

Environmental and Development Economics

Week 1 - Introduction

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Introduce yourself

- ▶ First, lets do introductions
- ▶ Name, year, memorable summer activity, **research interests**
- ▶ Why are you taking this class?

Today

- ▶ Why study environmental economics in LMICs?
- ▶ Course overview + detailed outline
- ▶ Grade breakdown
- ▶ Course website: <https://github.com/rmadhok/enviro-dev-grad>
 - ▶ lectures, assignments, syllabus

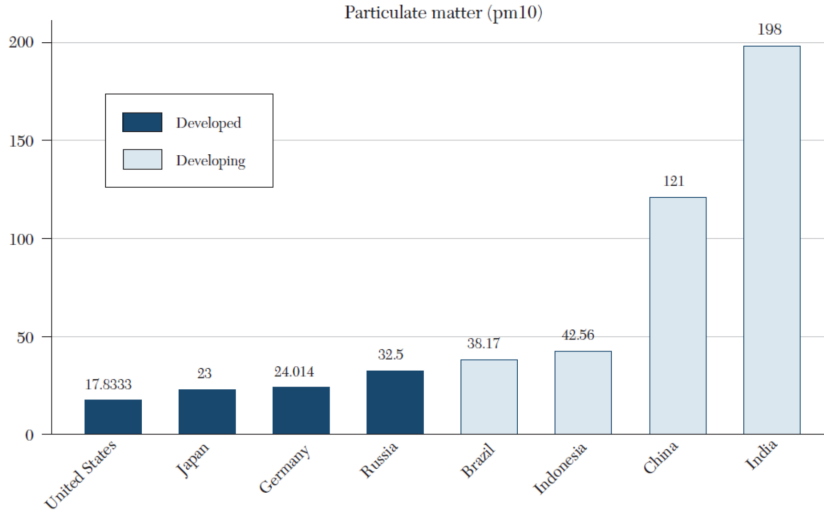
Why study environmental economics in LMICs?

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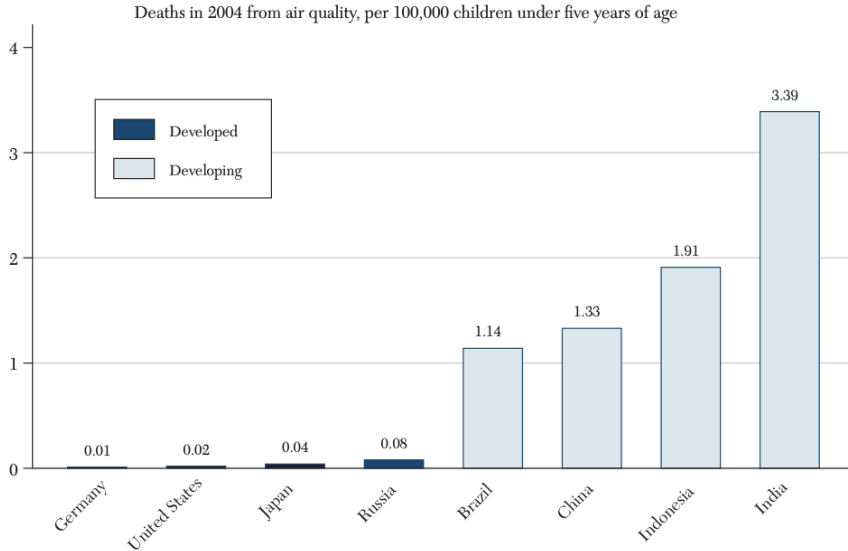
- ▶ Environmental quality is worse and has worse consequences in LMICs
 - ▶ Highest pollution, highest deforestation
- ▶ New field: room for applied theory, empirical innovation
- ▶ Data breakthroughs
 - ▶ Measurement: remote sensing, DHS, etc.
 - ▶ Access: lower barriers to government access and experimentation
- ▶ Evidence needed; big implications for poverty alleviation

Environmental quality worse in LMICs

Panel A. Air pollution



Disease burden higher in LMICs



Is environmental economics different in LMICs?

My answer: sometimes...

- ▶ Magnitudes
 - ▶ Same questions, but costs and benefits different
- ▶ **Local** environmental quality is more important
- ▶ Different topics
 - ▶ cookstoves, enforcement/corruption, ethnic favoritism
- ▶ Institutions and state capacity

Course Overview

Course Overview: There is no textbook

Instead, I am organizing around **FOUR** key questions:

- ① Why is environmental quality so bad in developing countries?
- ② What are the costs of poor environmental quality in developing countries?
- ③ Why is WTP for environmental quality low in developing countries?
- ④ What are the political economy barriers to environmental protection?

Course Approach

I will:

- ▶ Frame (almost) each topic with some theory
- ▶ Teach applied papers
 - ▶ research design, identification strategy, estimation techniques
- ▶ Emphasize recent JMPs

I will NOT:

- ▶ Teach econometrics
- ▶ Teach coding
- ▶ Teach every topic in environment/development

Course Goals

- ① Show you environment/development research frontier
- ② Inspire your thesis/JMP ideas
- ③ Advance your training as applied microeconomists
- ④ Show you what makes a top-tier research question

Course Structure

- ▶ This is a brand new class, so I give myself leeway to make changes
- ▶ You have the unique opportunity to determine direction of the course
 - ▶ Think about what topics do and don't interest you
 - ▶ And let me know!
- ▶ Please check the course website regularly for updates

Course Outline and Topics

Week 1: Theory of Environment/Development

- ▶ How to use theory to ask the right questions (lecture 2)

Week 2: The effect of development on the environment

- ▶ air quality, water quality (lecture 3)
- ▶ forests, biodiversity (lecture 4)

Week 3: The effect of the environment on development

- ▶ human capital (lecture 5)
- ▶ firms (lecture 6)

Week 4: WTP for Environmental Quality

- ▶ TBD (lecture 7)
- ▶ TBD (lecture 8)

Week 5: Environmental policy design

- ▶ Spillovers (lecture 9)
- ▶ Pollution markets in developing countries (lecture 10)

Week 6: Political economy of the environment

- ▶ Corruption and weak enforcement (lecture 11)
- ▶ Environmental justice (lecture 12)

Week 7: Research presentations

- ▶ I will provide more details throughout the semester

Grade Breakdown

Breakdown

In-class presentations	10%
Problem Set	20%
Research Proposal	60 %
Participation	10%

In-class presentations (10%)

- ▶ At start of **first** lecture each week, you'll give a 15 min paper presentation
- ▶ Each student submits **seven** summary slides (5% of grade)
 - ▶ motivation, research question, methods, results
 - ▶ 10 mins presentation + 5 mins Q&A (5% of grade)
- ▶ I will select presenter on-the-spot
 - ▶ **randomly** with replacement**

** If you are never chosen, your grade is based on slides.

Problem Set (20%)

- ▶ You will replicate an environment/development paper
 - ▶ You will also **extend** the results
- ▶ You will become familiar with coding in publication-quality papers
- ▶ You will use R or Stata

Research Proposal (60%)

Written Proposal	30%
Peer Review	20%
Proposal Presentation	10%

- ▶ You will develop a research proposal for an original idea
 - ▶ You are NOT expected to actually do the analysis
 - ▶ I will provide small deadlines (outline, first draft, etc.) along the way
- ▶ You will peer review each others proposals
- ▶ You will present the proposal at the end of the semester (30 mins)

Participation (10%)

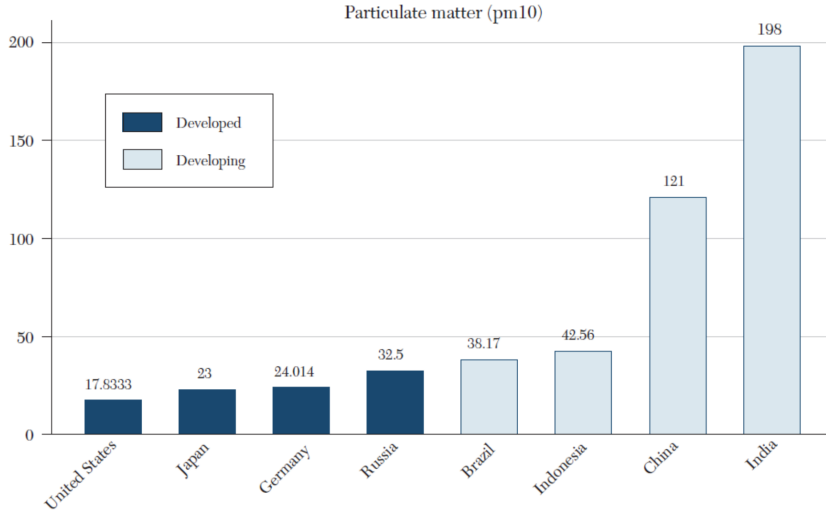
- ▶ I take this seriously
- ▶ Not enough to just show up to class
- ▶ Quality of questions/discussion count

Questions?

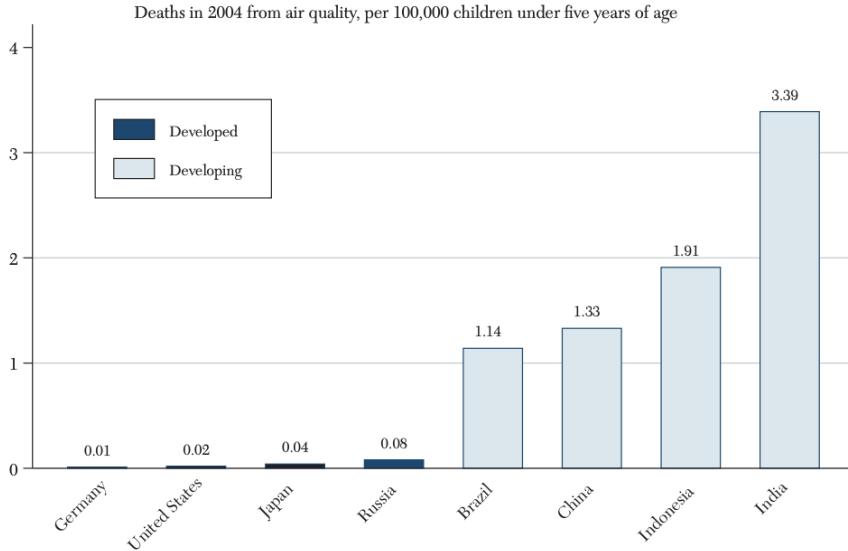
- ▶ **Guiding question:** Why is environmental quality so low in LMICs?
- ▶ Your explanations
- ▶ **Main goal:** Conceptual framework
 - ▶ Four *theory-informed explanations*
 - ▶ Set the stage for rest of class

Remember from last time

Panel A. Air pollution



Remember from last time



Why is environmental quality low in LMICs?

- ▶ MWTP is low (paradox)
 - ▶ Berkouwer and Dean (2022): \$12 for clean air
 - ▶ Kremer et al. (2013): ~ \$4 for clean water
 - ▶ Imply VSL \$USD 860 vs \$USD 8.6 million for USA
- ▶ Do we take this as given? Perhaps status quo is optimal
 - ▶ is bad environmental quality another dimension of poverty?
- ▶ Is welfare loss from pollution greater in rich countries, even though they're cleaner?
- ▶ **What are your explanations?**

Theory-informed Explanations

Greenstone and Jack (2013)

Aside: why is applied theory important?

- ▶ Builds structure for answering big (and small) questions
- ▶ Generates potentially unexpected insights w/ testable predictions
- ▶ In reverse: helps rationalize results
- ▶ Gets you into better journals (and better jobs)
- ▶ Field is headed that way (from my recent experience)

Conceptual Framework of Environmental and Development Economics

- ▶ Social planner chooses optimal EQ where social $MWTP_e = MC$
 - ▶ Need to know MWTP for representative agent

Set up:

- ▶ n identical agents with utility from consumption, EQ, and health
- ▶ Initial wealth y_0 , health h_0 , environmental equality e_0
- ▶ health depends on self-protection, s , and e
- ▶ Assume perfect markets (i.e. no externalities)

- ▶ Agent chooses c , Δe , and s to maximize:

$$U(e, h(s, e), c) \quad \text{s.t.} \quad y \geq c_e(\Delta e) + c_s(s) + c$$

- ▶ where wealth (endowment + income) and experienced EQ are:

$$y = y_0 + \Delta y(e, h(s, e))$$

$$e = e_0 + \Delta e + a(c, s)$$

- ▶ where $a(c, s)$ captures impact of c and s on EQ

Model Particulars

- ▶ EQ affects utility directly through existence value
- ▶ EQ affects utility indirectly via health (which also affects income)
 - ▶ e.g. pollution exposure affects productivity
 - ▶ This can be mitigated by self-protection, s (e.g. mask, air purifier)
- ▶ EQ affects income, which in turn affects utility via budget constraint
 - ▶ e.g. agricultural productivity
- ▶ Experienced EQ depends directly on Δe , and indirectly via c , s
 - ▶ $a(c, s)$: defensive investments i.e. clean cookstove, bottled water, etc.

MWTP for improving environmental quality

- ▶ Let $\lambda_e = \frac{\partial u}{\partial \Delta e}$, $\lambda_y = \frac{\partial u}{\partial c}$
- ▶ Set up lagrangian and solve for $MWTP_e$:

$$MWTP_e = \frac{\lambda_e}{\lambda_y} = \frac{1}{\lambda_y} \left(\frac{\partial u}{\partial e} + \frac{\partial u}{\partial h} \frac{\partial h}{\partial e} \right) + \frac{\partial \Delta y}{\partial e} + \frac{\partial \Delta y}{\partial h} \frac{\partial h}{\partial e}$$

- ▶ aesthetic benefit from improved EQ (converted to dollars)
- ▶ indirect benefit of EQ for health (converted to dollars)
- ▶ direct impact of EQ on income and indirect impact via health

Note: if $U''(c) < 0$, low $y \rightarrow$ high MUC (λ_y) and low $MWTP_e$

MWTP for self-protection

- Set up lagrangian and solve for $MWTP_s$

$$\begin{aligned} MWTP_s &= \frac{\lambda_s}{\lambda_y} \\ &= \frac{1}{\lambda_y} \left(\frac{\partial u}{\partial e} \frac{\partial a}{\partial s} + \frac{\partial u}{\partial h} \left(\frac{\partial h}{\partial s} + \frac{\partial h}{\partial e} \frac{\partial a}{\partial s} \right) \right) + \frac{\partial \Delta y}{\partial e} \frac{\partial a}{\partial s} + \frac{\partial \Delta y}{\partial h} \left(\frac{\partial h}{\partial s} + \frac{\partial h}{\partial e} \frac{\partial a}{\partial s} \right) \end{aligned}$$

- indirect effect of s on EQ and health (converted to dollars)
- indirect effect of s on income via productivity and health

Note: if $U''(c) < 0$, high $y \rightarrow$ low MUC (λ_y) and high $MWTP_s$

The Social Planner

- ▶ In first best, social planner sets $MB = MC$
 - ▶ where $MC_e = \frac{\partial c_e}{\partial \Delta e}$ and $MC_s = \frac{\partial c_s}{\partial \Delta s}$
- ▶ But to aggregate over n , we must assume:
 - ▶ No preferences of her own
 - ▶ No market failures
 - ▶ Can observe true MWTP
 - ▶ Anything else?
- ▶ Do these hold in LMICs?

Course Structure

- ▶ Set the stage:
 - ▶ how does environment affect development ($\frac{\partial h}{\partial e}$) (week 2)
 - ▶ how does development affect the environment (week 3)
- ▶ Bulk of course:
 - ▶ Explain why environmental quality low in LMICs
 - ▶ Identify as many parameters of the social planner problem as possible
- ▶ Goal: where can you make a contribution?

Why is environmental quality so low in LMICs?

Four explanations informed by the model:

- ① High marginal utility of consumption
- ② High marginal abatement costs – includes state capacity
- ③ Political economy distortions (first best violation)
- ④ Market failures (first best violation)
 - ▶ frictions cause revealed MWTP \neq true MWTP

Preview of Answers

1. High marginal utility of consumption

- ▶ Intuitively, poor people care more about meeting basic consumption needs
- ▶ Economically, agent trades off c and e by setting $u'(c) = u'(e)$
 - ▶ If $u''(c) < 0$, prefer c at lower levels of y
 - ▶ even if health benefits of e are large!
- ▶ **Very** few revealed preference studies on $MWTP_e$
 - ▶ Kremer et al. (2013) randomly clean up springs in Kenya
 - ▶ WTP USD 11/year for clean water; VSL of USD 860
- ▶ Larger literature on $u'(h)$ also suggests low valuation (Berkouwer and Dean, 2022)

2. High MC

- ▶ High MAC suggests sub-optimal environmental quality. Why?
 - ▶ Upward sloping MAC suggests low MC in poor countries
- ▶ MC not only driven by MAC; also reflects weak state capacity
 - ▶ Enforcement (Duflo et al., 2013)
 - ▶ Incentives (Jagnani and Mahadevan, 2024; Gulzaar and Dipoppa, 2024)
 - ▶ Spillovers (Viera et al. 2024)
- ▶ High MC **does not** mean deviation from first best

3. Political economy

- ▶ Social planner includes own utility weights social welfare function
 - ▶ i.e. corruption
- ▶ Many examples from LMICs
 - ▶ pollution (Duflo et al., 2013)
 - ▶ deforestation (Burgess et al., 2012; Viera et al., 2024)
 - ▶ human-wildlife conflict (Madhok et al., 2024)
- ▶ Leads to second best policy (inefficient)

4. Market Failures

- ▶ This is partially a course on development economics
 - ▶ About market failures: land, labor, credit, etc.
- ▶ Implication for us: revealed $MWTP_e \neq$ first best $MWTP_e$
- ▶ Example: weak property rights \rightarrow underinvestment in e
 - ▶ Underestimate $MWTP_e$ from observed data
 - ▶ RCT evidence from crop-burning PES contracts: Jack et al. (2024)

Lots of room for research

- ▶ Environment and development economics is new
 - ▶ Challenge: find something unique about LMICs
- ▶ Goal: identify model parameters
- ▶ Evidence on many parameters are absent
- ▶ Barriers to research in LMICs are falling
 - ▶ remote sensing, administrative/survey data, webscraping

- ▶ In-class presentations
- ▶ Impact of development on the environment (air, water)
- ▶ Impact of development on the environment (forests, biodiversity)