Environmental and Development Economics
Module 1 - Introduction

Raahil Madhok
UMN Applied Economics

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Introduce yourself

▶ First, lets do introductions

▶ Name, year, memorable summer activity, **research interests**

▶ Why are you taking this class?

Housekeeping

- **Class Time/Location:** Tues/Thurs 11:45am-1:25pm, Ruttan 119
  - Last class: Oct 17th

- **Office Hours:** Thursdays 1:30pm-2:30pm, Ruttan 337D

- **Course website:** https://github.com/rmadhok/enviro-dev-grad
  - lectures, assignments, syllabus
  - Try to skim reading(s) beforehand

- **Assignments**: Upload through Canvas

- Why study environmental economics in LMICs?

- Course overview + detailed outline

- Grade breakdown

- If time: conceptual framework for environment & development econ
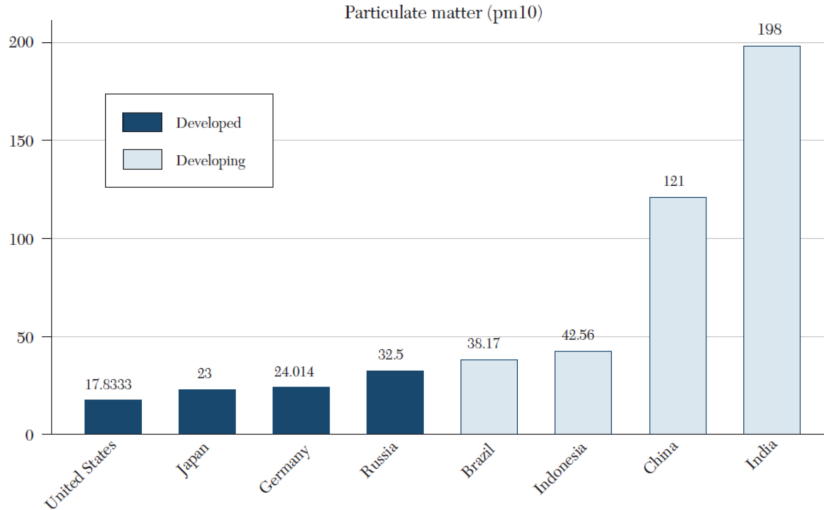
Why study environmental economics in LMICs?

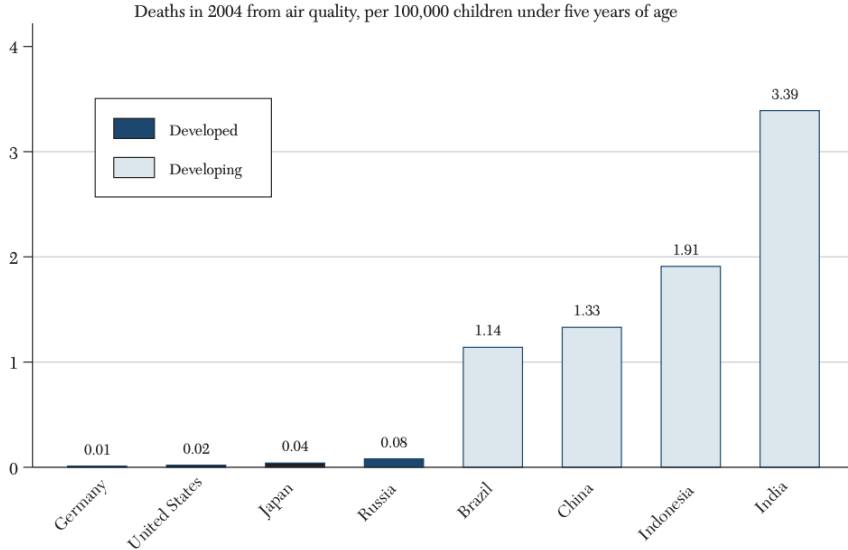# Why study environmental economics in LMICs?

- ▶ 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

Panel A. Air pollution

Particulate matter (pm10)

Disease burden higher in LMICs

Deaths in 2004 from air quality, per 100,000 children under five years of age

Legend:
- Developed
- Developing

Country	Value
Germany	0.01
United States	0.02
Japan	0.04
Russia	0.08
Brazil	1.14
China	1.33
Indonesia	1.91
India	3.39

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

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

1. How does economic development affect the environment, and vice versa?

2. Why is environmental quality so bad in developing countries?

3. What are the costs of poor environmental quality in developing countries?

4. Why is WTP for environmental quality low in developing countries?

5. 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
    - ► aim for two per class (please skim beforehand)

- ► Emphasize recent papers

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

Course Outline

Module 1: Introduction

▶ Lecture 1: Course intro + how to use theory to ask the right questions

Module 2: The effect of development on the environment

▶ Lecture 2: Income effects
▶ Lecture 3: Access to capital (technology and infrastructure)

Course Outline

Module 3: The effect of environment on development

▶ Lecture 4: Health
▶ Lecture 5: Productivity

Module 4: Why is WTP low in developing countries?

▶ Lecture 6: Revealed preference approaches
▶ Lecture 7: Incentive compatible approaches

Course Outline

Module 5: Environmental Policy Design

▶ Lecture 8: Monitoring, enforcement
▶ Lecture 9: Barriers to optimal design

Module 6: Political Economy of the Environment

▶ Lecture 10: Electoral cycles, corruption
▶ Lecture 11: State Capacity

Module 7: Research Proposal Presentations

- ▶ Lecture 12: TBD
- ▶ Lecture 13: Presentations
- ▶ Lecture 14: Presentations

Grade Breakdown

Breakdown

In-class presentations	10%
Replication Assignment	20%
Research Proposal	60 %
Participation	10%

In-class presentations (10%)

- ▶ I want you to become expert conference presenters after taking this class

- ▶ At start of **each** class, you'll give a 10 min paper presentation

  - ▶ The paper for presentation is on the syllabus

- ▶ Each student submits **10** 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
  - Many papers on the syllabus have replication files

- You will submit a write-up explaining what you did

- You will become familiar with coding in publication-quality papers

- You will use R or Stata

Research Proposal (60%)

Written Proposal	30%	Oct. 31
First Draft	pass/fail %	Oct. 3rd
Peer Review	20%	Oct. 10th
Proposal Presentation	10%	Oct 15/17

▶ You will develop a research proposal for an original idea

    ▶ You are NOT expected to actually do the analysis
    ▶ I will provide small deadlines (first draft, etc.) along the way

▶ Come to office hours to pitch your idea

▶ You will peer review each others proposals

▶ You will present the proposal at the end of the semester (30 mins)

- ▶ I take this seriously

- ▶ Not enough to just show up to class
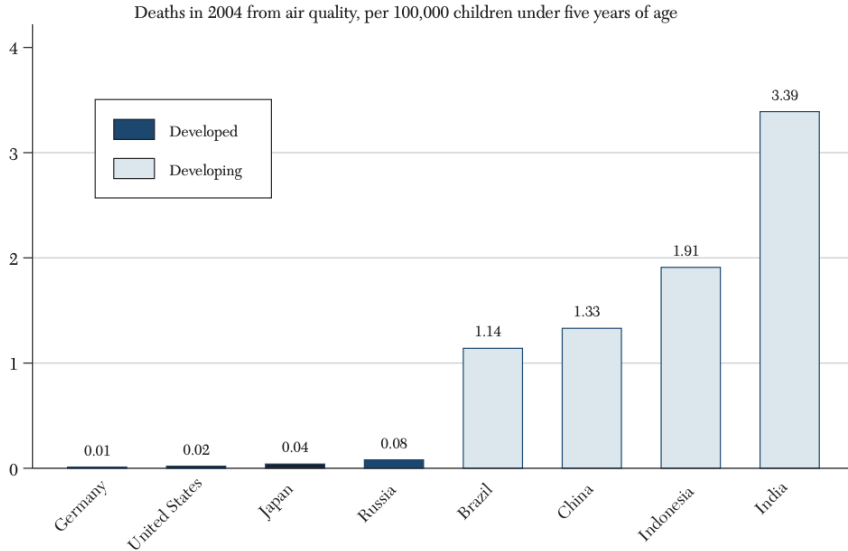
- ▶ Quality of questions/discussion count

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

Panel A. Air pollution

Particulate matter (pm10)
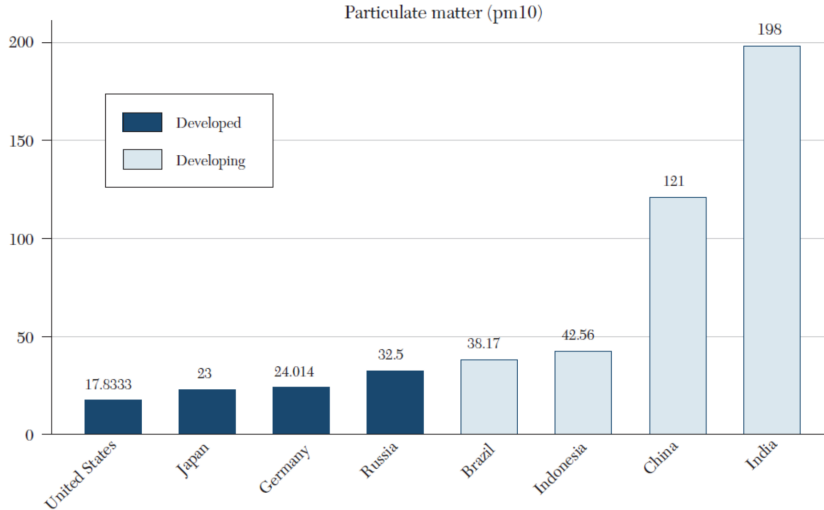
Deaths in 2004 from air quality, per 100,000 children under five years of age

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)

- 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 individual 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) to benchmark first-best

First Best

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

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

▶ 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 $y \to$ high MUC (λ_y) and low $MWTP_e$

MWTP for self-protection

- Set up lagrangian and solve for $MWTP_s$

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

- 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 $y \to$ low MUC (λ_y) and high $MWTP_s$

The Fist Best Outcome

▶ Agent sets ratio of marginal costs = ratio of marginal benefits

$$\frac{MWTP_e}{MWTP_s} = \frac{\frac{\partial c_e}{\partial \Delta e}}{\frac{\partial c_s}{\partial \Delta s}}$$

▶ For social planner to aggregate over n, we must assume:
  ▶ No preferences of her own
  ▶ Can observe true MWTP
  ▶ Anything else?

▶ Do these hold in LMICs?

Course Structure

- Set the stage:
  - how does environment affect development ($\frac{\partial h}{\partial e}$) (module 2)
  - how does development affect the environment (module 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?
  - E.g. Lots of work on $\frac{\partial h}{\partial e}$, but very little on $\frac{\partial \Delta y}{\partial e}$

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 couse 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, administrtive/survey data, webscraping

- ▶ In-class presentations

- ▶ Impact of economic development on the environment (income effects)

- ▶ Impact of development on the environment (forests, biodiversity)

Aside: Best Practice for Short Presentations

Best Practices: Structure

- ▶ You cannot present a paper in 10 minutes
  - ▶ Do not give detailed lit review or go into extreme detail

- ▶ Instead, you are giving a trailer for the movie
  - ▶ Convince the audience that they should read the paper

- ▶ Your goal is only to state why the paper is important, and what you did

- ▶ Convey paper's importance in first slide

Best Practices: Slides

- ▶ Motivation + broad research question (1 slide)

- ▶ Full paper overview (1 slide)

- ▶ Lit review (optional, 1 slide)

- ▶ Background (1 slide)

- ▶ Data (2 slides)

- ▶ Empirical Strategy (2 slides)

- ▶ Results (2 slides)

- ▶ Summary (1 slide)

Example of Preview Slide

- **Question:** How do firms react to tribal forest policy?

- **Idea:** Model aggregate economic response and changes in firm composition

- **Setting:** India Forest Rights Act (2008)
    - Imposes transaction cost on firms

- **Data:** Manufacturing census (2001-2015); Deforestation permits (2001-2021)

- **Empirical Strategy:** Diff-in-diff using policy shift in tribal and non-tribal district

Results Preview
1. decline in firm activity, 2) less forest encroachment by industry
2. larger, but less productive firms survive

Best Practices: Slide Format

- ▶ 1 minute per slide
- ▶ Avoid chart junk
- ▶ One line bullets
    - ▶ No need for full sentences
- ▶ Vary text slides and text + image slides
- ▶ Don't put too many equations
    - ▶ Save details for speaking, or talk "about'' equation
- ▶ Summarize findings again at the end

Best Practices: Presentation

- ▶ Speak clearly and loudly

- ▶ Speak slowly

- ▶ Look at audience; Do not show your back

- ▶ Do not stand in front of slides

- ▶ Avoid jargon

- ▶ Avoid pacing around room

- ▶ Stick to your time limit