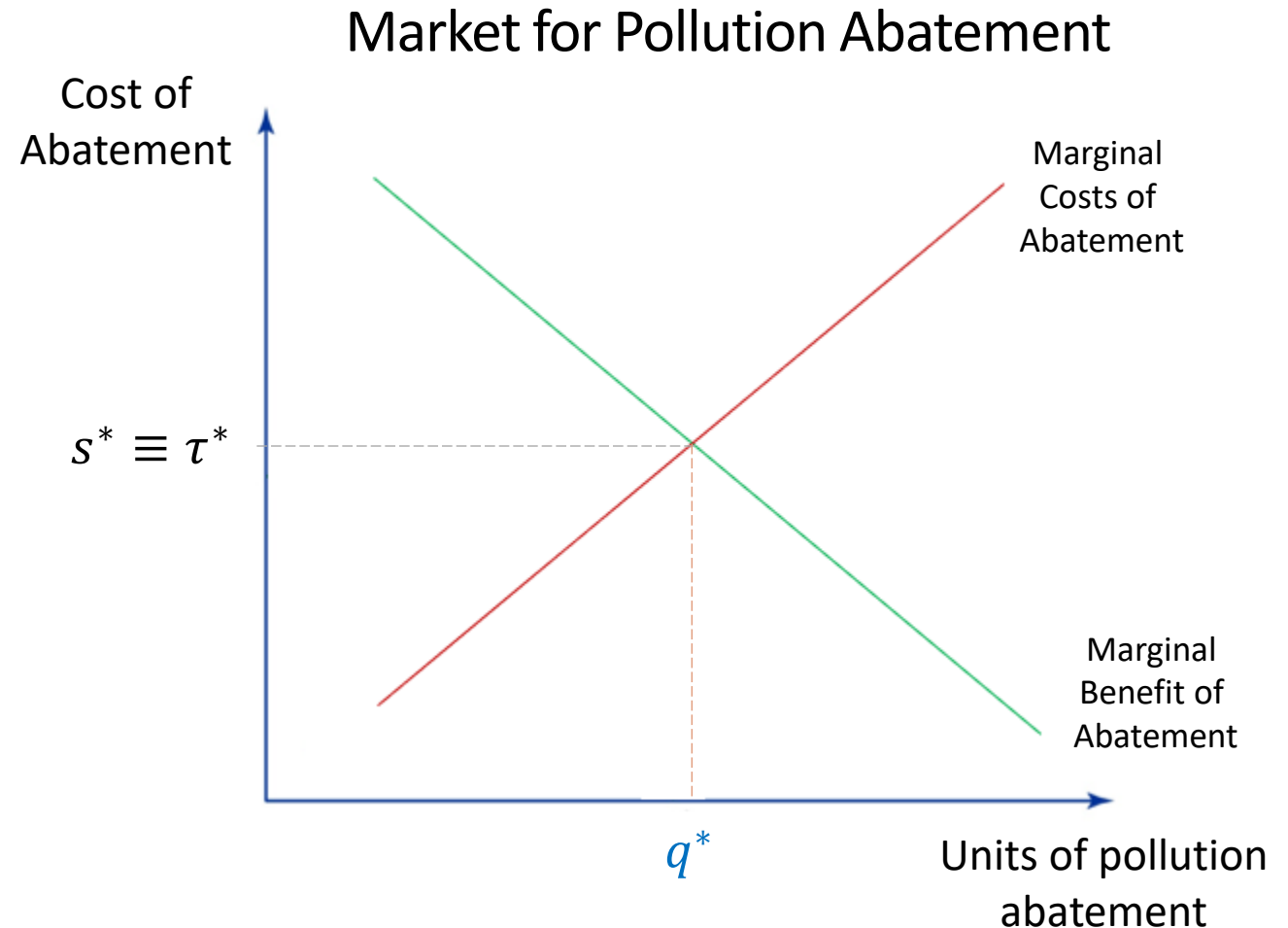
Quantity Control and Allowance Trading

What is a cap-and-trade regulatory instrument?

- Quantity control (“cap”) places a restriction on the total quantity of emissions for a given pollutant by distributing allowances that sum to that quantity.
- Allowance trading (“and trade”) is the subsequent market for pollution allowances. Trading creates an incentive for firms to abate, buy, and/or sell allowances to save money. Market forces ensure efficiency.

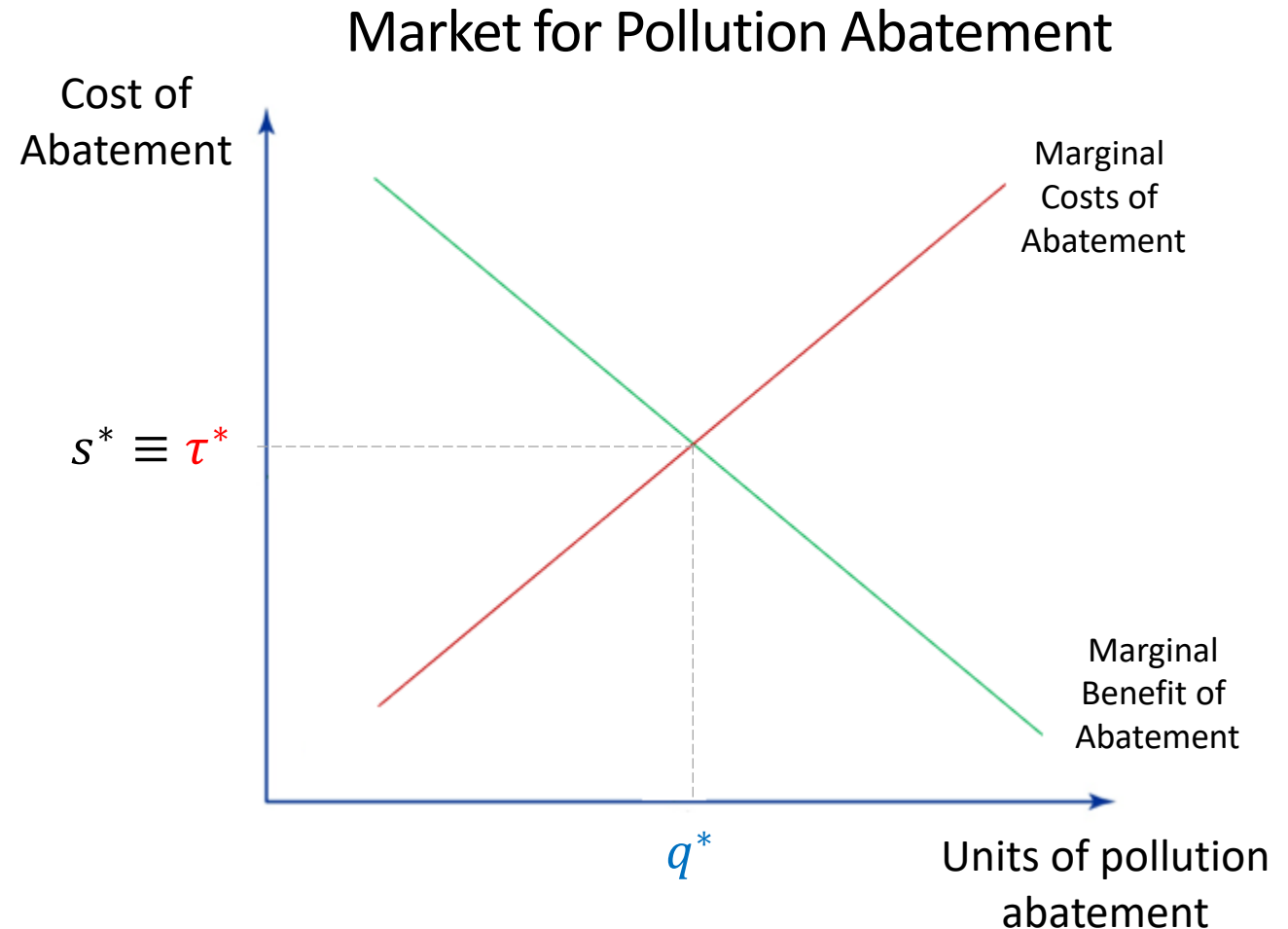
The Optimal Quantity of Pollution Abatement

The tax/subsidy where the marginal cost of abatement equals the marginal benefit of abatement is also associated with a specific quantity of abatement, q^* .



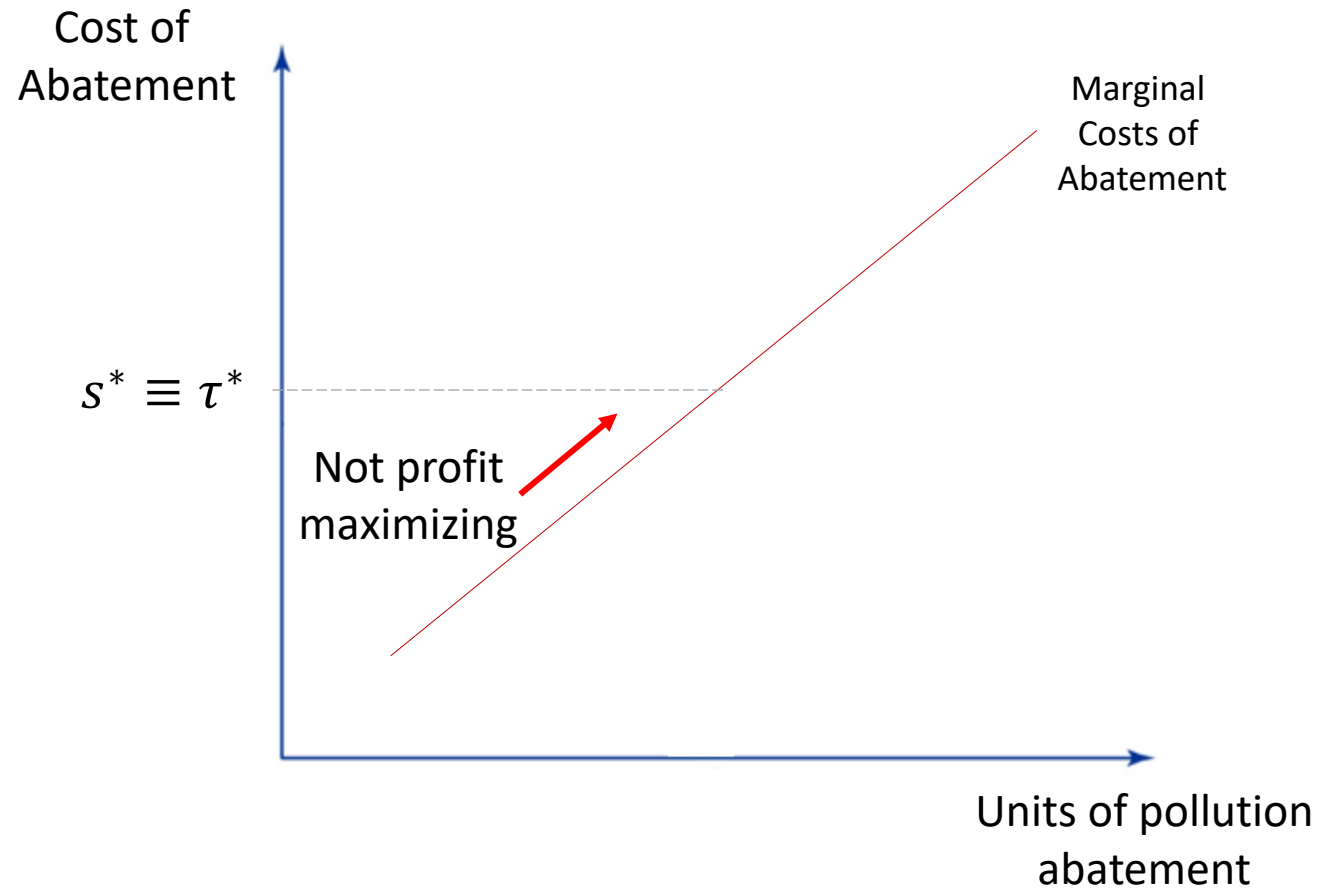
Combining Price and Quantity Regulatory Instruments

Theoretically, a regulator could achieve the same optimal pollution abatement with a **Pigouvian tax at τ^*** as they could with a **quantity control at q^*** .



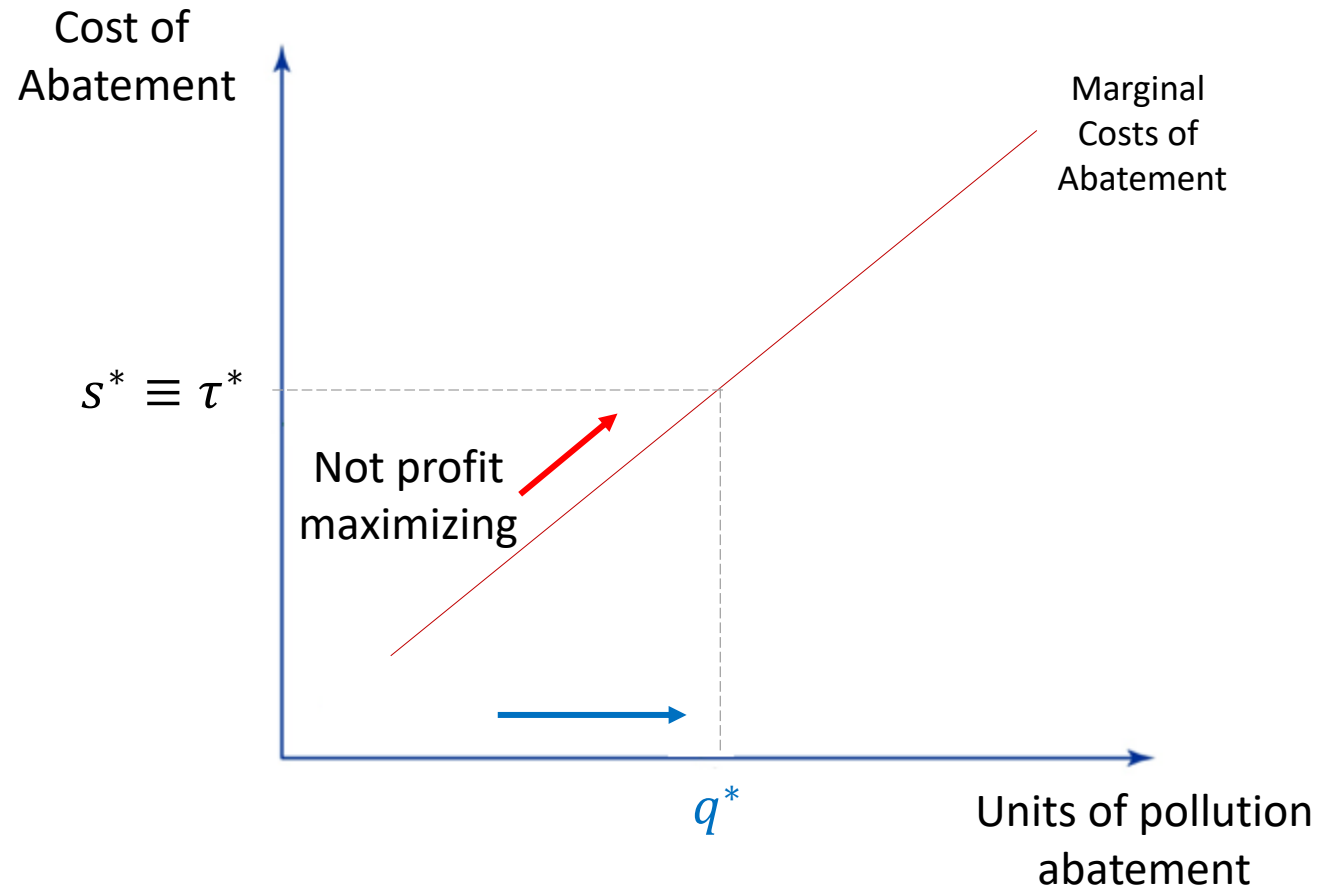
Equivalence of Market-based Incentives

A tax or subsidy pushes firms to the optimal quantity because it is more profitable to abate than to pay the tax for emitting a unit of pollution.



Equivalence of Market-based Incentives

A quantity control mandates the quantity by creating q^* pollution allowances and distributing them to regulated entities for free or by auction.

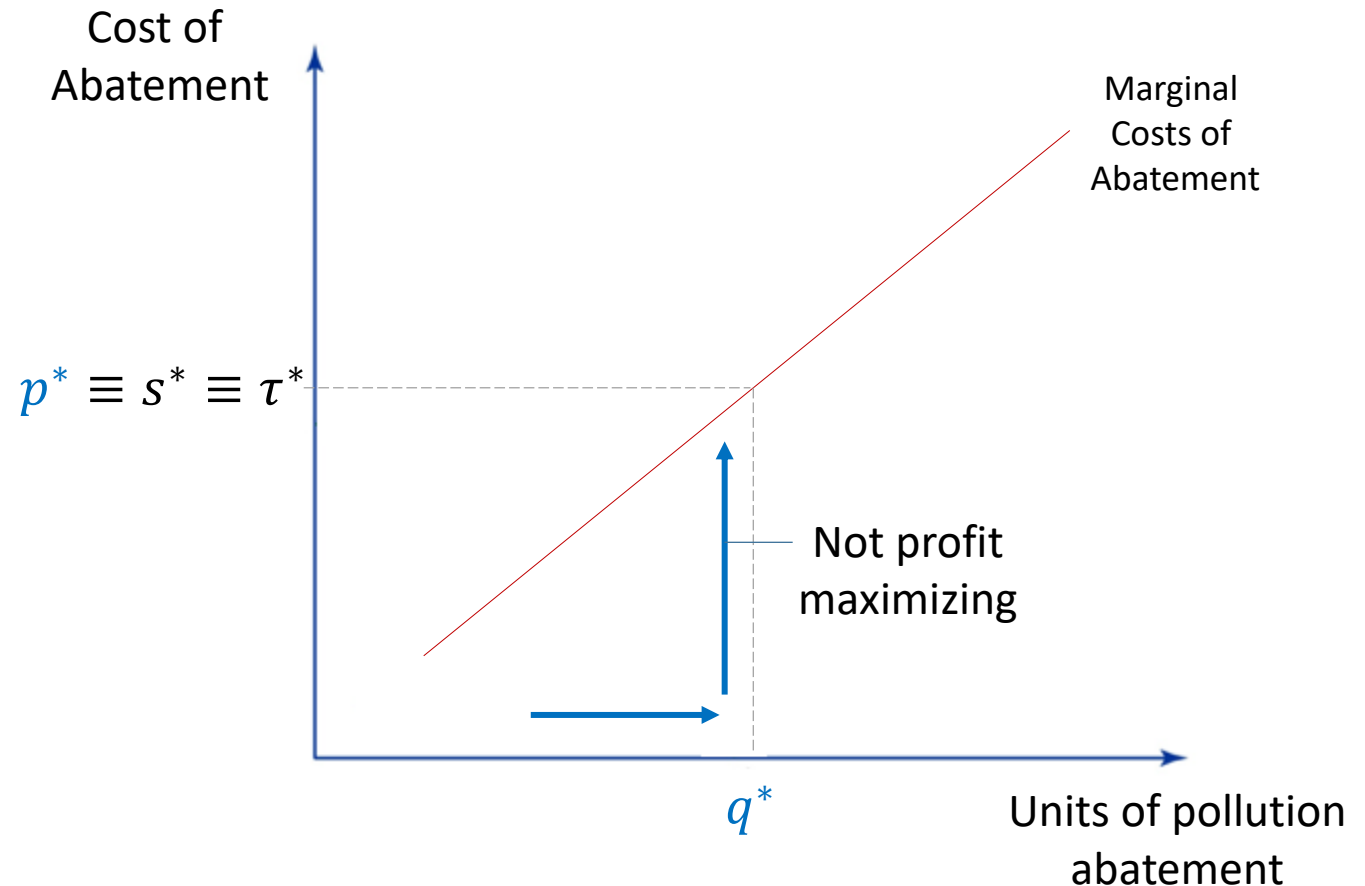


Equivalence of Market-based Incentives

Firms buy and sell (i.e., trade) allowances if it is profitable.

- Buy if allowance price $<$ cost of abatement
- Sell if allowance price $>$ cost of abatement

In a competitive market, this pushes the price of an allowance p^* to the level of an efficient tax/subsidy.



Next class

- **We will be playing a pollution trading game to illustrate cap-and-trade next class. It is a modified version of musical chairs. Please let me know if you have any concerns about your willingness or ability to participate.**
- Assigned materials for Wednesday:
 - K&O (textbook) Chapter 10 (and 8-9 if you haven't read them yet)
 - *Optional:*
 - Building a Carbon Trading System in New York ([RFF Podcast](#))
 - [Hernandez Cortes and Meng \(2023\)](#)