SPEA-V-202
Contemporary Economic Issues in Public Affairs
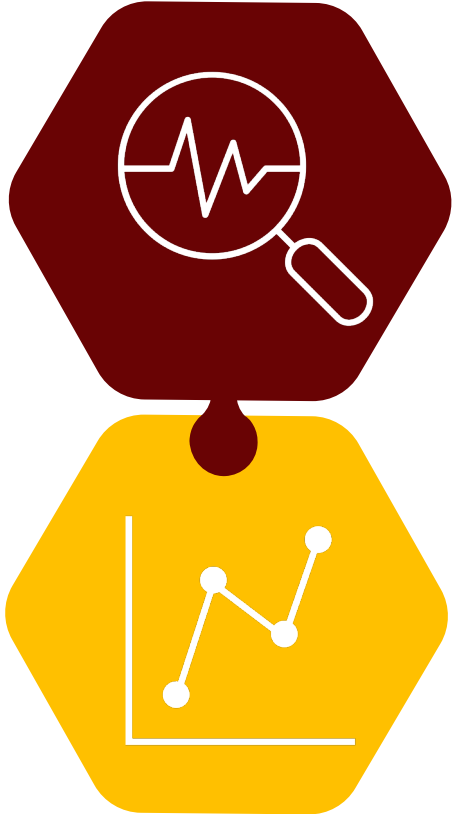
Externalities I

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Outline for Today

Externalities

- Definition and examples
- Type of externalities
- Positive and negative externalities
- Intuition and visual representation

Examples

- Environmental externalities
- Environmental policy
- Practical example of health policy

Externalities

Externality: an externality arises when a person engages in an activity that influences the well-being of a bystander but neither pays nor receives compensation for that effect.

<u>Example:</u> smoking in a closed room. Smokers create smoke with each cigarette they consume.

- Exposure to smoke decreases the health of the non-smokers in the room.

- Due to smoke exposure, non-smokers now will consume a higher amount of health care services.

- Question: what is the non-smokers WTP for cigarettes?

- Zero! They do not smoke because they do not derive benefit from it. Still, they bear some of the costs of smoking.

- Is this efficient? Is this fair?

Introduction

- Example: consider the market for burgers. Suppose that a pizza place opened right next to the only burger restaurant supplying this economy.

- Opening the pizza place creates a market for pizza. Assumption: pizza and burgers are substitutes. What is the effect on the demand for burgers?

- Is this an externality? (Hint: what is the market failure in this case?)

Pizza Market

P_Z

S_Z

p_z^*

D_Z

Q_Z

q_z^*

Burgers Market

P_B

S_W

p_B^*

D_B'

D_B

Q_B

q_B' q_B^*
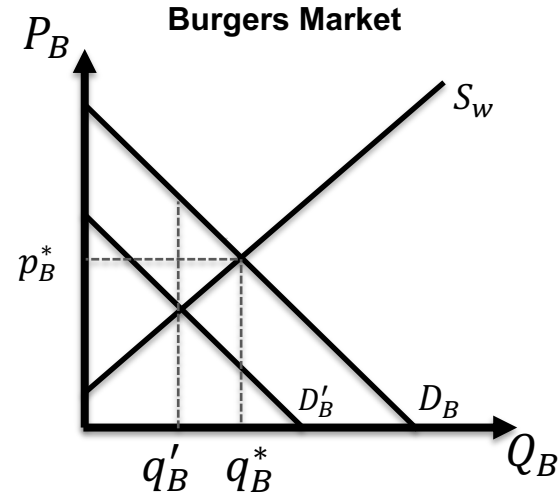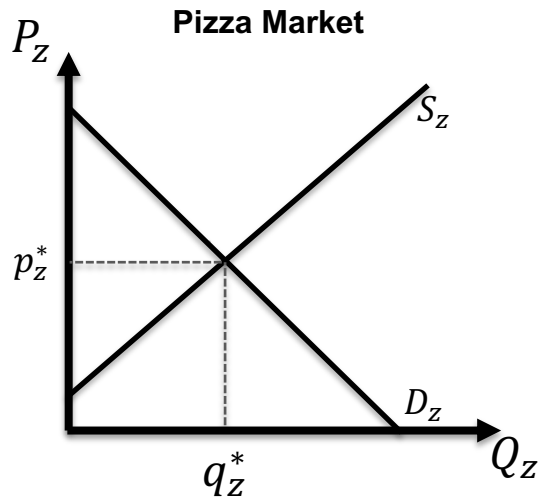
Pecuniary Externalities

- <u>There is no market failure!</u> Opening the pizza place might be a response to demand for pizza. Markets are working as they should.

- <u>1. Pecuniary Externalities:</u> externalities transmitted through the price system.

- Opening the pizza place: increases the supply for pizza, decreases the demand for burgers. There is a negative effect on the burger's market, but (in theory) it should be compensated by the benefit from having a pizza place. Hence, the DWL of both markets is zero. Actually, there could be a welfare gain.

Pizza Market

Burgers Market

DWL in the burgers market
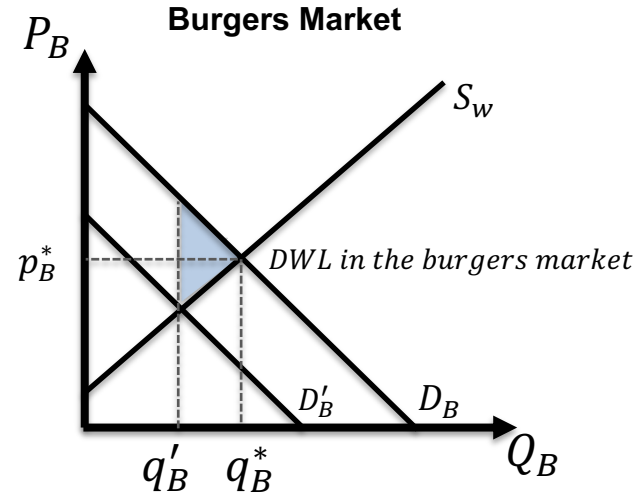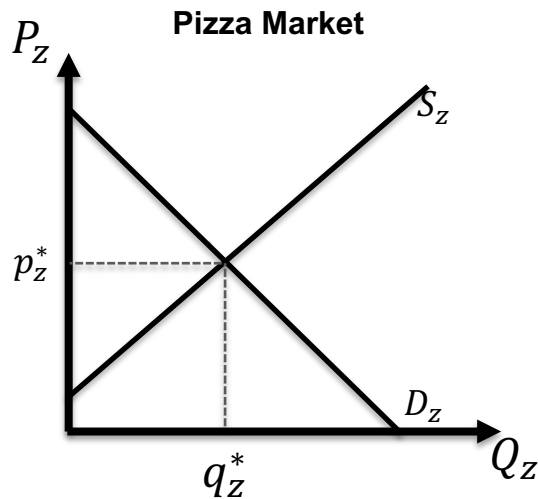
Introduction

- Suppose we are analyzing the steel and water markets independently and that these markets are operating properly (i.e. there are no market failures).

- In theory, supply and demand curves reflect WTS and WTP. Market forces determine the equilibrium q_w^* and q_s^*, along with the equilibrium prices p_w^* and p_s^*.

Steel Market

P_s

S_s

p_s^*

D_s

Q_s

q_s^*

Water Market

P_w

S_w

p_w^*

D_w

Q_w

q_w^*
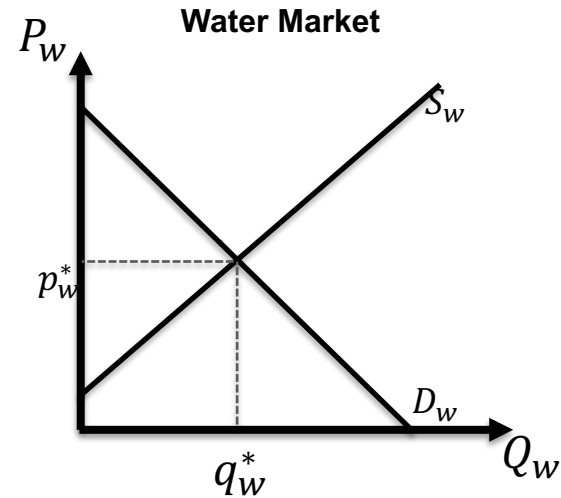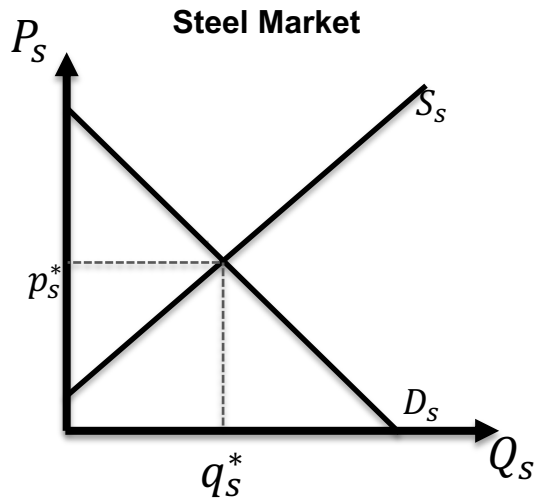
An example
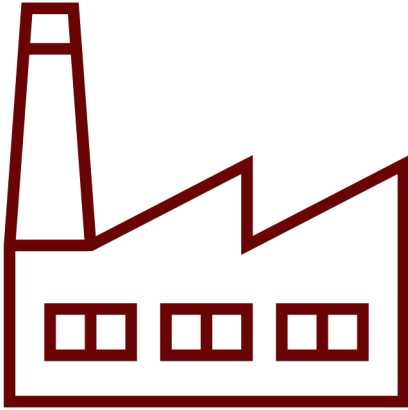
- In this economy, the supplier is one steel factory, and the consumers are local businesses that use steel as input to produce final goods (e.g. car repair shops, construction).

- Steel production requires several strong chemicals (acids) and creates toxic waste.

- In other words, <u>for each unit of steel produced some units of toxic waste are also produced</u>.

Units of Steel Produced	Toxic Waste Created
10 tons	500 pounds
20 tons	1,000 pounds
30 tons	1,500 pounds

An example

- Suppose the steel factory disposes of the toxic waste on a nearby river, which converges with the river supplying water to the community.

- What is the effect of this action on the water supply?

- **Reduction in the water supply.** Less clean water is available. Price of water increases due to scarcity.

- **Takeaway:** each unit of steel produced derives in a reduction of the water supply, which leads to higher prices for the community.

Non-Pecuniary Externalities

What is the lesson behind the story? q_w^* has a negative relation on water supply. The presence of the steel market creates a deadweight loss in the water market.
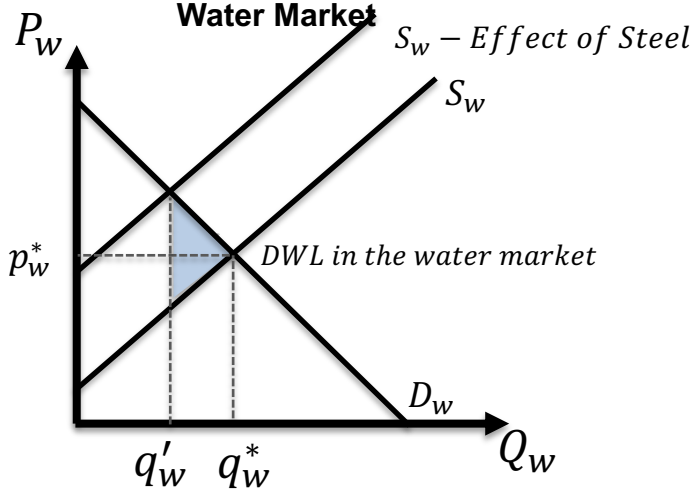
- 2. Non-Pecuniary Externalities: externalities <u>not occurring</u> through the price system.

- In this case, change in p_w^* does not reflects changes in the preferences or productivity of water consumers/producers.

- **Implication**: water consumption is below its optimal level. Which effects will this have in other markets ?
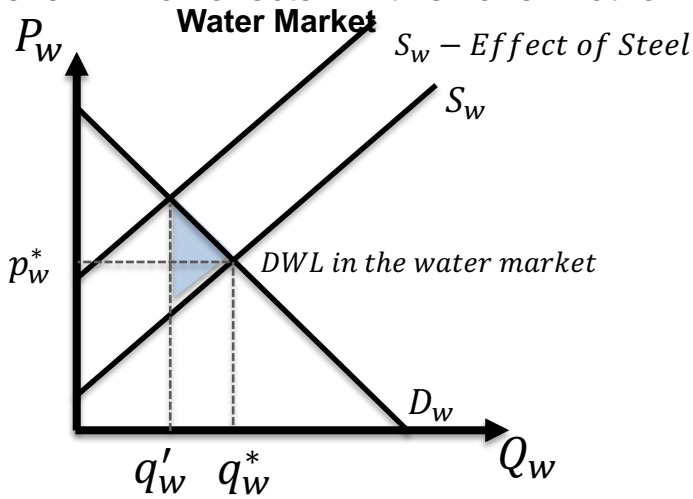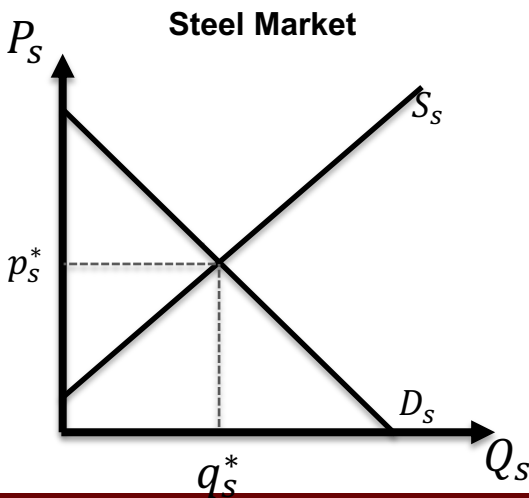
Non-Pecuniary Externalities: Intuition

Intuitively: what is the imperfection in the economy? Why does free-exchange not lead to efficiency?

- Supply of water is not fully capturing producer's willingness to sell. Why is this the case?

- **Market failure:** property rights are not well defined. Some of the costs of producing steel are borne by water suppliers (and consumers). Question: which is the market experiencing the market failure in our example?
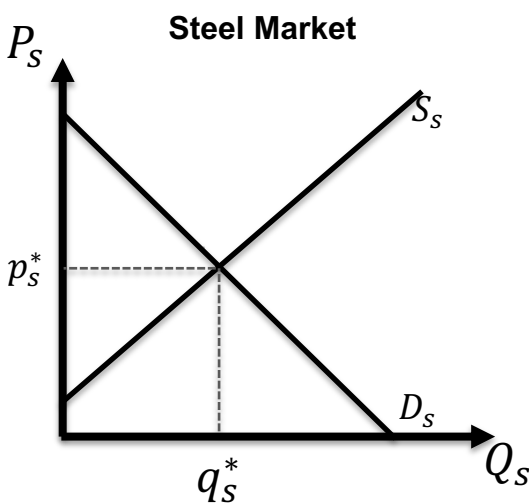
Non-Pecuniary Externalities: Intuition

<u>In the absence of market failures:</u> equilibrium happens when WTP = WTS → Private MB = Private MC

- However, under the presence of externalities private MB/MC might differ from social MB/MC.

- **Private Marginal Cost:** direct cost to producers of producing an additional unit of a good.

- **Private Marginal Benefit:** direct benefit to consumers of consuming an additional unit of a good by the consumer.

- **Social Marginal Cost:** private marginal cost + any costs associated with the production of such good that are imposed or borne by others.

- **Social Marginal Benefit:** private marginal cost - any costs associated with consumption of such good that are imposed or borne by others.

- The difference between private and social marginal benefit/cost is called **Marginal Damage** (*in our example the marginal damage is the effect of steel on water supply*).

- **Homework:** see Mankiw's Figures 5-3 and 5-4.

Externalities

Problem: private costs (only faced by suppliers) differ from social costs (faced by everyone). Recall the social planner. What would he do in this market?

- Social planner: Social Marginal Benefit = Social Marginal Cost.

- Free-market exchange: Private Marginal Benefit = Private Marginal Cost. If private ≠ social, then we have an externality.

FIGURE 6.1

EXCESSIVE PRODUCTION OF GOODS YIELDING NEGATIVE EXTERNALITIES

The presence of a negative externality means that marginal social costs exceed marginal private costs, and the market equilibrium will entail an excessive production of the commodity. Q_m is market equilibrium, Q_e is the efficient level of output.
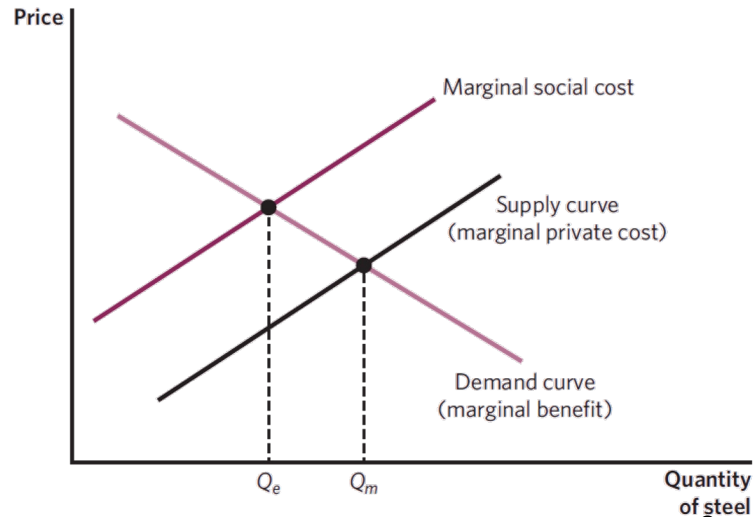
Source Stliglitz and Rosengard Chapter 6

Externalities categorization

In general, we can categorize externalities in four main groups, defined by two sets of characteristics.

- **Direction of the unintended effect:** this could be negative or positive.

- **Channel to the economy:** externalities could be either on consumption (demand curve) or production (supply curve).

	Negative	**Positive**
Production	Steel and water production.	Oil exploration.
Consumption	Roommate's smoking habits and your healthcare.	Neighbor landscapes his garden, and your house benefits from the view.

For more details on the examples see Gruber Chapter 5.

Externalities

- <u>Question:</u> if negative externalities lead to DWL, do positive externalities lead to welfare gains?

- No! Even positive externalities are the result of market failure. Private marginal benefits/costs do not reflect social marginal benefits/costs.

- Recall the social planner chooses the optimal level of production (i.e. to maximize total surplus, accounting for any market failure).

- **Negative** externalities cause **overproduction** of the good in a competitive market. (i.e free market exchange leads to produce/consume the good above its optimal level)

- **Positive** externalities cause **underproduction** of the good in a competitive market. (i.e free market exchange leads to produce/consume the good below its optimal level)

- <u>In both cases leading to a deadweight loss.</u>

Externalities

Negative externalities cause overproduction of the good in a competitive market.

■ FIGURE 5-3

Price of cigarettes (per pack)

Marginal damage, *MD*

$0.40

$S = PMC = SMC$

P_1

A

C

Deadweight loss

B

$D = PMB$

$SMB = PMB - MD$

Q_2 Q_1

Overconsumption

Quantity of cigarettes (in packs)
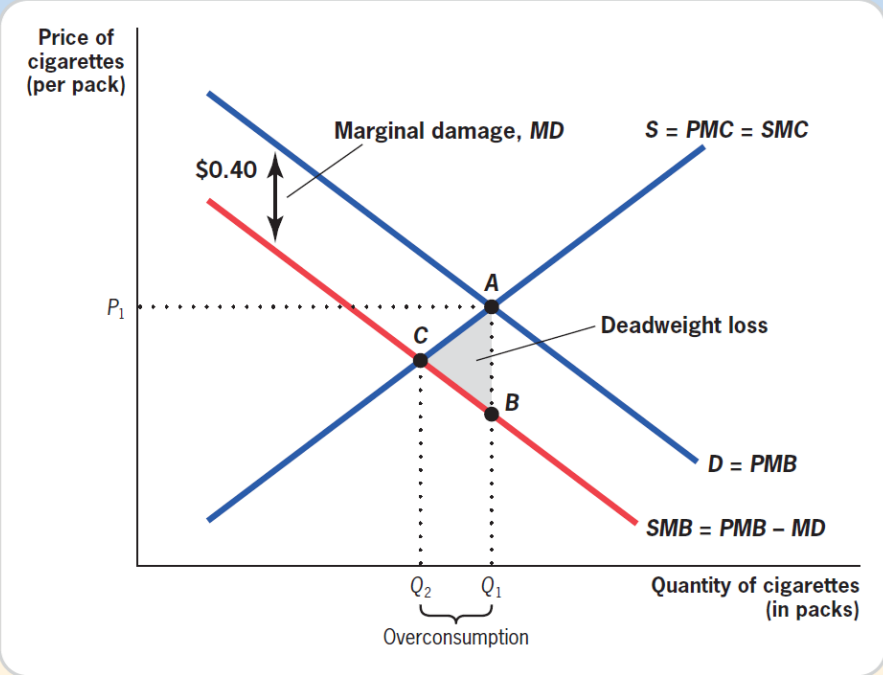
Market Failure Due to Negative Consumption Externalities in the Cigarette Market • A negative consumption externality of 40¢ per pack of cigarettes consumed leads to a social marginal benefit that is below the private marginal benefit, and a social optimum quantity (Q_2) that is lower than the competitive market equilibrium quantity (Q_1). There is overconsumption $Q_1 - Q_2$, with an associated deadweight loss of area *ACB*.
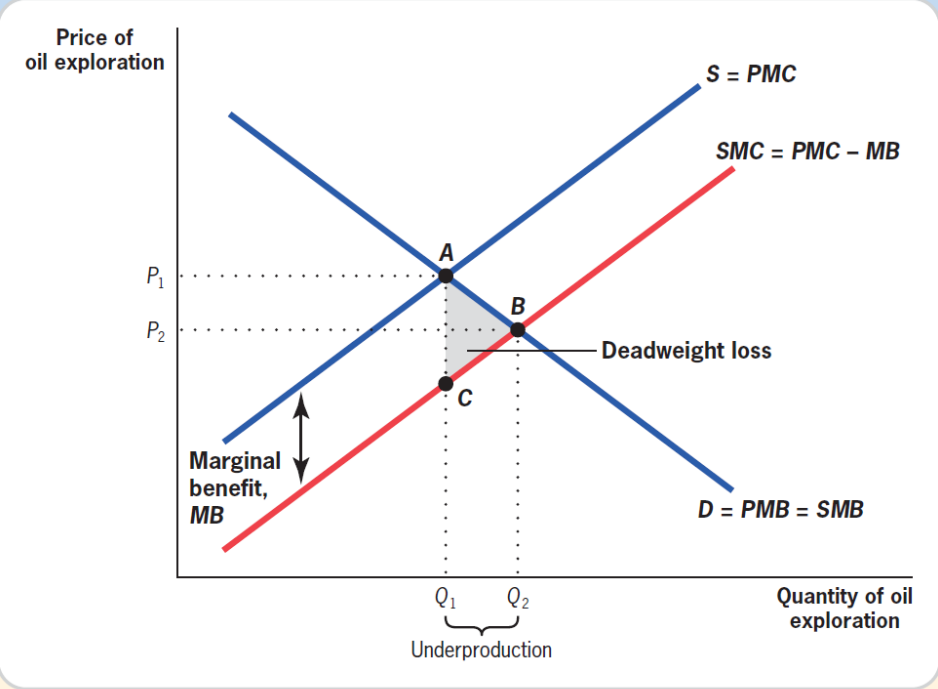
Source Gruber Chapter 5.

Externalities

Positive externalities cause underproduction of the good in a competitive market.

■ FIGURE 5-4

Market Failure Due to Positive Production Externality in the Oil Exploration Market • Expenditures on oil exploration by any company have a positive externality because they offer more profitable opportunities for other companies. This leads to a social marginal cost that is below the private marginal cost, and a social optimum quantity (Q_2) that is greater than the competitive market equilibrium quantity (Q_1). There is underproduction of $Q_2 - Q_1$, with an associated deadweight loss of area *ABC*.

Source Gruber Chapter 5.

Example: Environmental Externalities

- Economic activity involves in pollution. There is an unavoidable amount of pollution associated with the provision of goods and services in the economy.

- Releasing pollutants to the environment creates consequences for all agents, regardless on whether they participate in the market or not.

- **Example: Global Warming.** Greenhouse effect 101: the earth is heated by solar radiation that passes through the atmosphere. Most of the radiation is trapped by certain gases in the earth's atmosphere.

  - The problem: economic activity increases the amount of carbon dioxide, methane and other gases to the atmosphere, trapping more radiation and, thus, increasing the temperature of the earth.

  - Consequences: melting poles, increasing sea level leads to higher probability of floods.

Example: Environmental Externalities

- **Another example: Acid rain.** Acid rain occurs when sulfur dioxide and nitrogen oxides are released in to the atmosphere.

- Damages of acid rain:

  - Forest erosion: death and slower growth for a variety of trees.

  - Property damage: corrosion of metals, paint, and several materials.

  - Reduced visibility in the air.

Regulation-based solutions to environmental externalities

- **1970 Clean Air Act:** set maximum standards for atmospheric concentrations of various substances, including sulfur dioxide.

  - ✓ The catch: only new plants were subject to this cap. How could firms comply? Switch to coal with lower sulfur content.

  - ✓ Economic intuition: cap of emissions is basically a cap on quantity supplied.

  - ✓ Intended effects: total sulfur dioxide emissions declined by the early 1980s.

- Was policy design optimal? What would you change/improve? (Hint: who is being targeted by the policy?)

- Not applicable to current plants, only to new plants.

- It created incentives for suppliers to run older, dirtier plants for longer than they should have.

- **1990 Amendments:** mandated a reduction of more than 50% in the level of sulfur dioxide emissions nationwide, now including all plants. (More about this policy later).

Regulation-based solutions: a small caveat

- One of the reasons for performance-based regulations is that they may induce innovations. That is, new ways of producing that generate less pollution or new techniques to fight pollution.

- Ongoing debate on whether industries should be *forced* to innovate.

- ✓ Example: suppose a policy that imposes a cap where all cars must get at least 40 miles per gallon, in terms of fuel consumption efficiency.

- ✓ <u>Thinking like an economist</u>: what are the costs and benefits from this policy?

- ✓ Costs: more expenditures on research and development. Might be a more expensive technology.

- ✓ Benefits: reduction in gasoline consumption, and pollution associated to it.

- <u>Challenge</u>: it is not clear that forcing innovation is welfare-improving. Finding feasible alternatives is hard.

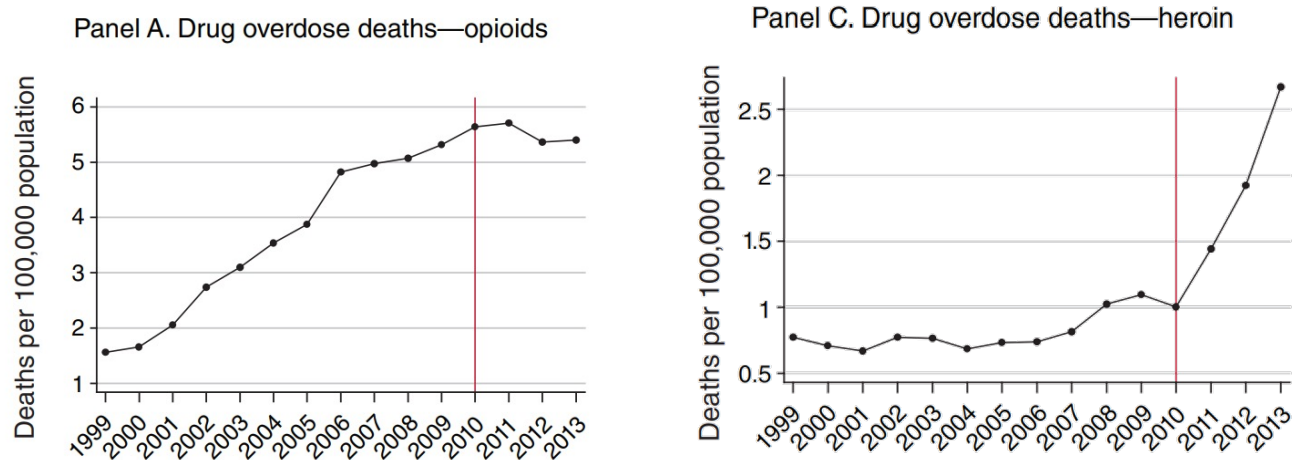# Practical Example: Alpert, Powell & Pacula (2018)

- <u>Context:</u> Opioid epidemic in the United States is health policy concern. More than 200K deaths due to opioid overdose.

- **Alpert, Powell & Pacula (2018):** study the effect of the reformulation of OxyContin (one of the most widely abused opioids) on the mortality rates due to opioids and the consumption of other drugs.

- In their paper, they analyze FDA's 2010 policy that approved a reformulated version of OxyContin.

  - ❑ <u>Policy objective:</u> decrease the abuse of OxyContin.

  - ❑ <u>Upgrade:</u> make the pill harder to crush or dissolve (when is crushed, the consumption of Oxycontin is most dangerous, consumers are more likely to overdose).

  - ❑ <u>Theory:</u> this increases the costs of using OxyContin. Thus, consumer's WTP for opioids should decrease.

  - ❑ <u>Question:</u> given these facts, do you think this policy was a good idea? Why?

Practical Example: Alpert, Powell & Pacula (2018)

- <u>Unintended Consequence:</u> raising the cost of OxyContin abuse lead to an unintended effect of increasing the abuse of substitute drugs, including more harmful ones like heroin.

- If this substitution occurred, then it would undermine the benefits of the policy.

FIGURE 1. TRENDS IN DRUG OVERDOSE DEATHS: PRESCRIPTION OPIOIDS AND HEROIN

Panel A. Drug overdose deaths—opioids

Panel C. Drug overdose deaths—heroin

Source: Alpert, Powell & Pacula (2018)

Practical Example: Alpert, Powell & Pacula (2018)

- Results: after the reformulation, overdose deaths from prescription opioids decreased for the first time since 1990.

- However, this drop coincided with an unprecedented rise in heroin overdoses. Heroin-related overdoses more than tripled between 2010 and 2014.

- This evidence is consistent with the hypothesis that the reformulation lead to the substitution from OxyContin to heroin.
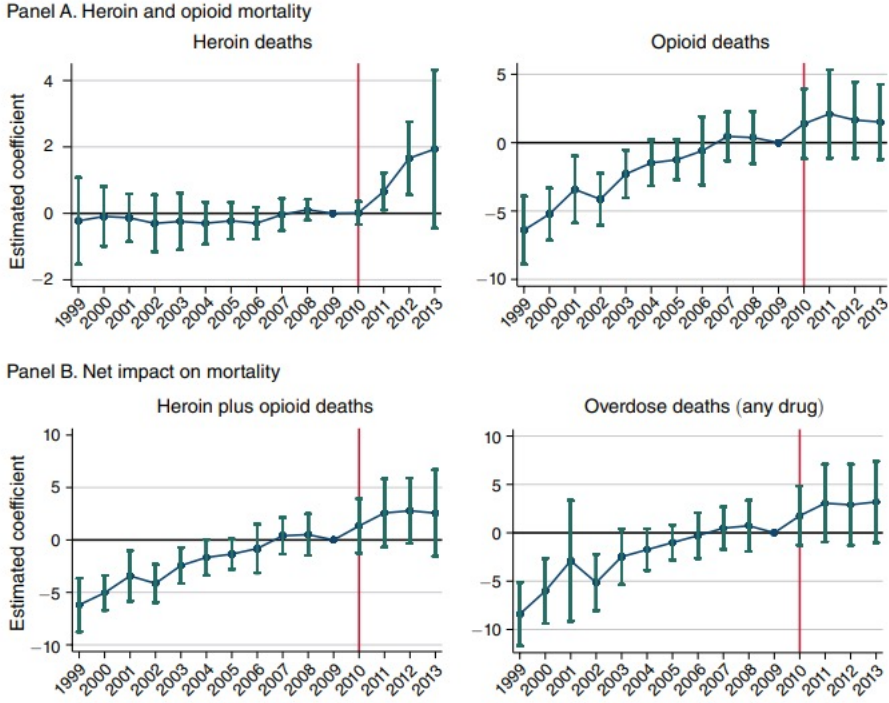

Panel A. Heroin and opioid mortality

Panel B. Net impact on mortality

FIGURE 4. EFFECT OF OXYCONTIN REFORMULATION ON OVERDOSE DEATHS—BASELINE EVENT STUDY SPECIFICATION

Note: Each graph includes point estimates from event study (normalized to 0 in 2009) and 95 percent confidence intervals that are adjusted for within-state clustering.

Source: Alpert, Powell & Pacula (2018)

Practical Example: Alpert, Powell & Pacula (2018)

- <u>Theoretical mechanism:</u> the policy increased the price of OxyContin, thus decreasing consumer's WTP for it. To satisfy their needs, they went to a substitute, a more dangerous one.

- What are the (relevant) market failure(s) here? What of type of externality is this?

  - Market failure: imperfect information (e.g. opioids consumers might not be aware of the risks of heroin consumption).

  - Type of externality: non-pecuniary externality. Hint: there was no change on the heroin supply. It wasn't the case that people substituted to heroin because it became cheaper, it was just easier.

- Overall effect: increase in drug mortality.

- Lesson: if you were the policymaker designing the policy, would you be able to anticipate this?

Practical Example: Unintended Effects of Health Policy

Supply-Side Drug Policy in the Presence of Substitutes: Evidence from the Introduction of Abuse-Deterrent Opioids[†]

By Abby Alpert, David Powell, and Rosalie Liccardo Pacula*

Overdose deaths from prescription opioid pain relievers nearly quadrupled between 1999 and 2010. We study the consequences of one of the largest supply disruptions to date to abusable opioids—the introduction of an abuse-deterrent version of OxyContin in 2010. Supply-side interventions that limit access to opioids may have the unintended consequence of increasing use of substitute drugs, including heroin. Exploiting cross-state variation in OxyContin exposure, we find that states with the highest initial rates of OxyContin misuse experienced the largest increases in heroin deaths. Our results imply that the recent heroin epidemic is largely due to the reformulation of OxyContin. (JEL I12, I18)

For Next Class

- **On the Next Episode:** Externalities II.

- **Readings:** Mankiw 10. Gruber 5 and 6. Stiglitz & Rosengard 6

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Externalities I

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