

Evaluation of Public Policies and Social Programs

Session 14: Externalities, Pricing, and Spillovers

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Wednesday, October 7, 2026

MA in Economics, Universidad de los Andes, Chile — Second Semester 2026

1. Pollution: private equilibrium, social optimum, and lost surplus
2. Property rights, Pigouvian taxes, and tradable emission permits
3. How to value an external effect in a policy evaluation
4. Disease transmission and the deworming spillover in Kenya
5. Neighbors and university enrollment: evidence from Chile

Learning Objectives

By the end of today's session, you will be able to:

- Explain how an external cost changes market equilibrium and creates an efficiency loss
- Compare bargaining, Pigouvian taxes, and tradable permits, including the conditions each requires
- Describe a practical sequence for estimating and valuing an external effect
- Explain how Miguel and Kremer identify health and attendance spillovers from school deworming
- Explain the neighbor-spillover question, identification strategy, main estimates, and limits in Barrios-Fernández (2022)

Why Externalities Matter

Pollution: a private choice, a cost imposed on others

A factory produces electricity and emits pollution. The factory does not necessarily bear the full health cost.

- The producer sees its fuel, labor, and equipment costs when choosing output.
- Nearby residents may face asthma, medical bills, missed school or work, and lower quality of life.
- If those harms do not affect the producer's decisions, its private cost is below the cost to society.

The economic problem is that the decision-maker does not face the full marginal consequence of its action.

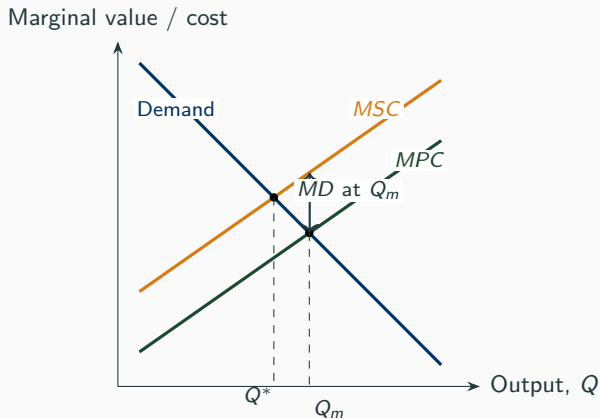
$$MSC(Q) = MPC(Q) + MD(Q)$$

- **Marginal private cost (MPC):** the producer's extra cost of one more unit.
- **Marginal damage (MD):** the extra harm imposed on people outside the transaction.
- **Marginal social cost (MSC):** private cost plus external damage.

If demand reflects marginal private benefit, the unregulated market equates $MPB = MPC$; the efficient quantity equates $MSB = MSC$.

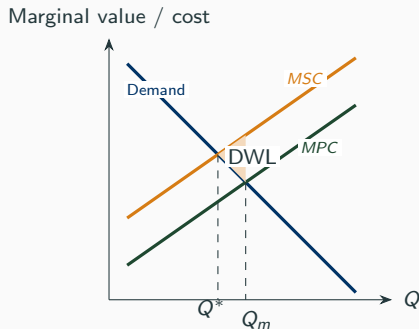
Private Equilibrium, Social Optimum, and Efficiency Loss

The unregulated market overproduces



Marked dots are the curve intersections:
 Q_m solves $D = MPC$; Q^* solves $D = MSC$. Hence $Q_m > Q^*$.

Overproduction creates a deadweight loss



- Between Q^* and Q_m , social cost exceeds consumers' willingness to pay.
- The shaded triangle is lost net surplus from those extra units.
- It is not the full pollution damage and not the tax revenue.

The intervention goal is to make private incentives reflect the external margin — not necessarily to eliminate all pollution.

How Can Society Respond?

1. Define rights and allow bargaining: Coase

- Give someone an enforceable right: residents' right to clean air, or the firm's right to emit.
- Affected parties can bargain over compensation and abatement if rights are clear and agreements can be enforced.
- With zero transaction costs and complete information, bargaining can reach an efficient allocation regardless of the initial right assignment.
- Initial rights still affect who pays and who receives compensation — efficiency does not imply distributional neutrality.

Why pollution is often hard to bargain over

Many victims, diffuse and uncertain harms, free-riding, unequal bargaining power, and enforcement costs.

Coase, R.H. (1960), "The Problem of Social Cost," *Journal of Law and Economics*, 3, 1–44.

2. Pigouvian tax: put a price on the harm

Set the tax equal to marginal external damage at the efficient quantity:

$$t^* = MD(Q^*)$$

- The tax raises the producer's private marginal cost to $MPC + t$.
- If calibrated correctly, the firm chooses Q^* without the regulator dictating each firm's technology.
- Tax revenue is a transfer; the efficiency gain comes from reducing units for which social cost exceeds social benefit.

Strength: price certainty and continuous incentives. Challenge: measuring marginal damage and updating the tax as conditions change.

3. Create a market: tradable emission permits

- The regulator sets a total emissions cap and creates tradable permits (allowances) authorizing emissions under that cap.
- Firms with low abatement costs reduce emissions and sell permits; firms with high abatement costs buy them.
- Trading moves firms toward equal marginal abatement costs and creates a market price for the right to emit.
- Unlike a tax, a cap fixes aggregate quantity while the permit price adjusts. A tax fixes the price while total emissions respond.

Terminology and design

These are tradable emission permits or allowances (sometimes called carbon credits), not ordinary debt bonds. Monitoring, enforcement, market power, permit allocation, and cap setting matter.

Compare the remedies

	Coasean bargaining	Pigouvian tax	Tradable permits
What is set?	Rights; parties negotiate	Price per unit of harm	Total quantity / cap
Can work well when	Few parties; clear rights; low transaction costs	Damage can be valued; regulator can set/update tax	Emissions can be monitored; trading is competitive
Main challenge	Bargaining, free-riding, enforcement	Measuring marginal damage	Cap, monitoring, market power, allocation
Who gets value?	Depends on initial rights	Public revenue	Permit rents depend on allocation

Common aim

All three aim to internalize the external margin; institutions and information determine which is feasible.

How Do We Price an Externality?

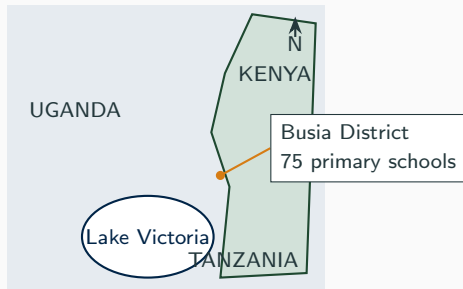
From physical impact to economic value

1. Define the external outcome: emissions, illness, attendance, mortality risk, or crime.
2. Estimate the causal physical effect relative to a credible counterfactual.
3. Identify affected people, place, and duration; account for spillovers, substitution, and displacement.
4. Apply a defensible unit value: resource costs, willingness to pay, value of risk reduction, or an official shadow price.
5. Aggregate over people and time; discount dated flows and test uncertain assumptions.

Impact estimation and economic valuation are separate steps. Avoid double-counting one harm through multiple proxies.

Spillovers: Deworming in Kenya

The study setting: Busia, western Kenya



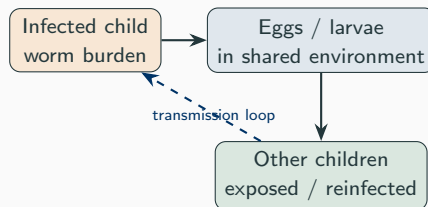
Schematic locator only; it does not show school boundaries or study-site coordinates.

- Busia is a poor, densely settled farming region in western Kenya, near Lake Victoria.
- Water contact and inadequate sanitation expose school-aged children to intestinal helminths.
- The study followed 75 primary schools and more than 30,000 pupils, 1997–2001.

Context and study sample: Miguel & Kremer (2004); J-PAL, “Primary School Deworming in Kenya.”

What is the worming problem?

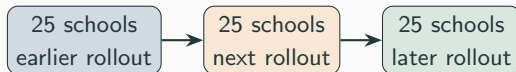
- Hookworm, roundworm, whipworm, and schistosomiasis affect school-aged children.
- Illness can cause abdominal pain, anemia, fatigue, and missed school.
- Reinfection can occur when exposure is shared through contaminated soil, fecal matter, or water.



Treating one child may reduce exposure for untreated children — a positive treatment externality.

Treatment and the phased school design

- The Primary School Deworming Project worked with 75 schools, organized into three rollout groups of 25.
- Schools were stratified by administrative zone and NGO activity, listed alphabetically, and assigned in turn to rollout groups over three years.
- Schools above the worm-prevalence threshold received mass deworming every six months, plus health education and teacher training.
- School-level phased rollout preserves community transmission as part of the policy: individual randomization could expose controls to treatment externalities.



Design summary: Miguel & Kremer (2004); J-PAL, "Primary School Deworming in Kenya."

How did the design reveal spillovers?

- Compare treated pupils with pupils in schools not yet treated to estimate direct health and attendance effects.
- Measure outcomes for untreated pupils in nearby schools at different exposure distances from treated schools.
- If untreated pupils nearer treated schools have lower infection or higher attendance, that is evidence consistent with disease-transmission spillovers.
- Because proximity is not randomly assigned, interpretation also requires attention to geography, school location, baseline comparability, and exposure measurement.

Updated policy summaries report benefits to untreated children near treatment schools; distinguish those spillover estimates from the direct effect on treated pupils.

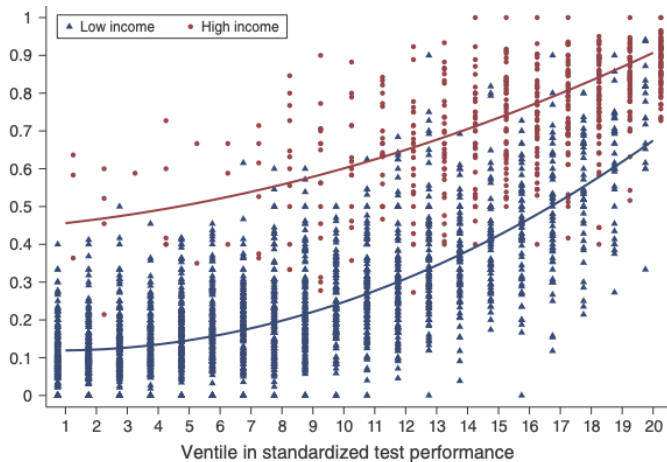
What did the deworming evaluation find?

- Deworming reduced moderate-to-heavy infections and improved health among treated pupils.
- School participation increased for treated children; the paper did not find gains in academic test scores.
- Untreated children near treatment schools also benefited through reduced transmission — evidence that the total social benefit exceeds the direct recipient effect.
- Later corrected summaries emphasize spillovers within roughly 3 km; the original paper's farther-distance estimate was affected by a coding error, so avoid presenting a broad radius as settled.

Miguel & Kremer (2004), *Econometrica*, 72(1), 159–217; J-PAL updated evaluation summary.

Neighbor Spillovers

Inequality in access persists across the ability distribution



Barrios-Fernández (2022), Figure 1, p. 35. Descriptive relationship; not causal evidence.

What does the inequality figure show?

- University enrollment rises with standardized-test performance.
- At similar achievement levels, low-income students are less likely to enroll than high-income students.
- The gap motivates the question: can neighbors' experiences change whether a student acts on their academic potential?

Next question

The figure is descriptive. How can we distinguish a neighbor's influence from correlated effects and common circumstances?

Research question: do close neighbors affect university enrollment?

When a nearby young person gains loan eligibility and enrolls, does a potential applicant become more likely to attend university?

- University attendance requires more than academic potential: students must take the admission exam, apply, and understand financing options.
- A successful neighbor may change information, perceived access, preparation, or expectations.
- The paper asks whether a financial-aid shock to a close neighbor spills over to the applicant, beyond the direct effect on the loan recipient.

Why is this difficult to answer?

- **Correlated effects:** homophily, common shocks, and selection can make neighbors similar or expose them to the same conditions.
- **Reflection problem:** peers can influence one another, so it is hard to tell whose behavior causes whose outcome.

Why simple correlations fail

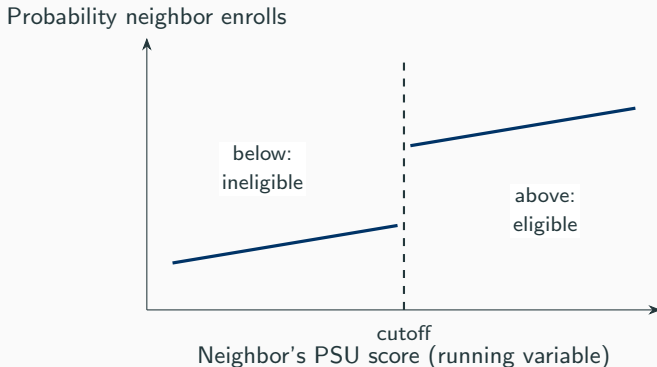
A positive association between neighbor attendance and own enrollment may reflect correlated effects or reflection, not a causal spillover.

The research design: an eligibility cutoff as an instrument

- In the relevant loan rules, financial-need eligibility was combined with a PSU average-score cutoff of 475.
- Compare older close neighbors just below and above the score threshold, among those meeting the relevant need criteria.
- Crossing the threshold shifts the older neighbor's loan eligibility and university enrollment; use this eligibility jump as an instrument for the neighbor's enrollment.
- Outcome: whether the younger potential applicant enrolls the following year. The temporal ordering helps with reflection.

RD intuition: what changes at the cutoff?

Just below versus above the loan cutoff, older-neighbor enrollment jumps; the younger applicant's outcome is measured afterward.



Local effect for applicants whose neighbor responds to the cutoff.

Identification logic: first stage to spillover effect

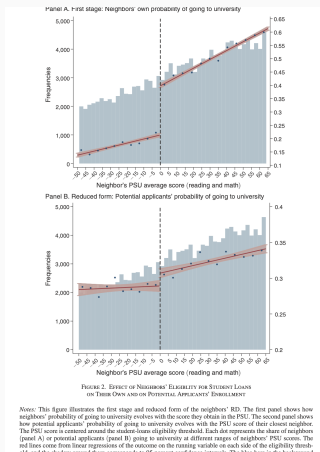
First stage: neighbor eligibility $\rightarrow$ neighbor enrolls (≈ 17 – 18 pp)

Reduced form: neighbor eligibility $\rightarrow$ applicant enrolls (≈ 2 pp)

$$2SLS: \frac{\text{reduced form}}{\text{first stage}} \approx 10\text{--}14 \text{ pp}$$

- Table 2 reports four specifications; estimated neighbor effects range from 0.104 to 0.138.
- The applicant enrollment baseline is about 0.31–0.33, so the effect is meaningful relative to the outcome mean.
- Interpret as a local IV effect under RD/IV assumptions; direct information from eligibility itself could complicate a pure enrollment-channel interpretation.

Paper Figure 2: first stage and reduced form



Reproduced for classroom discussion from Barrios-Fernández (2022), Figure 2, p. 43. Panel A: neighbor enrollment jump; Panel B: applicant enrollment reduced form.

Paper Table 2: the main neighbor estimate

TABLE 2—EFFECT OF NEIGHBORS ON POTENTIAL APPLICANTS' UNIVERSITY ENROLLMENT

	2SLS-1	2SLS-2	CCT-1	CCT-2
	(1)	(2)	(3)	(4)
Neighbor goes to university ($t - 1$)	0.104 (0.031)	0.127 (0.040)	0.116 (0.043)	0.138 (0.051)
First stage	0.178 (0.008)	0.167 (0.010)	0.179 (0.010)	0.174 (0.012)
Reduced form	0.019 (0.005)	0.021 (0.007)		
Year fixed effects	Yes	Yes	Yes	Yes
Number of students	144,724	255,636	144,724	255,636
PSU polynomial	1	2	1	2
Bandwidth	(49.09–64.35)	(67.04–124.88)	(49.09–64.35)	(67.04–124.88)
Kleibergen-Paap F -statistic	449.63	260.11		
Outcome mean	0.31	0.33	0.31	0.33

2SLS estimates: 10.4–13.8 pp across specifications. Barrios-Fernández (2022), Table 2, p. 44.

Distance decay: social proximity matters

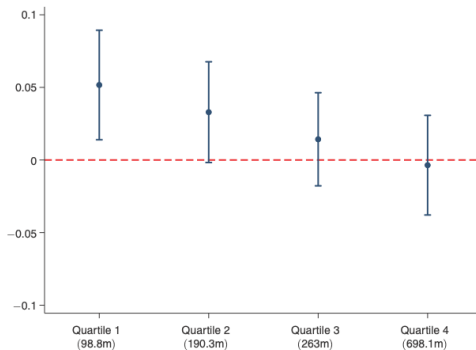


FIGURE 3. EFFECT OF NEIGHBORS ON POTENTIAL APPLICANTS' UNIVERSITY ENROLLMENT BY DISTANCE

The estimated effect is largest for the closest-distance quartile and falls toward zero farther away; confidence intervals widen and overlap zero for the farther groups. Reproduced for classroom discussion from Barrios-Fernández (2022), Figure 3, p. 48.

What mechanisms and limitations remain?

- The paper finds that exposed applicants are more likely to take the PSU and apply to university — consistent with awareness or information channels.
- Results are stronger for socially closer neighbors (e.g., closer in distance, age, or socioeconomic status), supporting a local-network interpretation.
- The design does not perfectly separate role-model effects, information transmission, help with applications, preparation, and preferences.
- The IV estimate is local to threshold compliers and relies on continuity and exclusion assumptions; it is not a universal multiplier for every financial-aid program.

What should a policy evaluator take away?

1. Identify a plausible mechanism linking one person's treatment to another person's outcome.
2. Define who is directly treated and who is exposed indirectly; map distance or network links.
3. Choose a design that measures both direct effects and spillovers, rather than assuming controls are untouched.
4. Value spillovers using the affected population and outcomes, then test uncertainty and avoid counting effects twice.

External effects matter for both market regulation and program evaluation: the decision-maker's action can change outcomes beyond the direct participant.

What We Learned Today

- Pollution overproduction occurs when producers face MPC but society bears MSC; the gap creates a deadweight loss.
- Coasean bargaining, Pigouvian taxes, and tradable permits internalize the external margin under different institutional conditions.
- Miguel & Kremer show that school deworming can benefit untreated nearby children through reduced disease transmission.
- Barrios-Fernández finds that a close neighbor's loan-induced university enrollment raises a potential applicant's enrollment locally; the RD/IV design and its assumptions define what can be concluded.

Before Session 15

- General equilibrium and market feedbacks
- Continue Problem Set 4 (self-study checkpoint: Session 18)