# Environment and Development

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# What is Environmental Economics?

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- Environmental **Economics is the study of how to allocate scarce resources** between environmental protection and use.
- Why not have zero pollution? Why not conserve all land?
  - If society has limited resources to meet all its wants, then decisions have to be made to determine what and how much to produce and consume.
  - There are many alternative uses for our resources. We want to know how to make the best use of them.
- Economics helps us to understand:
  - The value of environmental quality,
  - The costs of environmental quality,
  - The welfare consequences of different policies to control environmental quality.

# Why I Spend my Time on Environmental Economics

- **Importance:** Our environment is critical to human flourishing.
- **Intra-disciplinary Scope:** Environmental economics touches on almost every field of economics:
  - economic theory, market design, econometrics, macroeconomics, political economy, international trade, growth and development, industrial organization, labor economics, public finance, urban economics ...
- **Cross-Disciplinary Engagement:** Environmental economics requires collaboration with many other disciplines:
  - atmospheric physics, climate science, biology, ecology, hydrology, geology, engineering, law, philosophy, political science, sociology, ...
- **Influence:** Environmental economics facilitates serious engagement with some of the most important issues we face as a society.

# Environment and Development: Two Major Global Challenges Collide

- Developing countries are where the tension between economic activity and the environment looms largest
  - Close to a billion people remain in extreme poverty and economic growth – including large increases in energy use – has historically played a major role in reducing poverty.
  - Per capita consumption is currently lowest in developing countries, but growth in energy consumption, forest, and marine degradation is higher.
  - Large share of the population depends on agriculture, forests, and fisheries
  - Most exposed to climate change and environmental degradation.
  - Gap between *de facto* and *de jure* institutions are more significant.
- How do we balance the imperative for continued growth with the need to mitigate and adapt to the externalities that growth creates?

# Is Environmental Economics applied to Developing countries any different?

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- Sometimes.
  - Magnitudes
  - Topics
  - Institutions and state capacity
- Policy design with context in mind is an important margin

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- No markets for environmental goods and services so can't rely on prices and revealed value.
  - Two approaches:
    - **Stated Preferences:** Contingent valuation and Choice Modeling (Carson, 2012) $\Rightarrow$ issues are quite clear, but only option for evaluating non-use values (Krutilla, 1967).
    - **Revealed Preferences:** Hedonic/capitalization (Rosen, (1974) and travel cost approaches (Clawson & Knetsch (1966))) $\Rightarrow$ precise, but incomplete.
  - Is some number better than no number?

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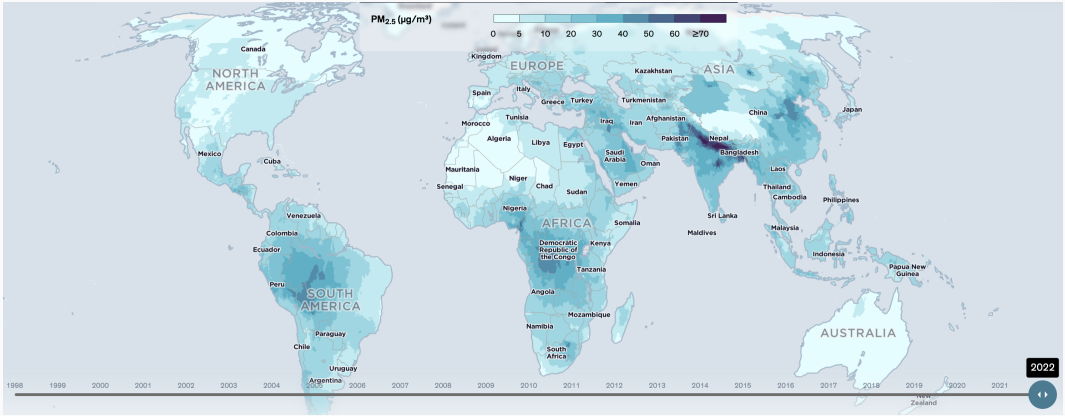
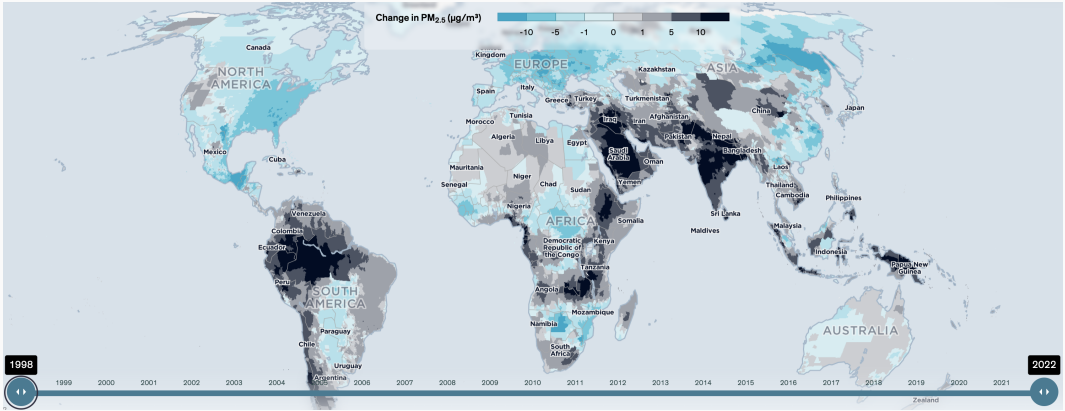
  - Is some number better than no number?
    - Eventually, someone will come up with a number.
    - That number ought to be generated as thoughtfully as possible.

# Air Pollution

# In 2022, 98% of the world population lived in areas that did not meet WHO guidelines for fine particulate pollution.

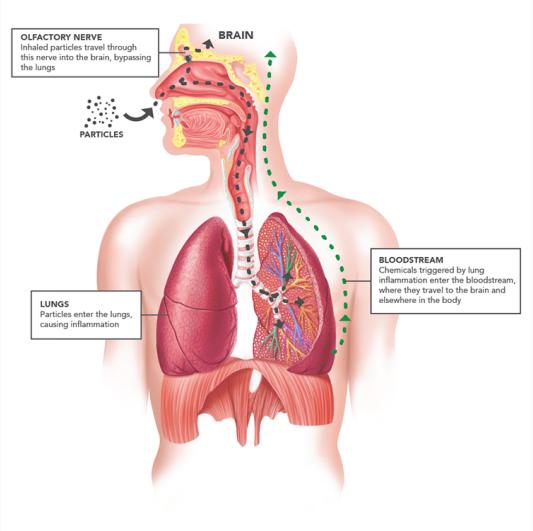


# Between 1998 and 2022, fine particulate pollution increased by 13% globally



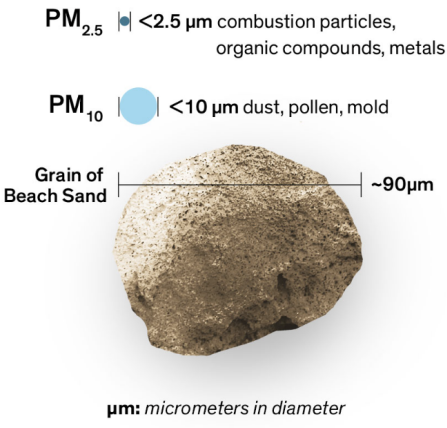
# What's the Big Deal?

- Primary consequence of inhaling air pollution is inflammation in the lungs:
  - Impedes exchange of carbon dioxide and oxygen, affecting cellular function throughout the body.
  - Chronic exposure leads to chronic inflammation.
  - Affects cardiovascular function and cognitive function as well as respiratory function.
- PM is attributed to as many as 9 million premature deaths each year.
  - 2x more than war, all other forms of violence, HIV/AIDS, tuberculosis, and Malaria combined.



# Evidence on Health Effects of Air Pollution

- Hundreds of studies across disciplines have shown health effects of air pollution
- Effects on life expectancy, cancer risk, cardiovascular disease, respiratory disease, neurological conditions, immune system disorders, etc.
- Empirical challenge: Identifying causal effects is challenging.
  - Sicker people (who are poorer) tend to live in polluted areas.
  - Are they sicker because of pollution?



# Pollution and Infant Health

- In the 1950s, epidemiologists believed that a fetus was a "perfect parasite" that was "afforded protection from nutritional damage that might be inflicted upon the mother" (Susser and Stein, 1994)

- The placenta was regarded as a "perfect filter, protecting the fetus from harmful substances in the mother's body and letting through helpful ones" (Landro, 2010)

  - Roughly half of U.S. mothers reported smoking in pregnancy in the 1960s (Aizer, Stroud, and Buka, 2009)

  - They were told it was fine.

# The "Fetal Origins" Hypothesis

- However, recent evidence suggests that the 9 months *in utero* are the most critical periods in a person's life, shaping future abilities and health trajectories.
- The intrauterine environment "programs" the fetus to have particular metabolic characteristics (Barker, 1990)
- The fetal origins hypothesis combines several key ideas:
  - The effects of fetal conditions are persistent
  - The health effects can remain latent for many years
  - There is a specific biological mechanism — epigenetics (Petronis, 2010)

# The Non-Health Effects of Air Pollution

- Much of the focus has been on health effects, but these are the tip of the ice berg.
- Many less visible "non-health" effects of pollution affect well-being.
- Even acute exposure to pollution has both immediate and persistent, long-run, effects on educational attainment, learning, decision-making, productivity, criminal behavior, labor force participation, and earnings.
  - Isen et al., (2017): "... a 10 percent decrease in TSPs in the year of birth is associated with a 1 percent increase in annual earnings at age 30."
  - Colmer and Voorheis (2021): "... first-generation individuals who experienced lower pollution exposure in the gestational environment are more likely to have children who end up attending college 40-50 years later."
  - Colmer, Voorheis, and Williams (2023): "... early life exposure pollution exposure is one of the top five predictors of upward mobility in the United States."

# Reasons for Continued Interest in the Fetal Origins Hypothesis

- The large effects, resulting from short exposure times, suggest that pareto improvements can be made by re-allocating resources from later to earlier in the life cycle.
    - The literature resonates with a core interest of economists: efficiency
    - However, it is far from obvious how this potentially high-return reallocation can best be achieved.
- The FOH is a surprisingly general phenomenon, affecting a wide range of outcomes.
- Mechanisms and policy implications are still not well understood,
    - Investments in pregnant women, children, and their environment may counter-balance forces leading to greater inequality.
    - What are the relevant policy levers?
- The Missing Middle.

# A Simple Model

# WTP: Utility and Budget Setup

- Consider a single-period static model with $n$ identical agents.

- Agents choose consumption $c$, improvements in environmental quality $\Delta e$ and self protection $s$ to maximize utility:

$$u(e, h(s, e), c)$$

subject to the budget constraint,

$$y \geq c_e(\Delta e) + c_s(s) + c$$

# WTP: Income and Experienced Environment

- total wealth and the agent's experienced environmental quality are defined by,

$$\begin{aligned} y &= y_0 + \Delta y(e, h(s, e)) \\ e &= e_0 + \Delta e + a(c, s) \end{aligned}$$

where the function $a(c, s)$ captures the impact of consumption and self protection on environmental quality as experienced by the agent, and $h(s, e)$, reflects the agent's health.

# MWTP for Environmental Quality

- The agent chooses $c$, $\Delta e$, and $s$ to equalize the MU of investments.

$$\begin{aligned} MWTP_e &\equiv \frac{\lambda_e}{\lambda_y} \\ &\equiv \frac{1}{\lambda_y}\left(\frac{\partial u}{\partial e} + \frac{\partial u}{\partial h}\frac{\partial h}{\partial e}\right) + \frac{\partial \Delta y}{\partial e} + \frac{\partial \Delta y}{\partial h}\frac{\partial h}{\partial e} \end{aligned}$$

- $\lambda_e$ captures the MU of environmental quality improvements
- $\lambda_y$ captures the MU of consumption.
- If utility is concave in consumption, low levels of income will correspond to high MU of income and low $MTWP_e$

# MWTP for Self-Protection

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

- If the MU of consumption is decreasing then $MWTP_s$ is higher at higher levels of consumption as long as any negative effects of self-protection on $e$ can be offset by compensatory investments in self-protection.

# Equating Marginal Costs and Benefits

- The marginal cost of improving environmental quality is $\frac{\partial c_e}{\partial \Delta e}$.
- The marginal cost of self protection is $\frac{\partial c_s}{\partial \Delta s}$.
- The representative agent will therefore set the MC of environmental quality improvements and self-protection equal to their respective MWTP, such that the ratios are equal to each other,

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

- With this set-up, individuals' decisions about $c$, $\Delta e$, and $s$ will produce the first-best outcomes.

# Willingness to Pay for Environmental Quality

- A high health burden from environmental quality in developing countries does not directly imply a high $MWTP_e$.

- Most papers describe $\frac{\partial h}{\partial e}$ or $\frac{\partial \Delta y}{\partial h}\frac{\partial h}{\partial e}$.

- However, the $\text{MWTP}_e$ associated with these changes is required to determine optimal policy.

# Willingness to Pay for Environmental Quality

- Few studies have attempted to develop revealed preference estimates of $MWTP_e$.
- Kremer et al. (2011) use an RCT to generate exogenous variation in water quality across springs in Kenya.
  - Investment reduced fecal contamination by 66 percent, which led to a reduction in diarrhea of 25 percent.
  - However, households are only willing to pay \$11 per year for clean water, where $MWTP_e$ is calculated from rural wage rates and revealed willingness to walk to clean water.
  - This translates into a revealed preference VSL of \$860 (Typical VSL numbers for the US are on the order of \$8.6 million).
  - Revealed $MWTP_e$ is substantially lower than the valuations given in a contingent valuation survey.

# Willingness to Pay for Self-Protection

- There is a larger literature that seeks to measure $\text{MWTP}_s$, under the assumption that market failures do not bias valuations.
  - Berry, Fischer, Guiteras (2018)
  - Ito and Zhang (2018)
  - Barwick et al. (2018)

Is the current level of environmental quality
in developing countries optimal?

# Possible Explanation 1: High MU of consumption

- Proposition: $MWTP_e$ is low because people in developing countries are poor.
- MU of consumption is high relative to the MU of environmental quality.
- This is captured in the comparative statics of the framework.
  - The agent trades off consumption and environmental quality
  - If the MU of consumption is decreasing then the agent will forego investments in environmental quality at low levels of consumption.
  - As the budget constraint is relaxed the value of an additional unit of consumption falls and the trade-off becomes less extreme.

# Possible Explanation 1: High MU of consumption

- Richer models provide related explanations:
  - If in a two-period model the probability of living to the second period is affected by $e$ then $MWTP_e$ increases in income (Hall and Jones, 2007).
  - For poor households that face myriad risks the MU of immediate consumption may be much higher

# Possible Explanation 1: High MU of consumption

- An ideal experiment would measure how $\text{MWTP}_e$ changes with an exogenous change to income.
- However, most experiments generate only short-run changes in income and it may be difficult to find a quasi-experimental design that credibly identifies permanent changes to income.
- There is very little evidence on the individual-level income $\text{MWTP}_e$ relationship.

# Possible Explanation 1: High MU of consumption

- Hanna and Oliva (2014) examine the fuel choices of households in India following the randomized roll out of a transfer program that had measurable effects on income and assets.
    - Energy use increases substantially, but does not become much cleaner.
- Ito and Zhang (2018) find that *MWTP* is increasing in income (correlational)
- Berry et al. (2018) find no correlation between MWTP and income.
- Colmer et al (2025) find that in the US windfall income has a small but persistent effect on pollution exposure.

# Possible Explanation 2: High Marginal Costs

- **Proposition:** It is more costly to improve environmental quality in developing countries.
- Intuition suggests that increasing MAC would imply lower marginal costs of environmental quality in settings with few existing regulations and high levels of pollution.
- However MC of environmental quality improvement may not only be driven by abatement costs.

# Possible Explanation 2: High Marginal Costs

- High MC may reflect local capacity for policy design and implementation.
  - In settings where capacity is weak, the MC of environmental quality improvements may be high even if MAC are relatively low.
  - Weak capacity in other policy domains may also increase the cost of environmental quality improvements.
  - Alternatively, low MC of self-protection may lead individuals or policy makers to prefer investments in self-protection.

# Possible Explanation 2: High Marginal Costs

- Empirical evidence on the magnitude of the marginal cost of environmental quality improvements is important for solving the social planner's problem.
- High MC is a sufficient explanation for why environmental quality is worse in developing countries.
- Many countries have tough environmental regulations, yet have trouble achieving their environmental goals, potentially because of the high costs of doing so.
- Poor policy design and implementation doesn't imply high MAC.

# Possible Explanation 2: High Marginal Costs

- Many environmental quality improvements are most cheaply achieved through aggregate investments.
- Taxation offers the practical means for aggregating individual contributions to environmental quality.
- However, a growing number of studies highlight the challenges of collecting taxes in developing countries (Besley and Persson, 2013)
- The social cost of investing in public goods is higher when raising revenues is difficult.
- Weak capacity for taxation will also interfere with efforts to implement market-based pollution regulations.

# Possible Explanation 2: High Marginal Costs

- A lack of scientific expertise, poor policy guidance, or low levels of accountability may result in poorly chosen policy objectives.

- Field, Glennerster, and Hussam (2011) demonstrate a striking example of this.

    - The paper also highlights the challenges of multiple environmental risks, and an inability of households or policymakers to accurately rank them.

# Possible Explanation 2: High Marginal Costs

- Unanticipated effects of environmental regulation also arise through agents' responses to policies:
  - Davis (2008)
    - Mexico City policy to restrict driving according to license plate number had no effect on pollution levels and increased the number of registered cars.
    - Cost to households are estimated at $300 million with no improvements in environmental quality.
  - Duflo et al. (2013)
    - In many regulated markets, private, third-party auditors are chosen and paid by the firms they audit.
    - Status quo audit reporting is corrupted as auditors systematically report plant pollution readings just below the regulatory standard.
    - Authors run an RCT where they randomly assign auditors to plants in Gujarat, India.
    - Treatment plants were 80% less likely to falsely report a pollution reading
    - Treatment plants reduced emissions, with reductions concentrated among plants with the highest readings.

# Possible Explanation 2: High Marginal Costs

- Poor targeting also increases the MC of environmental quality improvements.
  - Davis, Fuchs, and Gertler (2014)
  - Boomhower and Davis (2014)
  - Calel et al. (2025)

## Possible Explanation 3: Political Economy and Rent-Seeking Behavior (Supply-side failures)

- In a first-best world, poor environmental quality implies low $MWTP_e$ or high $MC_e$.
- However, in a world of political economy constraints, poor environmental quality may stem from a social planner who does not maximize social welfare.
- Political economy factors add an additional element to the SWF – the planner's own payoff or utility weights for their preferred group.
- In many cases, this will result in a downward bias on the optimal level of environmental quality, driving a wedge between aggregate preferences and the payoffs over which the social planner optimizes.

# Possible Explanation 3: Political Economy and Rent-Seeking Behavior

- Empirical studies on the effects of political economy considerations and rent-seeking behavior on environmental quality provide estimates of distortions.

- An emerging literature has explored the role that rent seeking plays as an explanation for poor environmental quality.

  - Oliva (2015) studies a pollution control policy in Mexico City and finds extensive corruption in the smog emissions testing program for private vehicles.

  - Structural estimates suggest that at least 9.6 percent of old-car owners paid bribes of around $20 to circumvent the regulations.

# China's War on Pollution

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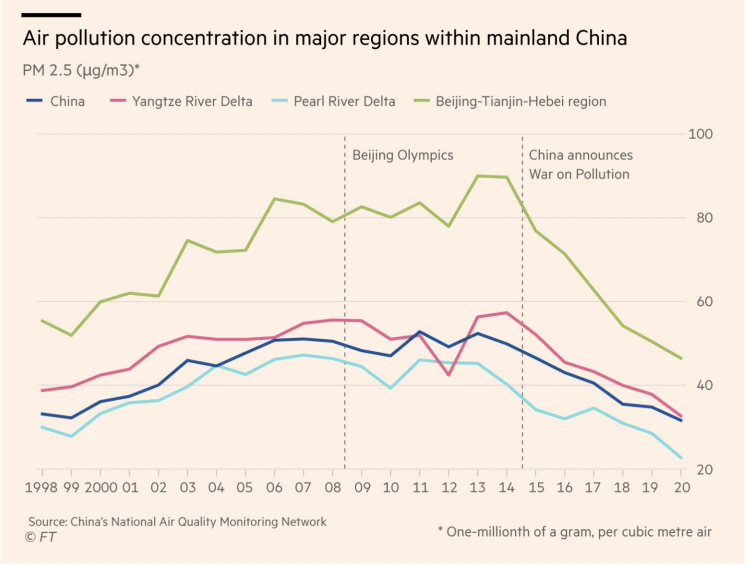


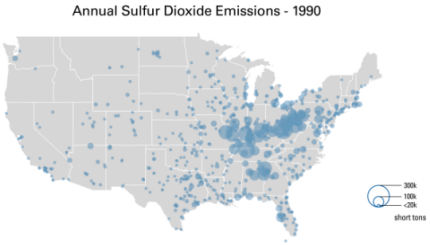
# Political Will

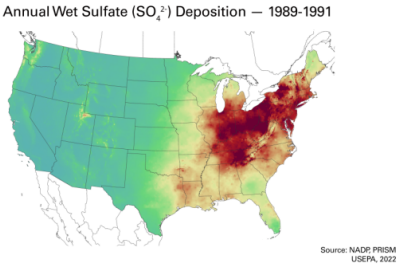
- Very few (if any) instances of meaningful improvements in environmental quality without strong political will.
- Nearly all successful cases preceded by consistent public demand.
- UK:
  - In 1306, King Edward I issued a ban on burning sea coal because it was "prejudicial to health", but was ignored by population despite threat of torture or hanging.
  - London Smog led to death of 4,000–12,000 people in one week in 1952, increasing public and political awareness $\Rightarrow$ Clean Air Act (1956)
- US:
  - Rachel Carson publishes "*Silent Spring*" (1962), 20 million demonstrate for Earth day (1970) $\Rightarrow$ Clean Air Act (1963), EPA created (1970).
- China:
  - US embassy tweets hourly pollution in Beijing (2008) $\rightarrow$ widespread public criticism in print and social media $\rightarrow$ China premier 'declares war' on pollution (2014).

# US Emissions Trading Schemes Have Been Successful

- Over the past four decades, the US has implemented a number of emissions trading programs
  - Lead Gasoline Phasedown (1980s)
  - Acid Rain SO2 Allowance Trading (1990s)
  - RECLAIM SO2 and NOx Markets (1990s)
  - Northeast NOx Trading (1990s)
- Flexibility of trading schemes yielded cost savings of as much as 50% and successfully achieved environmental goals.

# The Acid Rain Program showed the potential for market-based regulations to reduce pollution at low cost



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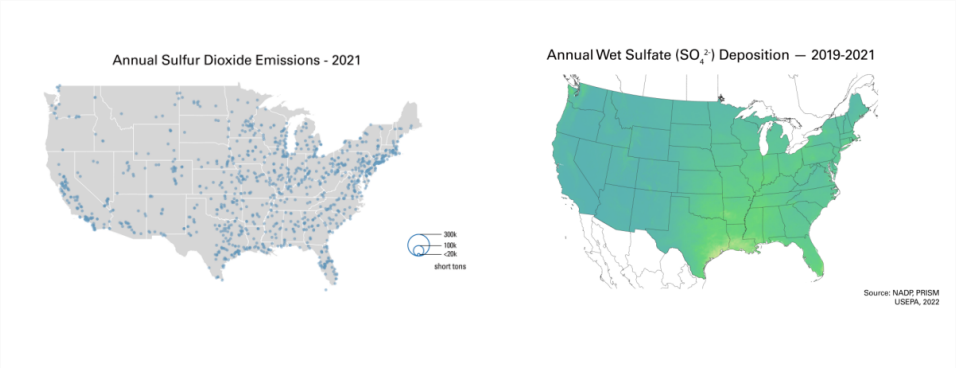


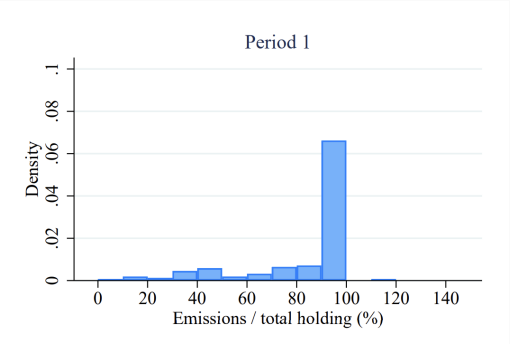
# Emissions Markets in India (Greenstone et al., 2023)

- Air Act of India (1981): Established Command Control Regime
- **Command:** Mandate for plants to install air pollution control devices (APCDs)
  - This is effective: every plant in sample had at least 1 piece of abatement equipment
- **Control:** Plants sanctioned if manually sampled emissions exceed specified concentrations limit (150 mg/$NM^3$)
  - This is ineffective: Significant non-compliance across sample
  - Financial sanctions largely unavailable, so sanctions generally involve shutting plants entirely.

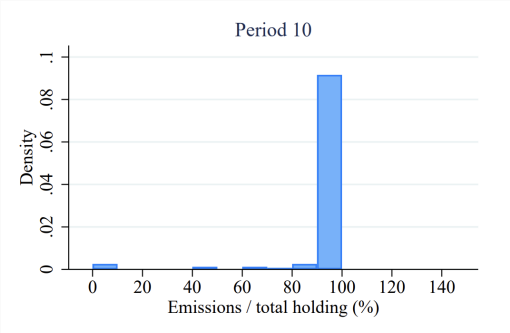
# Market Design Leveraging CEMS Devices

- **Cap** total pollution (PM2.5) from all plants
- **Allocate** 80% of permits given to plants, the remaining 20% auctioned by the regulator
- Plants **trade** at weekly auctions with uniform prices
- **Compliance:** Plants subject to a severe fine if they emit in excess of permit holdings

# Learning-by-Doing




Period 1




Period 10

- Permits unspent as a percentage of the period cap
  - Period 1: 12.5% (35 tons/280 tons)
  - Period 10: 2.8% (4.8 tons/170 tons)

# Markets Reduced Abatement Costs and Emissions

- Trading reduced emissions by 20-30% relative to control firms.
- At the market cap of 170 tons, total abatement costs within the trading market were 12% lower than under command and control.
- Expanding the ETS for one year to all industrial plants in Surat would result in a benefit-cost ratio of 215:1

# Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Market failures and behavioral biases and heuristics can cause measured $MWTP_e$ to diverge from true $MWTP_e$.
  - If all markets function well then the transformation of $y$ into environmental quality and self protection is frictionless.
  - However, information, credit, risk, or property rights imperfections may be reflected in measured $MWTP_e$.
  - Whether measured $MWTP_e$ is above or below the perfect-market $MWTP_e$ is theoretically ambiguous.

# Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Revealed preference measures of $MWTP_e$ rely on individuals knowing the payoffs from investments in environmental quality.
- The barriers associated with quantity and quality of information are likely higher in developing countries.
  - Misinformation may be more persistent because of limited liability rules around the provision of information, or because markets fail to convey incentives for accurate information producers.
  - Governments may fail to provide accurate information about $e$ and $h$.
  - Individuals may be illiterate or lack the education needed to understand the available information.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Jalan and Somanathan (2008) provide Delhi residents with information about the quality of their tap water and find a significant change in expenditures.
- Pattanayak et al. (2009) show that intensive information designed to generate social pressure as well as awareness increase latrine adoption in Orissa, India.
- Ashraf et al. (2013) offer an unfamiliar water purification solution at randomly varied prices to urban consumers in Zambia and observe that households are more price sensitive when they have more information about the product.
- Chowdhury et al. (2024) Households in Bangladesh hold inaccurate beliefs about indoor air pollution and the effectiveness of air purifiers. Correcting both beliefs is necessary to increase the adoption and use of air purifiers.

# Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- All of this relates to a large literature on the information and learning challenges associated with technology adoption.
  - A household that has never experienced clean water may not know the benefits of experimenting with technologies or behaviors that improve water quality
  - To the extent that peers and neighbors offer transferable information through their own actions, social learning is more likely to occur (Foster and Rosenzweig, 1995; Conley and Udry, 2010)
  - A trusted government agency may be able to help overcome information failures
    - However, individuals may not trust official information sources – in some cases for good reason.

# Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Credit market failures stem from a difficulty in writing and enforcing contracts
    - In settings with credit market frictions individuals may not be able to pay upfront for investments that generate future improvements in environmental quality.
    - If environmental quality investments require upfront payments and future payoffs, the income and other determinants of liquidity will confound measured $MWTP_e$

# Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Guiteras et al. (2014) randomly introduce different types of credit for water purification filters in Bangladesh and document a positive relationship between measured WTP and credit availability.

- Highlights clear distortion to revealed preference measures of $\text{MWTP}_e$ in settings with missing credit markets.

- However, credit constraints may inhibit environmental damage.

- Assuncao et al. (2016) show that a restriction on credit in Brazil lowered deforestation rates, likely by decreasing land-intensive livestock investments.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Missing risk markets can lower individual willingness to invest in environmental quality improvements if the payoffs are uncertain and insurance is not available.

- Missing insurance markets exacerbate exposure and reduce measured $MWTP_e$

- If an agent faces multiple environmental or health risks then measured $MWTP_e$ to improve one dimension may be affected by the endowment of $e$ on another dimension.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- If there are weak property rights then this may lower investments in environmental quality because agents are uncertain about their ability to retain the benefits.
- Incomplete property rights introduce frictions into the relationship between $e$ and $y$.
- Private bargaining solutions are unlikely to arise (Coase, 1960)
- Revealed preference measures of $MWTP_e$ will be biased downward because of weak property rights, relative to settings with strong property rights.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- There has been limited empirical work on property rights and environmental quality.
- Ali, Deininger, and Goldstein (2014) use a spatial RDD to measure the impacts of a land titling program on a number of outcomes, including investments in soil fertility.
- They show that more secure land titles increased investments in environmental quality

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- Numerous behavioral and cognitive biases may affect revealed preference measures of $MWTP_e$
- Behavioral biases are most likely to affect decision making when the decisions are infrequent, outcomes are probabilistic, and consequences are in the future.
- In developing countries, market failures undermine the feedback that helps individuals learn from their previous decisions and exacerbate standard behavioral biases (Bertrand, Mullainathan, and Shafir, 2004)
- Unlike developed countries where air, water, and food are governed by regulations to ensure quality, residents of developing countries must continuously take action to minimize exposure.
    - Repeated decision making can deplete cognitive energy.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- There is a sizable literature in development on MWTP for health investments (Dupas, 2011) that highlights the role of behavioral biases.
- There is little examination within the context of $\text{MWTP}_e$
- Behavioral biases and psychological factors offer a promising direction for future research.

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- So far we have ignored spillovers across agents.
- While a useful benchmark this is implausible as decisions that affect the environment involve externalities and public goods.
- To allow for the possibility of externalities, let aggregate environmental quality be given by

$$e = e_0 + \sum_{i=1}^{n} (\Delta e_i + a(c_i, s_i))$$

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- SMWTP for environmental quality accounts for externalities and public goods so it reflects the first-best allocation and is given by,

$$\begin{aligned} SMWTP_e &\equiv \frac{n}{\lambda_y^{SP}}\left(\frac{\partial u}{\partial e}+\frac{\partial u}{\partial h}\frac{\partial h}{\partial e}\right) \\ &\quad +n\frac{\partial \Delta y}{\partial e}+n\frac{\partial \Delta y}{\partial h}\frac{\partial h}{\partial e} \end{aligned}$$

## Possible Explanation 4: Measured $MWTP_e \neq$ True $MWTP_e$

- $SMWTP_e > MWTP_e$ if environmental quality investments create public goods of positive externalities, or if consumption generates negative externalities.
- $SMWTP_s$ will diverge from $MWTP_s$ if self-protection generates externalities or provides public goods.
- Generally, we don't expect the public good nature of environmental quality to differ across developed and developing countries.
- However, externalities may be exacerbated by, and interact with, other market failures that are more prevalent in developing country settings.

# Directions for Research

- Most regulation/policy is second-best (or third-best, or fourth-best...):
  - What are the constraints?
  - What are the benefits and costs of the actual regulations?
  - What is the efficiency loss?
  - What are the feasible gains from reform?
  - What are the equilibrium consequences of regulations?
  - What are the distributional consequences?
- Frontier research has several common features:
  - Clear institutional understanding of a generally relevant problem
  - Data that is novel or exceptional in coverage or depth
  - Policy, quasi-experimental, or experimental variation to estimate key parameters or validate model predictions

# Environment and Development

- Research is taking off in this area. Why?
  - Growing recognition and understanding of the problem (arbitrage opportunities)
  - Advances in modeling individual and firm behavior open the door to the estimation of parameters with a clear economic interpretation
    - the best empirical work will contribute to the identification of relevant parameters in the social planner's maximization problem.
    - However, most estimates reflect partial MWTP. Still, good to have a target!

# Environment and Development

- Research is taking off in this area. Why?
  - Advances in measurement through remote sensing allows researchers to bypass local data collection obstacles.
  - Advances in quasi-experimental and experimental methods
    - Experiments cannot answer many important questions, yet they can serve as a complement to other methods that may be better suited to understanding more aggregate problems.

# Discussion

- The intersection of environmental and development economics offers a wealth of questions that are of interest to economists and policymakers.

- Many of these questions are poorly understood.

- Finding reliable answers to these questions will advance economic understanding and inform policy, with the potential to enormously influence human well-being.