EEE Summer School
Development Economics

Susanna Berkouwer
(they/them)

The Wharton School, University of Pennsylvania

August 17, 2023

Goals for today

- Intro to EEE & development
- Identifying research designs
- What is good research?

Where did I learn this?

Welcome to the Berkeley/Sloan Summer School!

Inbox ×

Maximilian Auffhammer <... Thu, Jun 8, 2017, 12:50 AM

to Susanna, knotsund

Dear Susanna:

I am excited to let you know that you have been admitted to the 2017 Berkeley/Sloan Summer School in Energy and Environmental Economics! I

Most DEV dishes *(=papers)* have several flavors

(Non-exhaustive)

- **Financial constraints:** credit, savings, commitment
- **Technology adoption:** learning, networks, risk
- **Agriculture:** yields, markets, storage, productivity
- **Healthcare:** staff incentives, information, social signaling
- **Politics:** elections, regulatory structures, incentives
- **Industry:** management, labor supply, productivity

Good dishes have multiple ingredients!
DEV is usually combined with other fields:

- **Applied econometrics:** e.g. Instrumental Variables, Difference-in-Differences, Randomized Controlled Trial, Regression Discontinuity (sometimes spatial); natural/quasi-random variation
- **Labor:** e.g. wages, management, incentives, productivity
- **IO:** e.g. regulation of agricultural markets
- **Public:** e.g. weak tax enforcement or collection
- **Political economy:** e.g. politics of groundwater allocation, power outages, grid expansion, bill (non-)payment, enforcement

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- **Environment**
- **Energy**

The best recipes use chemistry **fundamentals** *(=theory)*:

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- Coasean bargaining: any allocation of property rights ('cap') together with an efficient market ('trade') will yield efficient allocation of abatement
  (≈ second welfare theorem)

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- Efficiency vs equity
  → Distributional consequences
- Tragedy of the commons: common resources

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What defines "development"?

The best recipes use chemistry **fundamentals** *(=theory)*:

What defines "development"?

Maximizing welfare subject to unique constraints:

- Weak legal institutions
- Weak political institutions
- Weak financial markets

Research tips for budding ~~chefs~~ researchers

- A paper can have multiple flavors, but in the end it is just one dish. Study one topic. Too many flavors makes for a bad dish.

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- Ask specific questions, give specific answers. Choose your flavors wisely.

Research tips for budding ~~chefs~~ researchers

- A paper can have multiple flavors, but in the end it is just one dish. Study one topic. Too many flavors makes for a bad dish.
- Ask specific questions, give specific answers. Choose your flavors wisely.
- The best recipes are both science and art.

"Envirodevonomics" Michael Greenstone & B. Kelsey Jack (JEL, 2015)

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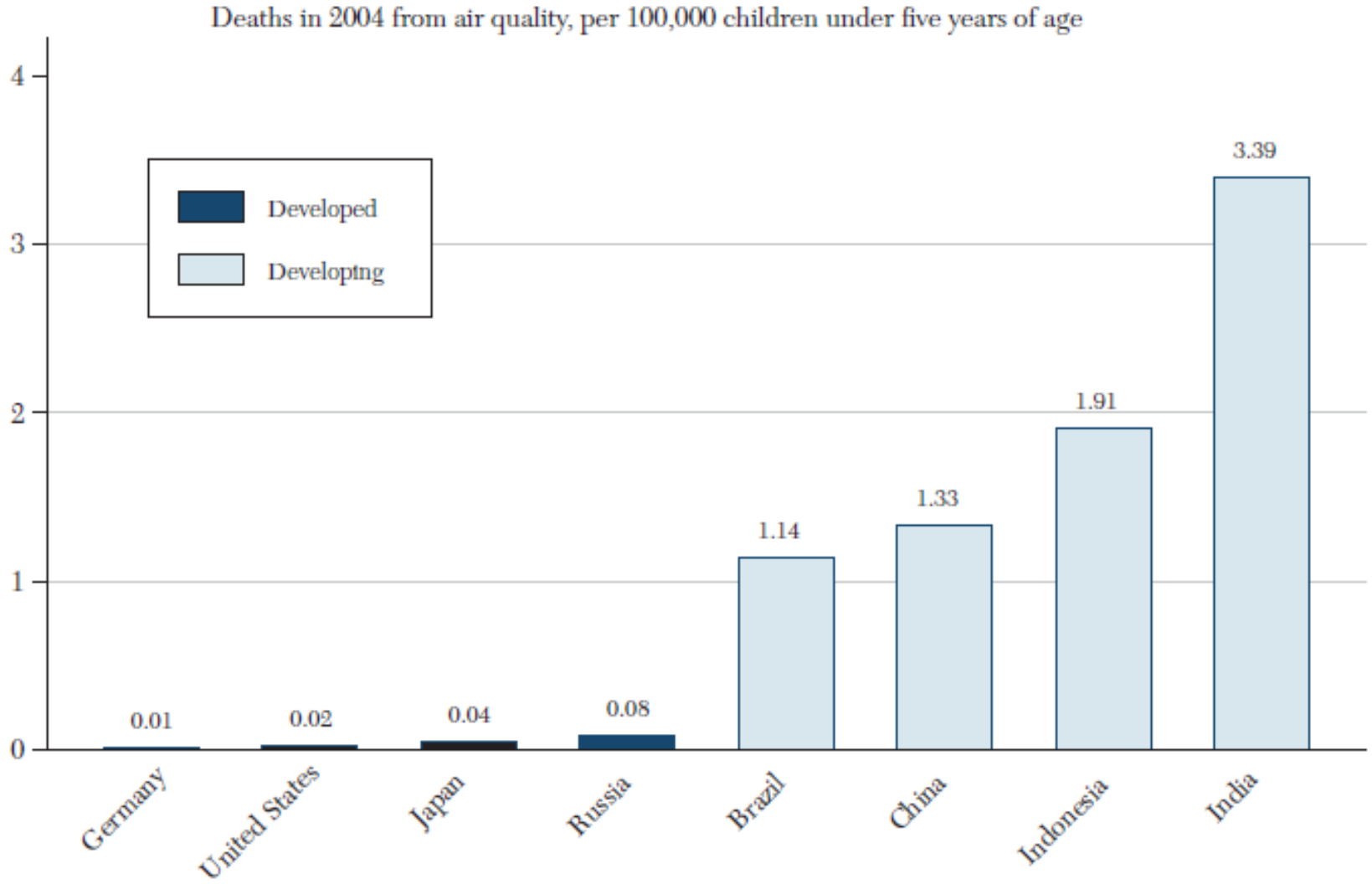
Developing countries have worse environmental quality on average:



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Developing countries have higher air pollution on average

Why?

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Why?

1. High Marginal Utility of Consumption
2. High Marginal Costs
3. Political Economy and Rent-Seeking Behavior
4. Market Failures and Behavioral Biases

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Are all of these *inefficiencies*?

Today: Development economics

Introduction

Impacts (Greenstone and Hanna; AER 2014)

Household decision-making (Berkouwer and Dean; AER 2022)

Break

Political economy and regulation (He, Wang, and Zhang; QJE 2020)

Infrastructure (McRae; AER 2015)

Future directions of research

Today: Development economics

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Future directions of research

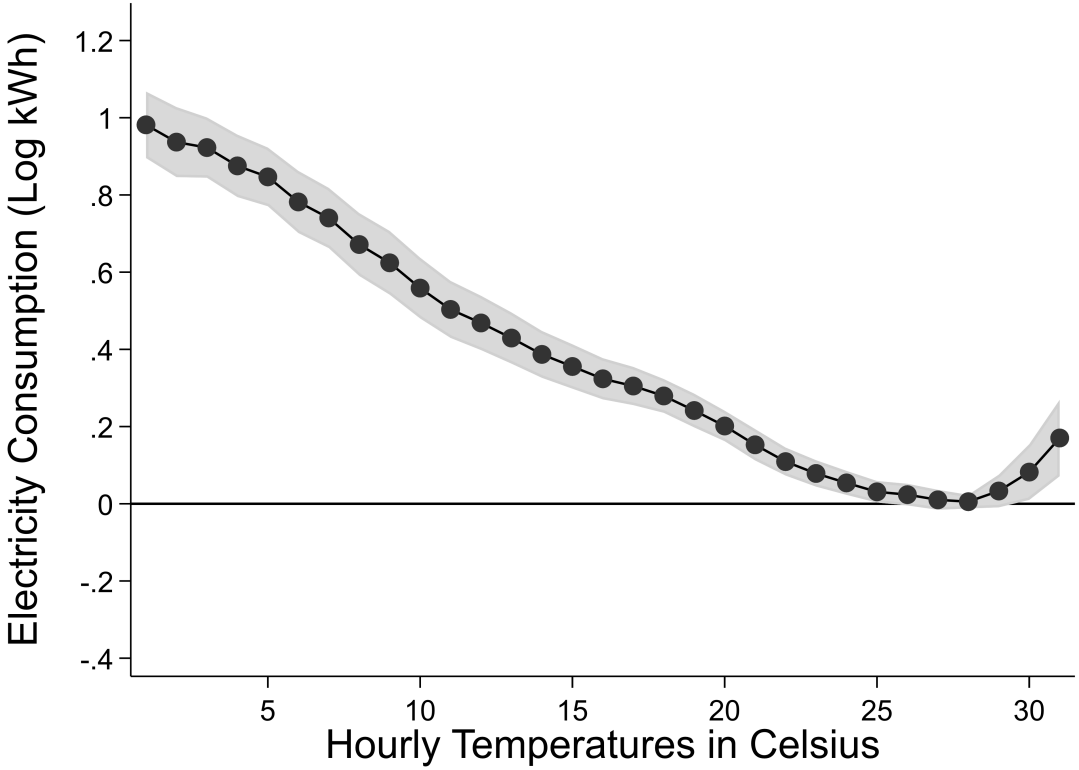
Impacts: Research questions

What is the impact of X on Y?

Impacts: Research questions

What is the impact of Temperature on Y?

(I am guilty of this too!)



Berkouwer (2020, Energy Journal)

Impacts: Research questions

1. What are the impacts of air and water pollution?
   - **Goal:** primarily estimate impacts on health and mortality
   - Instrumental Variables (wind, airline delays)
   - Regression discontinuity design (e.g. law/rule thresholds)
   - **Source:** Energy (eg. coal plants, cookstoves), non-energy (manufacturing)

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   - **Challenge:** Adaptation
2. Impacts of floods, droughts, hurricanes
3. Impact of using a new technology
4. Impact of a regulation
5. Impact of an investment

Michael Greenstone & Rema Hanna (AER 2014)

"Environmental Regulations, Air and Water Pollution, and Infant Mortality in India"

Michael Greenstone & Rema Hanna (AER 2014)

- **Specific research questions:**
  - How do demands for environmental quality by Indian press affect policies?
  - How do 3 key policies (Supreme Court Action Plans; Catalytic Converter policies; National River Conservation Plan) affect water pollution (BOD, DO, FColi), air pollution (NO_2, SO_2, and PM), and infant mortality?

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- **Research strategy:** diff-in-differences, city+time FE, τ=0 is policy start:

$$Y_{ct} = \alpha + \sum_{\tau} \sigma_{\tau} D_{\tau,ct} + \mu_t + \gamma_c + \beta X_{ct} + \epsilon_{ct}$$

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Concerns? What would you do differently?

Water pollution? Kind of a noisy mess:

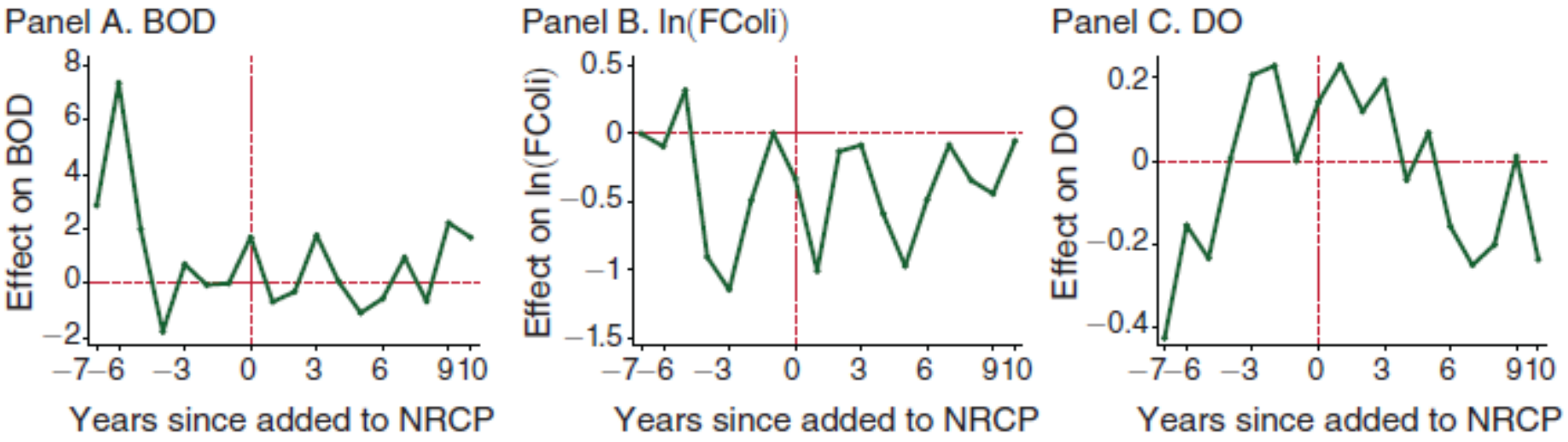
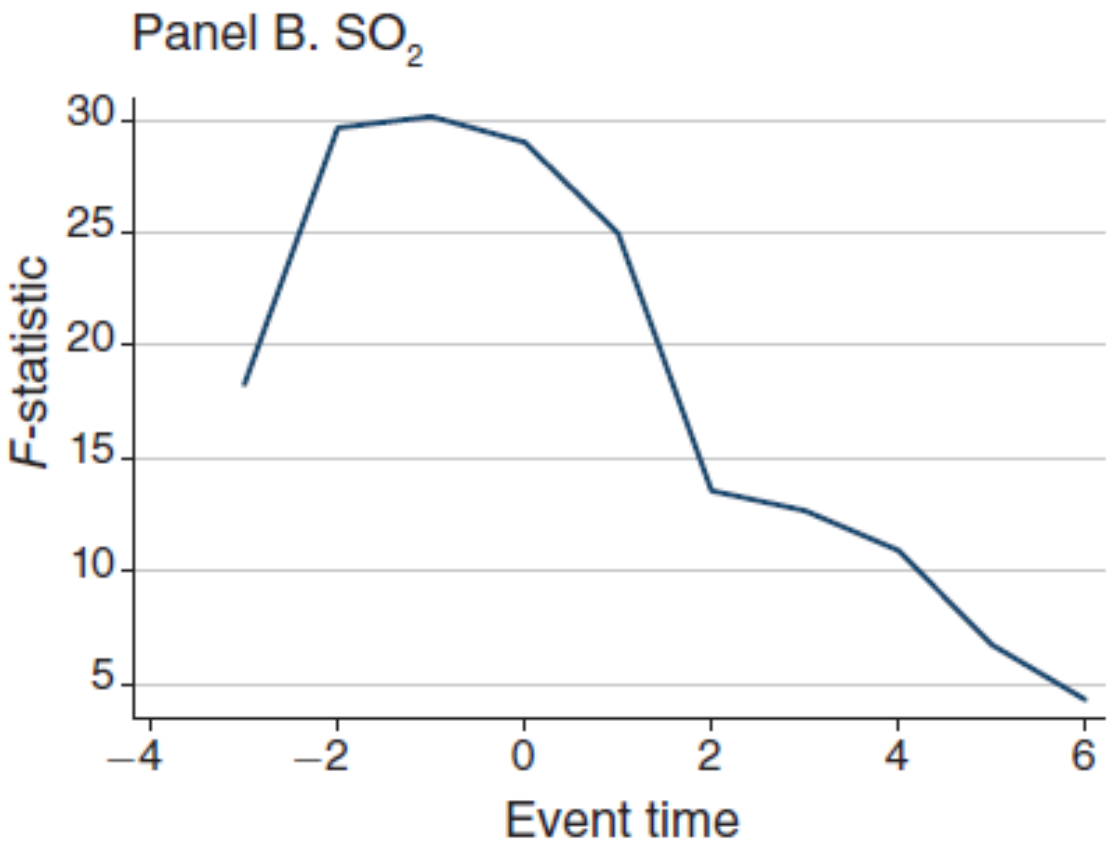


Figure 6. Event Study of Water Pollution Policy

Notes: The figures provide a graphical analysis of the effect of the NRCP policy on water pollution. The figures plot the estimated σ_τs against the τs from the estimation of equation (1). See the text for further details.

Air pollution? Maybe something there!



Infant mortality seems to have declined:

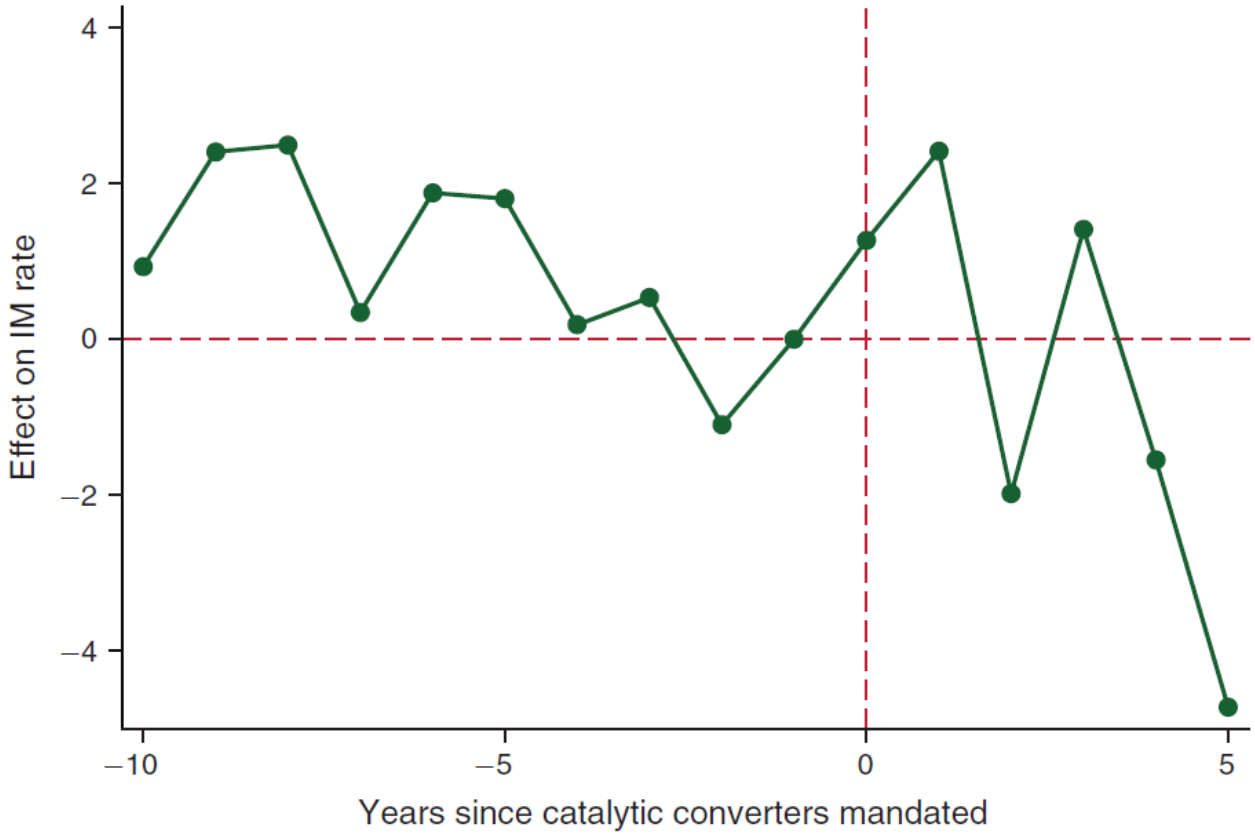


Figure 8. Event Study of Catalytic Converters and Infant Mortality

Notes: The figure provides a graphical analysis of the effect of the catalytic converter policy on the infant mortality rate. The figure plots the estimated σ_τs against the τs from the estimation of equation (1). See the text for further details.

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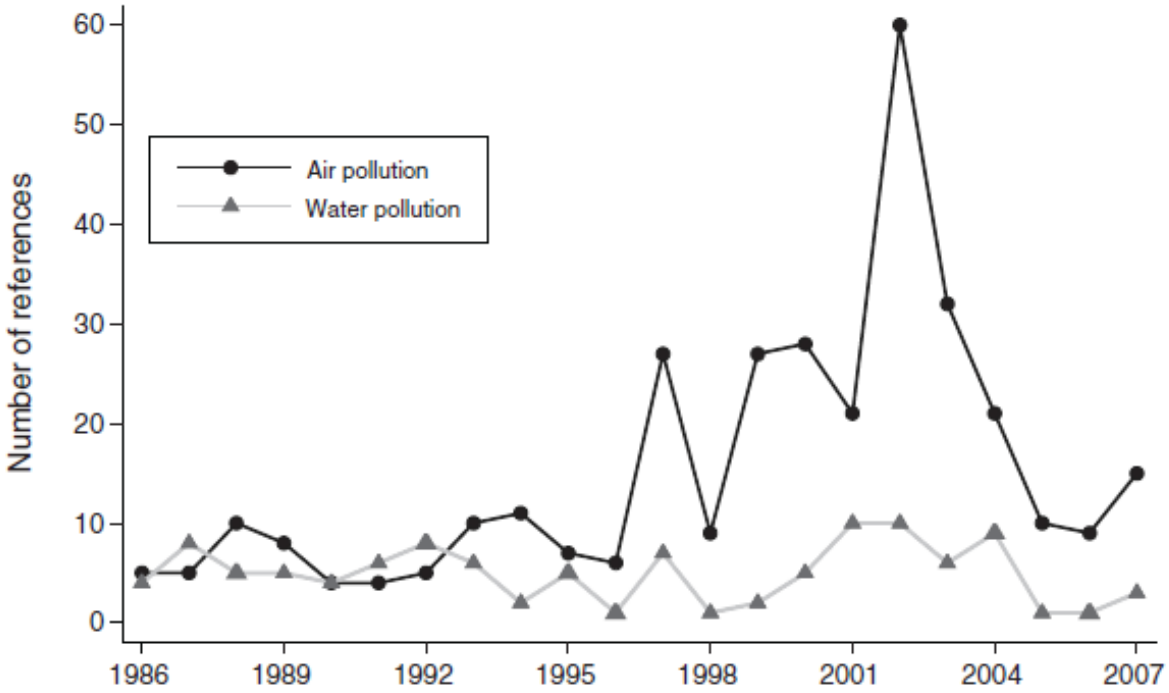

Figure 9. Total Nationwide References to Air and Water Pollution in *Times of India*, 1986–2007

Source: Author compilation from the *Times of India*.

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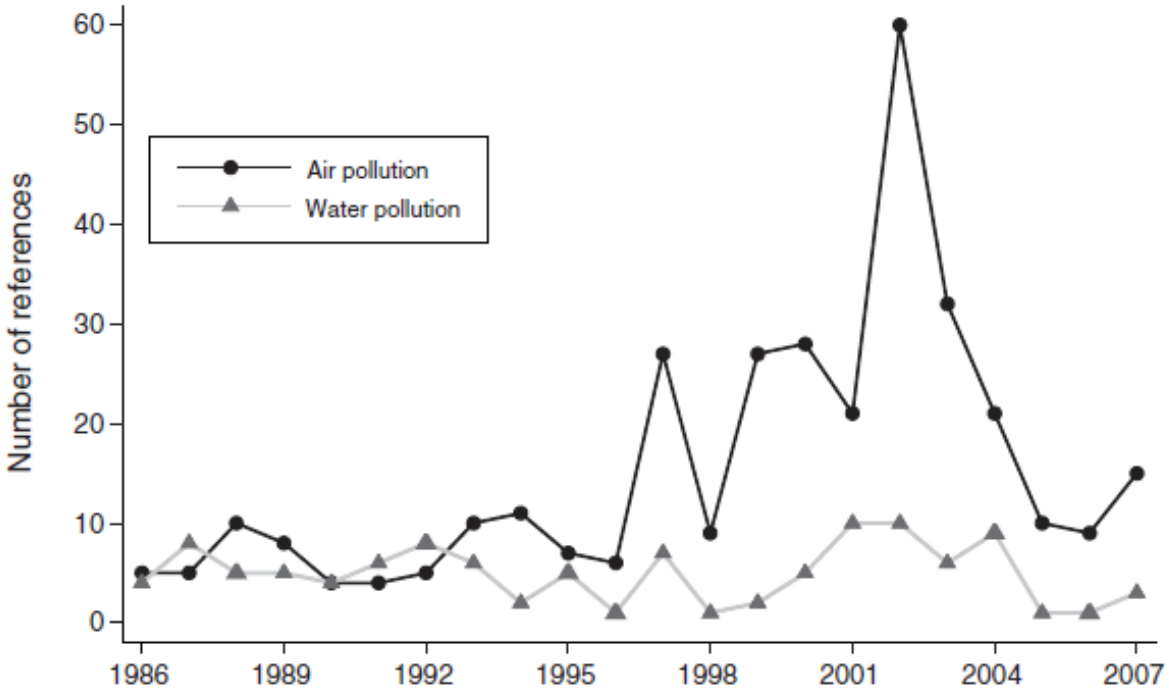

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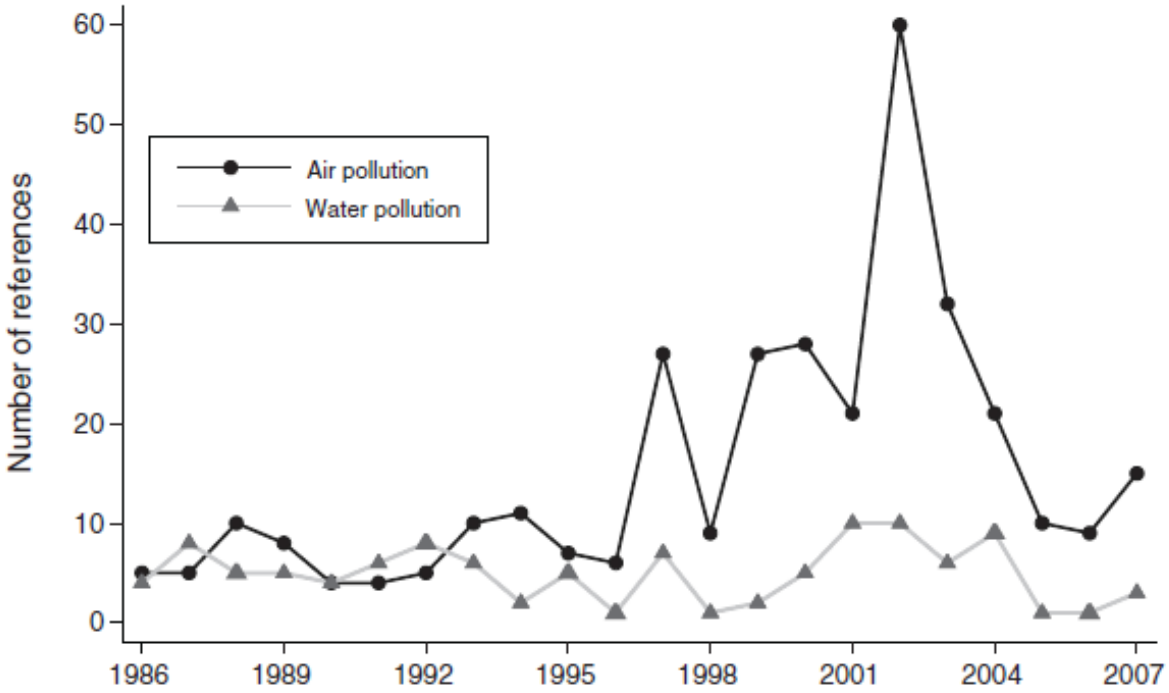

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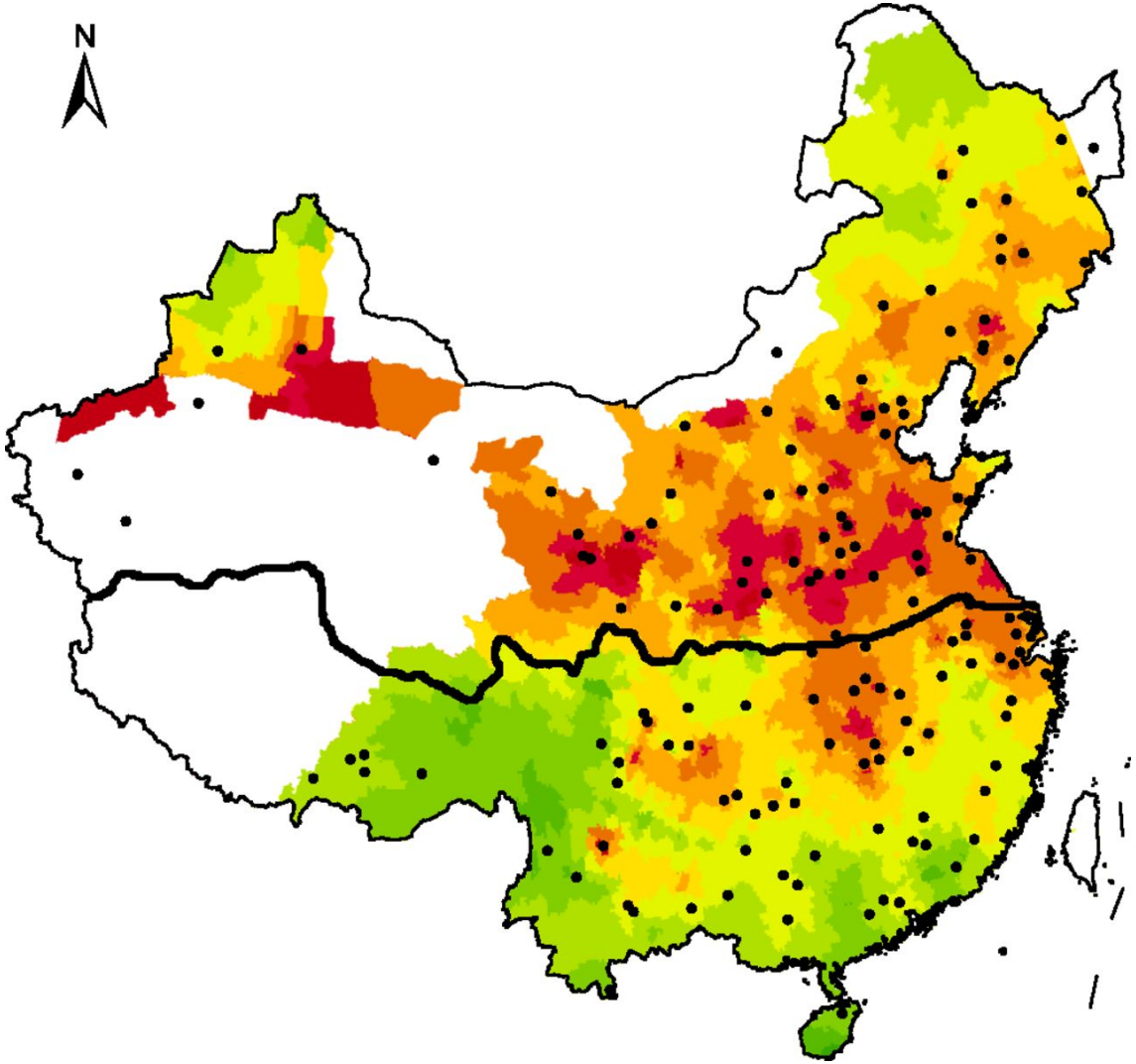
- Is this pre-post comparison realistic?

Finding natural random variation is hard!



Huai River Policy

Yuyu Chen, Avraham Ebenstein, Michael Greenstone, Hongbin Li (PNAS, 2013)

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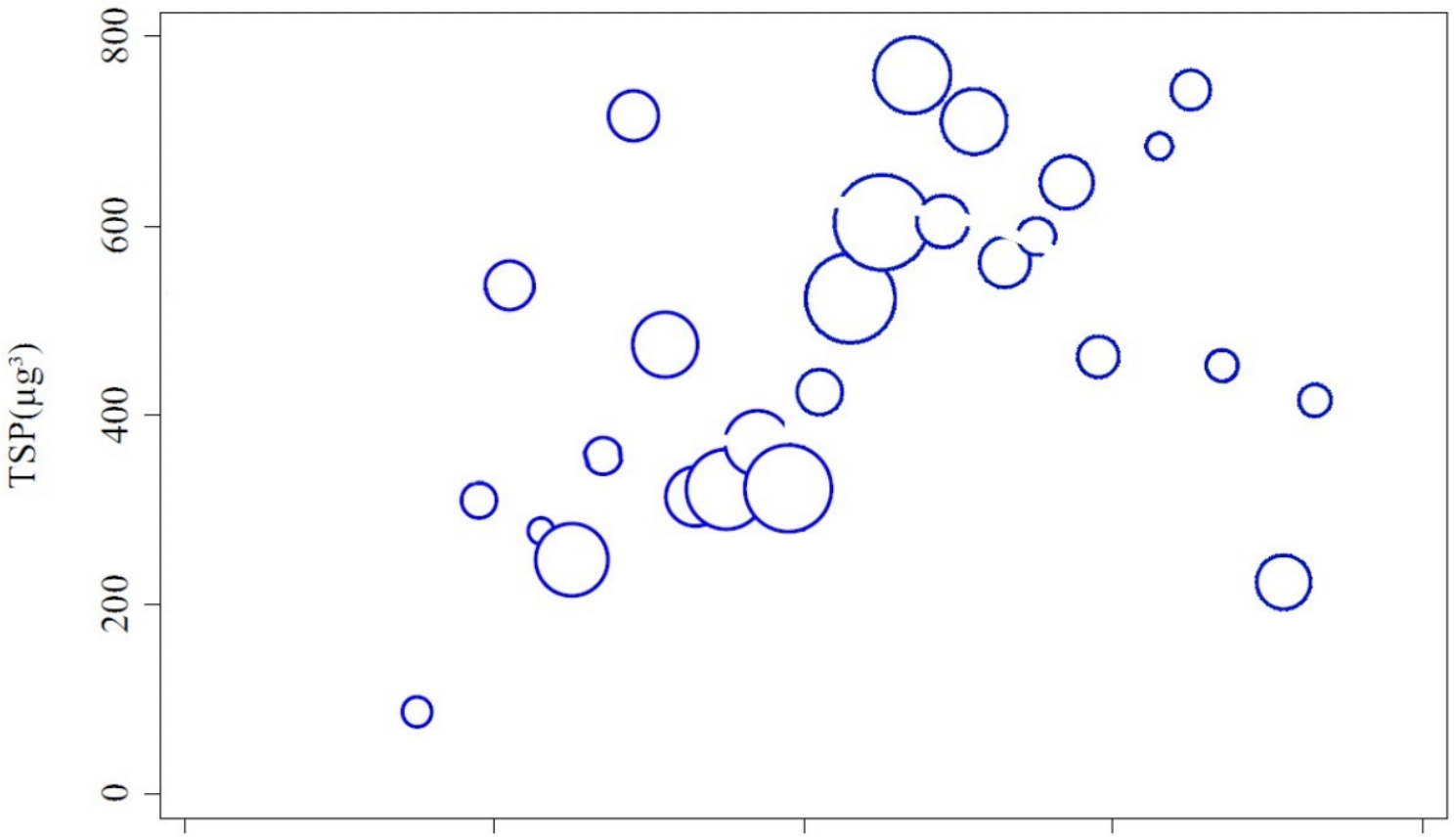

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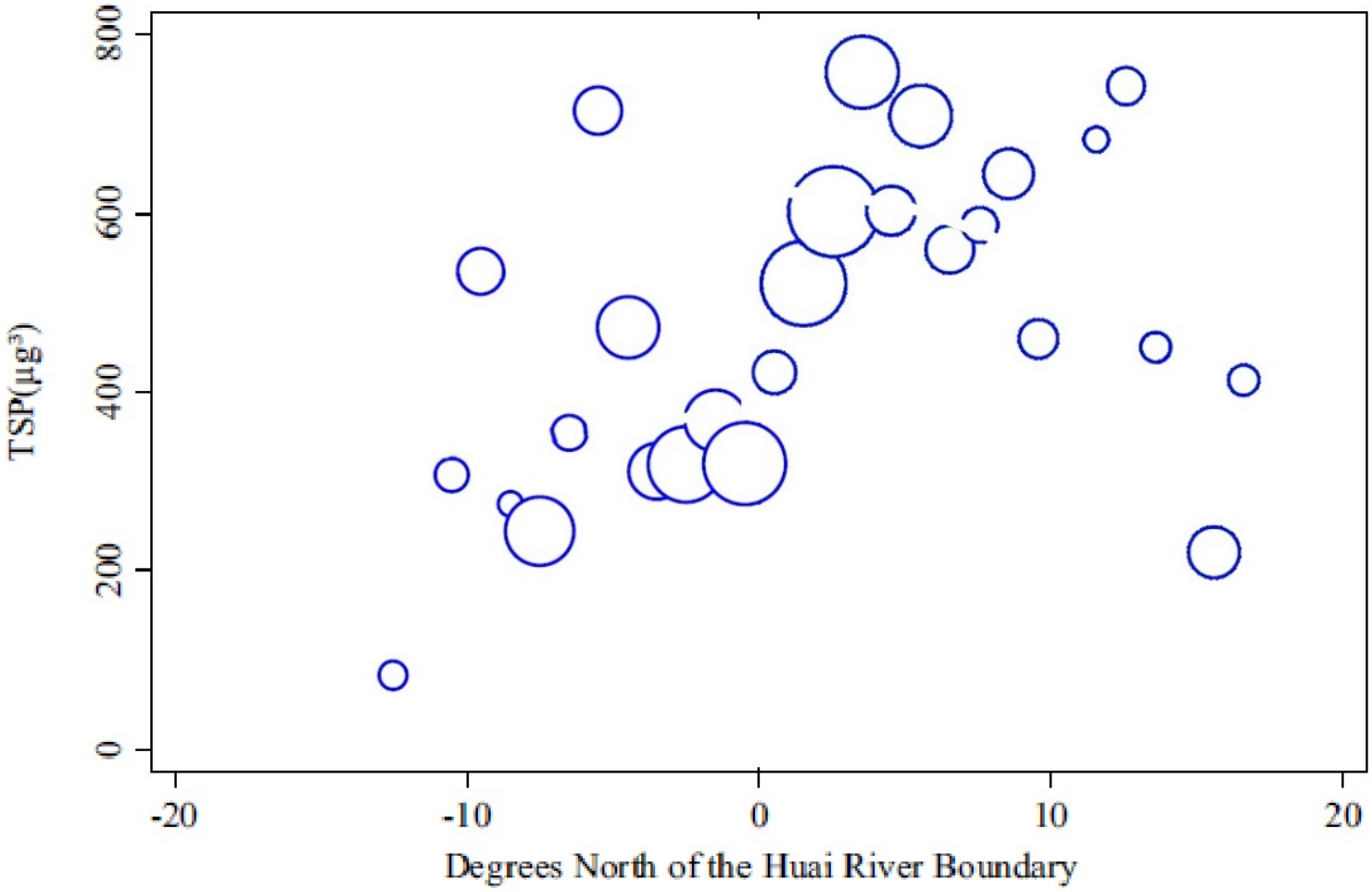

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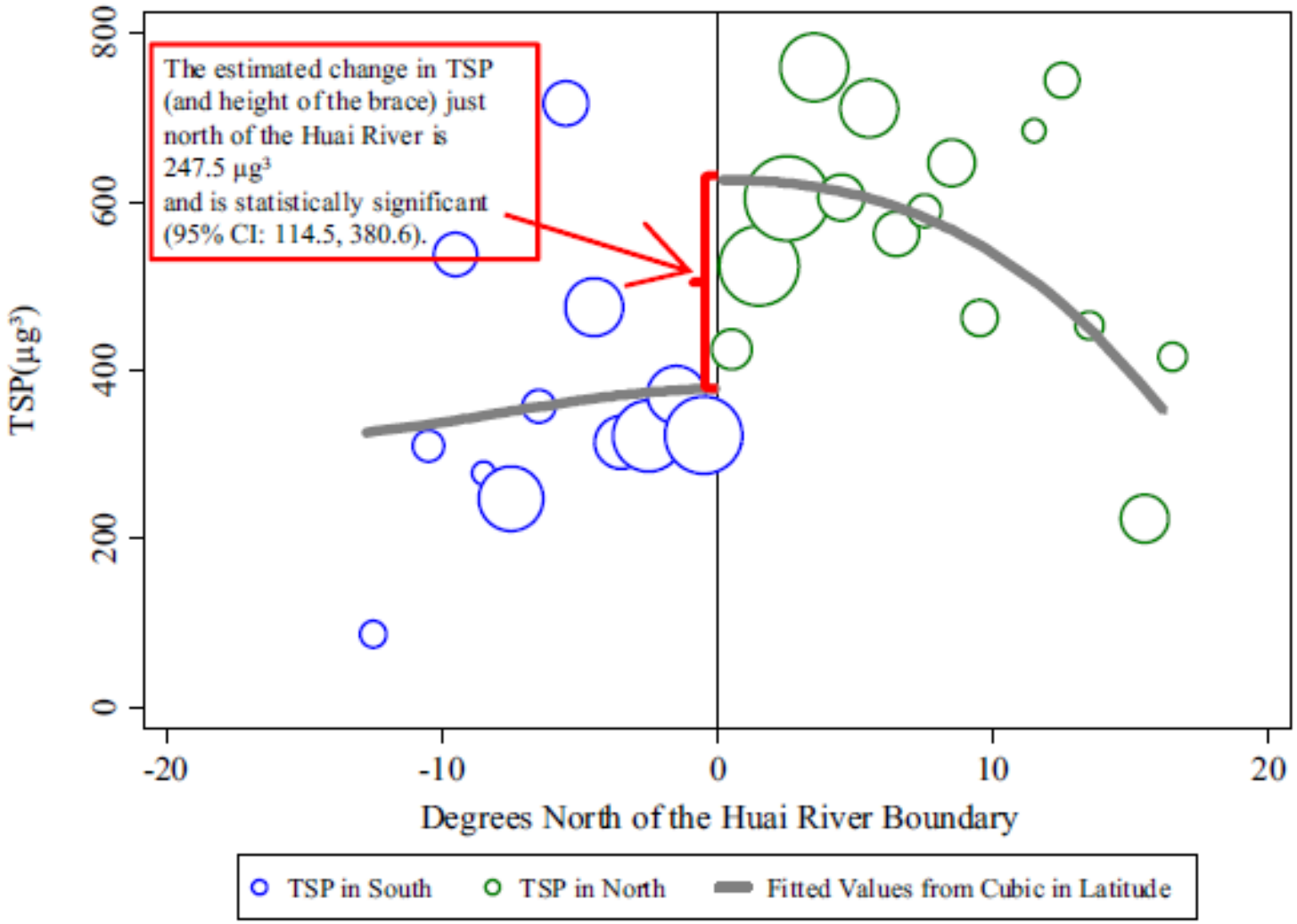

Lots of cool papers in this space!

- How does temperature affect worker productivity?
  $\rightarrow$ Output micro-data, Cobb-Douglas (capital v. labor) (E. Somanathan, Rohini Somanathan, Anant Sudarshan, Meenu Tewari; JPE 2021)

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- What is the effect of rural electrification on economic development?
  → RD: only villages in India with >300 people qualified for govt electrification scheme (Fiona Burlig & Louis Preonas; JPE 2023)

Impacts: Research questions

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2. Impacts of floods, droughts, hurricanes
3. Impact of technology adoption
4. Impact of a regulation
5. Impact of an investment
6. ... many more!

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4. How do individuals acquire and process information? → air & water pollution often difficult/costly to observe
5. What determines household consumption patterns?

Susanna Berkouwer and Joshua Dean (AER 2022)

"Credit, attention, and externalities in the adoption of energy efficient technologies by low-income households"

The conference that changed my life:

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

wPOWER HUB Partnership on Women's Entrepreneurship in Renewables

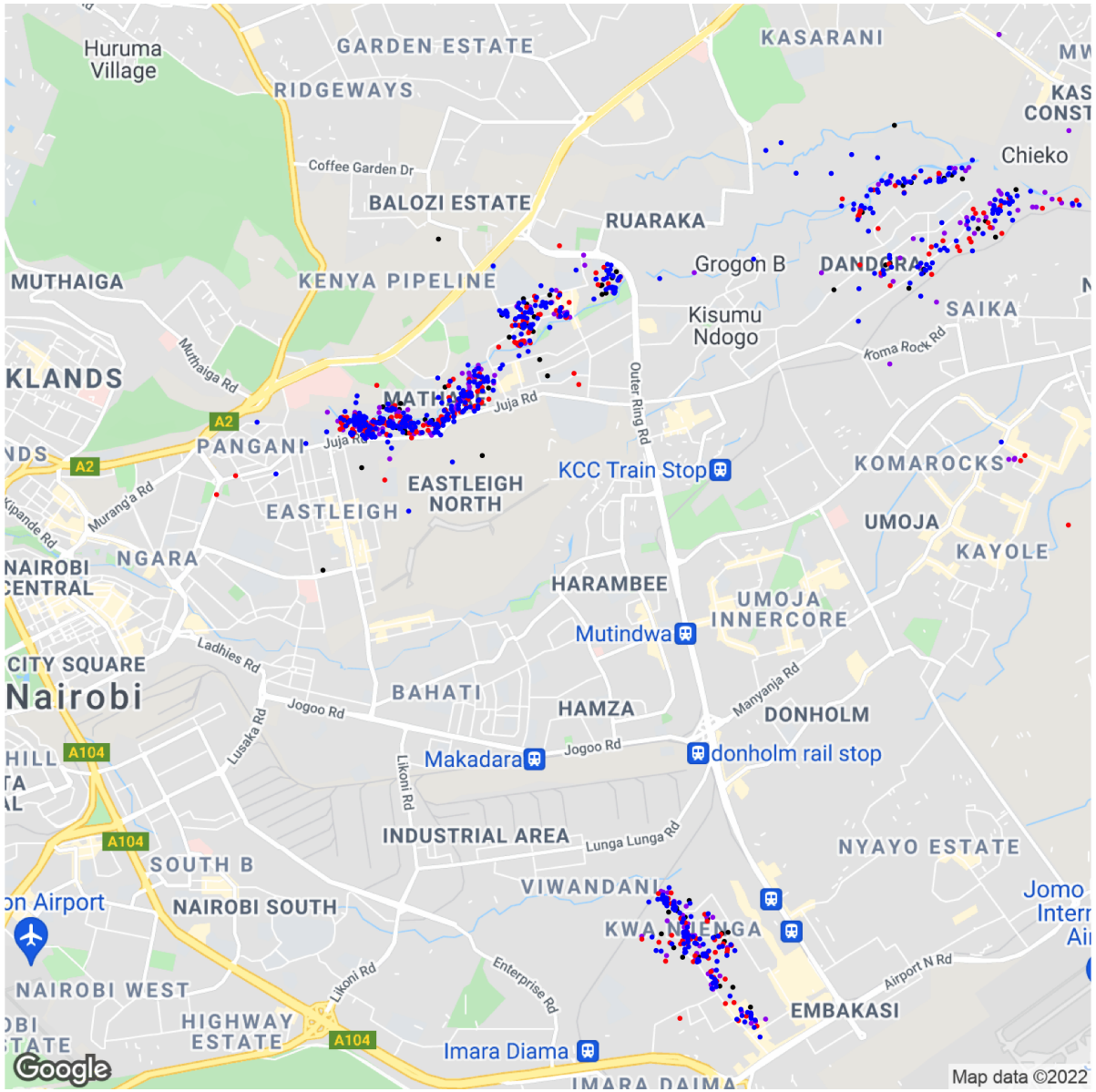
Women's Energy Entrepreneurship:
Empowering Women Entrepreneurs and Scaling Access to Energy

February 14th – 16th, 2016
Nairobi, Kenya

The conference that changed my life:

Empirical setting: Charcoal cookstoves in Nairobi

RCT with 1,000 households in Nairobi, Kenya



- Control
- Credit only
- Attention only
- Credit and Attention

Susanna Berkouwer and Joshua Dean (AER 2022)

- **Broad research question:** what constrains poor households' adoption of energy-efficient technologies?

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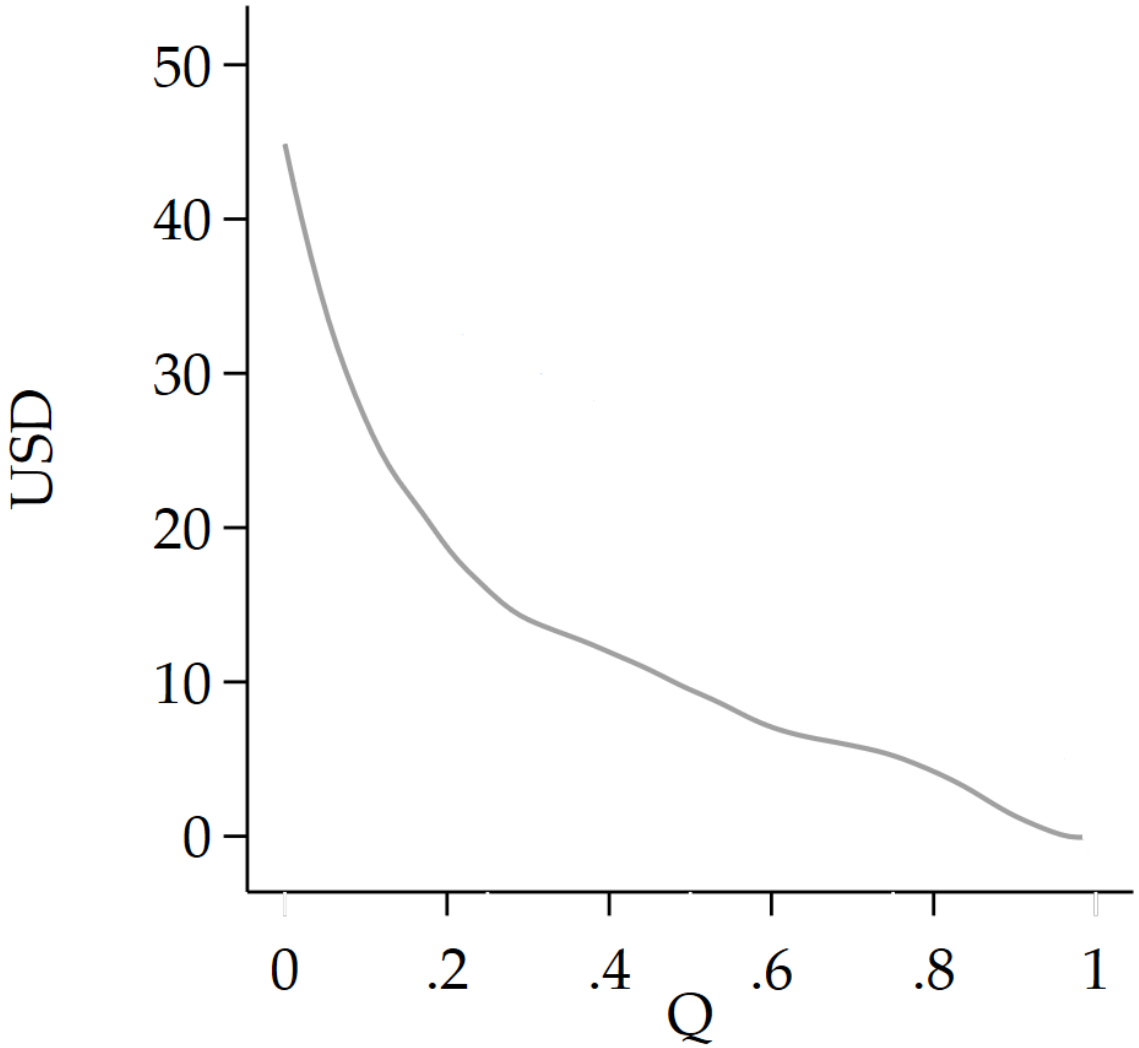
- **Four research strategies:**
  1. Becker-DeGroot-Marschak to elicit WTP
  2. IV using randomly assigned stove prices
  3. Randomly assign loan treatments
  4. Randomly assign attention treatments

(1) WTP is only $12! (The Jikokoa costs $40 in stores)



(1) WTP is only $12! Why is adoption so low?

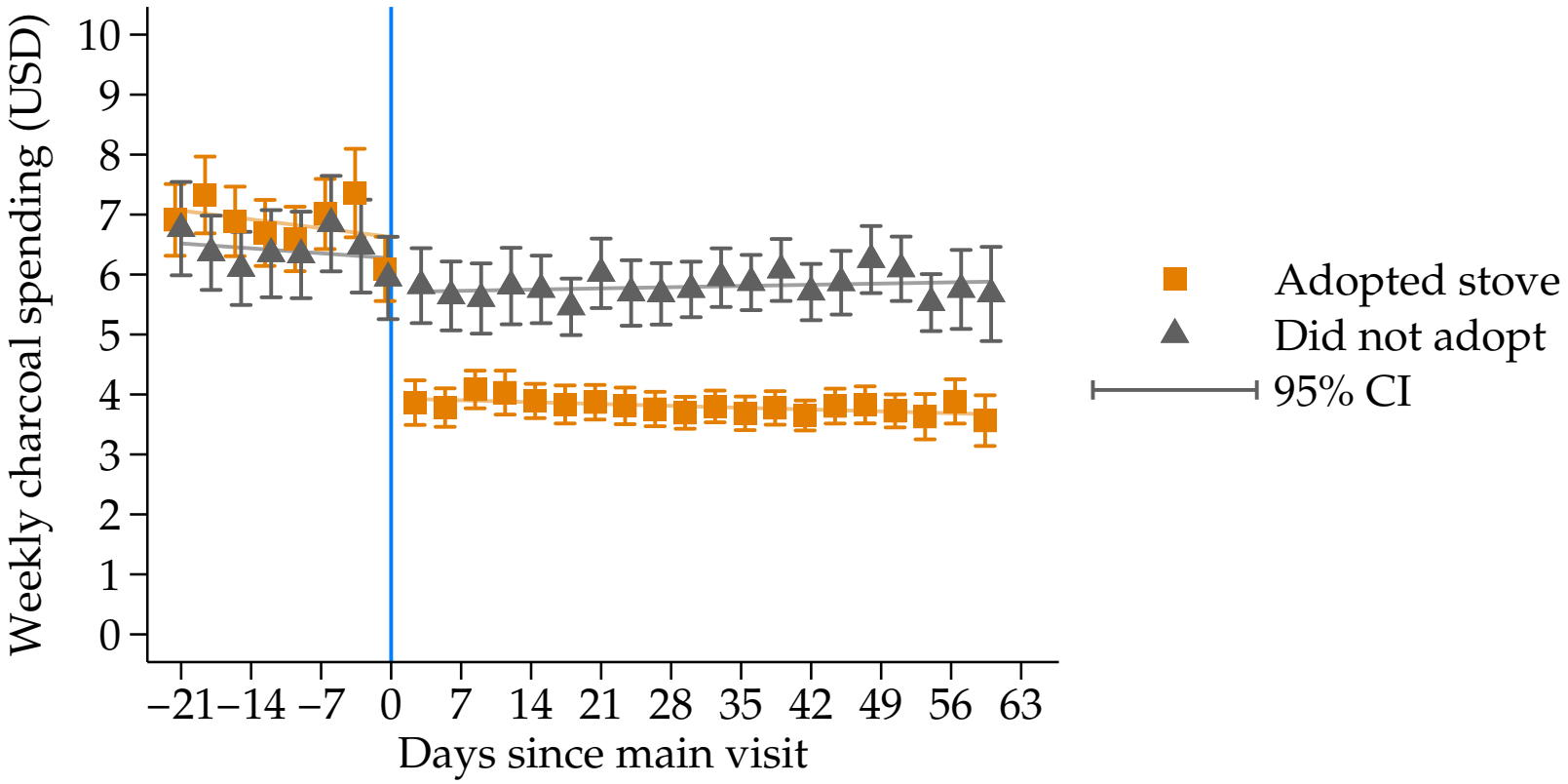
	TECHNOLOGY	PSYCHOLOGY	MARKETS
	What are the private and social benefits?	Do households attend to the potential savings?	Are households credit constrained?
Experimental variation	Stove adoption	Multiple nudges	Access to loan
Measure	Energy expenditures	Willingness -to-pay	Willingness -to-pay

Does it not generate sufficient benefits?

TECHNOLOGY	PSYCHOLOGY	MARKETS
What are the private and social benefits?	Do households attend to the potential savings?	Are households credit constrained?

(2) Stove reduces charcoal use by USD 2 per week (40%)

- 576 out of 962 respondents (60%) bought the improved stove



Do people attend to these private benefits?

TECHNOLOGY	PSYCHOLOGY	MARKETS
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Treatment: Attention to energy savings

Attention Sheet

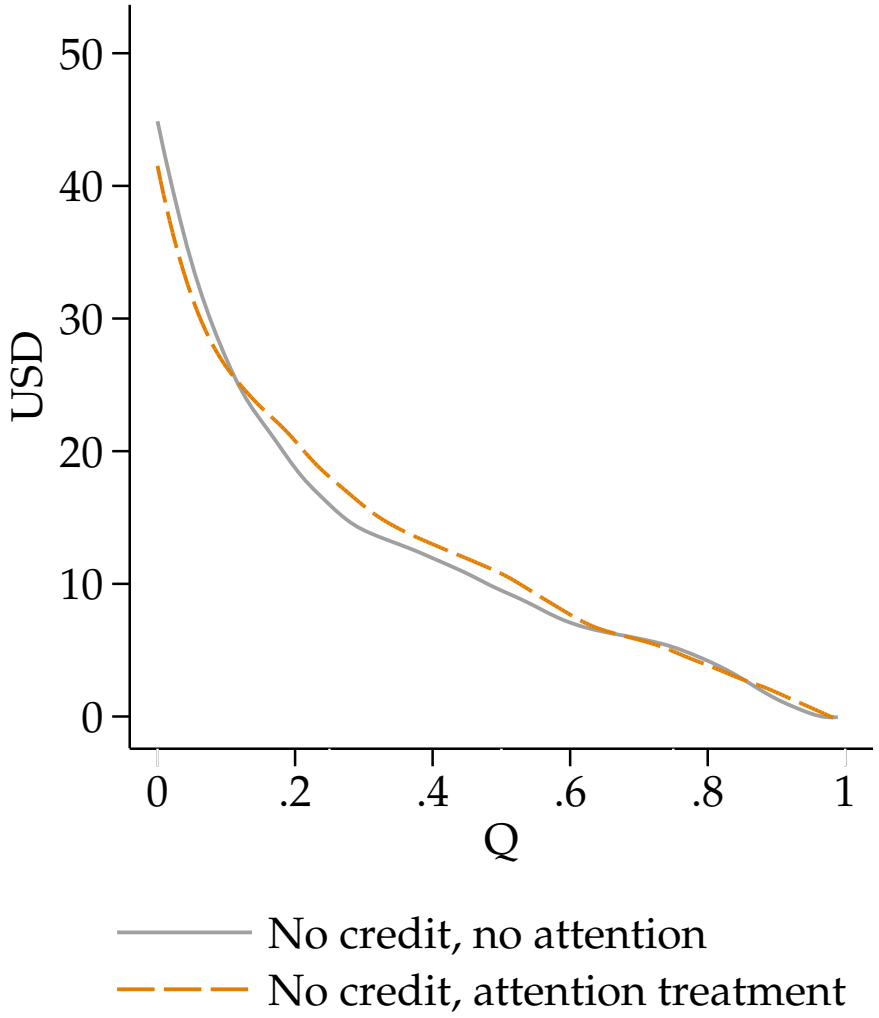
Respondent ID:
1 8 1 3 0 1 c 1 9 1 4 1 2 1

Akiba ya mwaka kwa Jumla: 14,980 (KES)

	Akiba inayotarajiwa wiki hii (KES)	Akiba ya kila mwezi inyotarajiwa (KES)	Ungefanyaje na fedha hii mwezi huu?
Wiki 1, kuanzia 03 Juni 2019	350	1,400	Kununua chakula
Wiki 2, kuanzia 10 Juni 2019	350		
Wiki 3, kuanzia 17 Juni 2019	350		
Wiki 4, kuanzia 24 Juni 2019	350		
Wiki 5, kuanzia 01 Julai 2019	210	1,050	Kununulia watoto text baks
Wiki 6, kuanzia 08 Julai 2019	210		
Wiki 7, kuanzia 15 Julai 2019	210		
Wiki 8, kuanzia 22 Julai 2019	210		
Wiki 9, kuanzia 29 Julai 2019	210		
Wiki 10, kuanzia 05 Agosti 2019	210		

(3) No evidence of inattention to energy savings

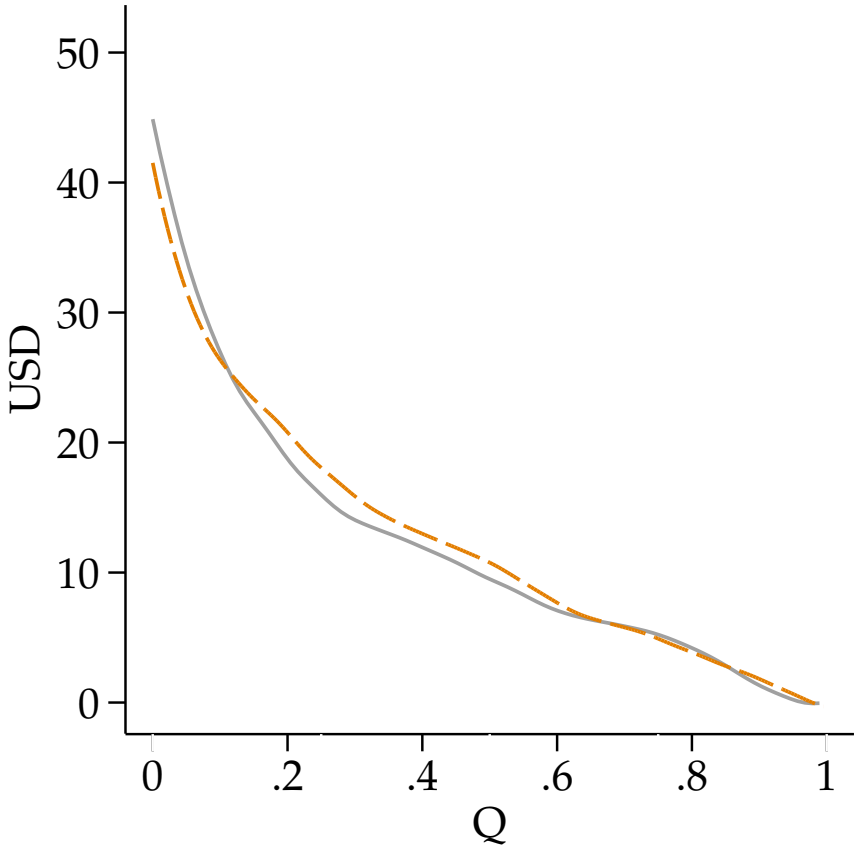
Demand Curve CDF of Willingness to Pay from BDM:



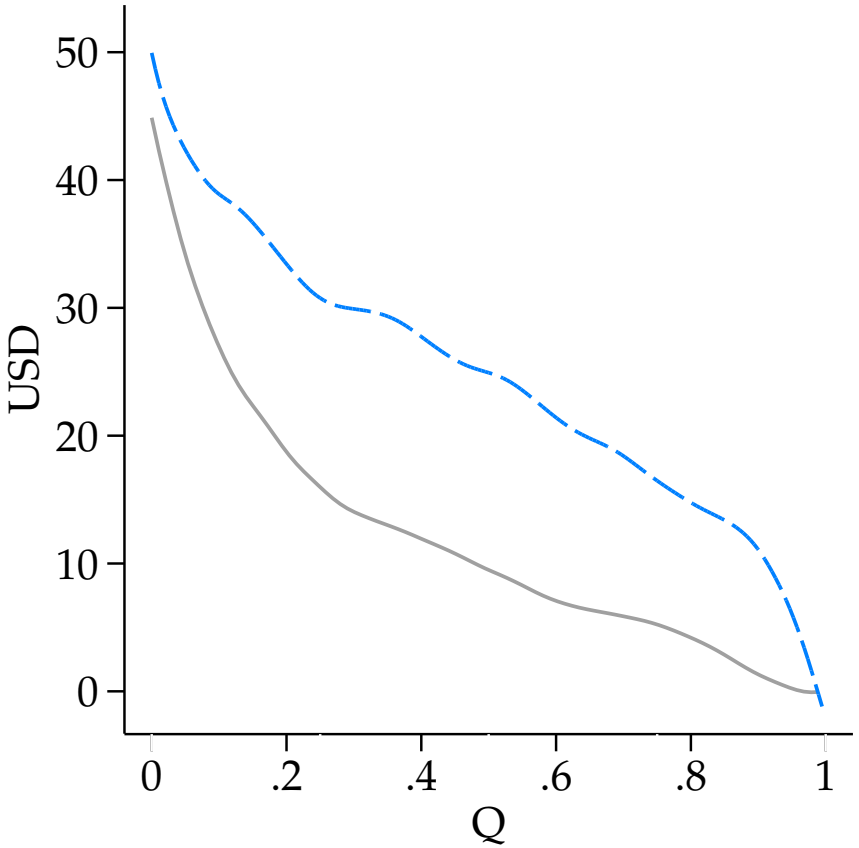
Does financing help?

TECHNOLOGY	PSYCHOLOGY	MARKETS
What are the private and social benefits?	Do households attend to the potential savings?	Are households credit constrained?

(4) Spot the difference



No credit, no attention
No credit, attention treatment



No credit, no attention
Credit treatment, no attention

Discussion

- What is the market failure?

Discussion

- What is the market failure?
- Why don't have people have credit?

Discussion

- What is the market failure?
- Why don't have people have credit?
- What policy recommendation(s) does this paper generate?

Some notes on writing a (development) job market paper

- Discuss, discuss, discuss: with advisors, classmates, professors outside your field
- Broaden your community: public health department, behavioral economics seminar
- All advice is useful

Lots of cool papers in this space! (Yes, this one too!)

- How do water subsidies affect household water consumption?
  $\rightarrow$ Structural model using rich variation variation of water tariffs in South Africa (Andrea Szabó; Econometrica 2015)

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- Can Payments for Ecosystem Services (PES) be effective carbon abatement?
  → RCT; test if Ugandan households reduce deforestation (Seema Jayachandran et al; Science 2017)

Household decision-making: Research questions

1. What constraints do households face? → eg. credit constraints → And how can these be alleviated?
2. How do households make decisions? → jointly or as individuals?
3. Do households suffer from behavioral biases? → energy efficiency investments require future thinking
4. How do individuals acquire and process information? → air & water pollution often difficult/costly to observe
5. What determines household consumption patterns?
6. ... many more!

15-minute break.

Today: Development economics

Introduction

Impacts (Greenstone and Hanna; AER 2014)

Household decision-making (Berkouwer and Dean; AER 2022)

Break

Political economy and regulation (He, Wang, and Zhang; QJE 2020)

Infrastructure (McRae; AER 2015)

Future directions of research

Political economy: Research questions

1. Which market failures can be corrected by which government regulations?
2. What incentives do individual government agents face, and how do these contrast with the regulations' objectives?
3. What determines citizen support and how do governments seek to influence this?
4. How does corruption affect investments and regulations?
5. What mechanisms are good sources of accountability?

Guojun He, Shaoda Wang, and Bing Zhang (QJE 2020)

"Watering Down Environmental Regulation in China"

Guojun He, Shaoda Wang, and Bing Zhang (QJE 2020)

- **Broad research question:** How do incentives faced by government bureaucrats affect environmental regulations?

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- **Research strategy (1):** Use discontinuity whether of whether a firm is upstream ($Down_{ijk} = 0$) or downstream ($Down_{ijk} = 1$) from the monitoring station:

$$TFP_{ijk} = \alpha_1 Down_{ijk} + \alpha_2 Dist_{ijk} + \alpha_3 Down_{ijk} \cdot Dist_{ijk} + u_j + v_k + \epsilon_{ijk}$$

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Concerns? What would you do differently?

Empirical setting: Discontinuity

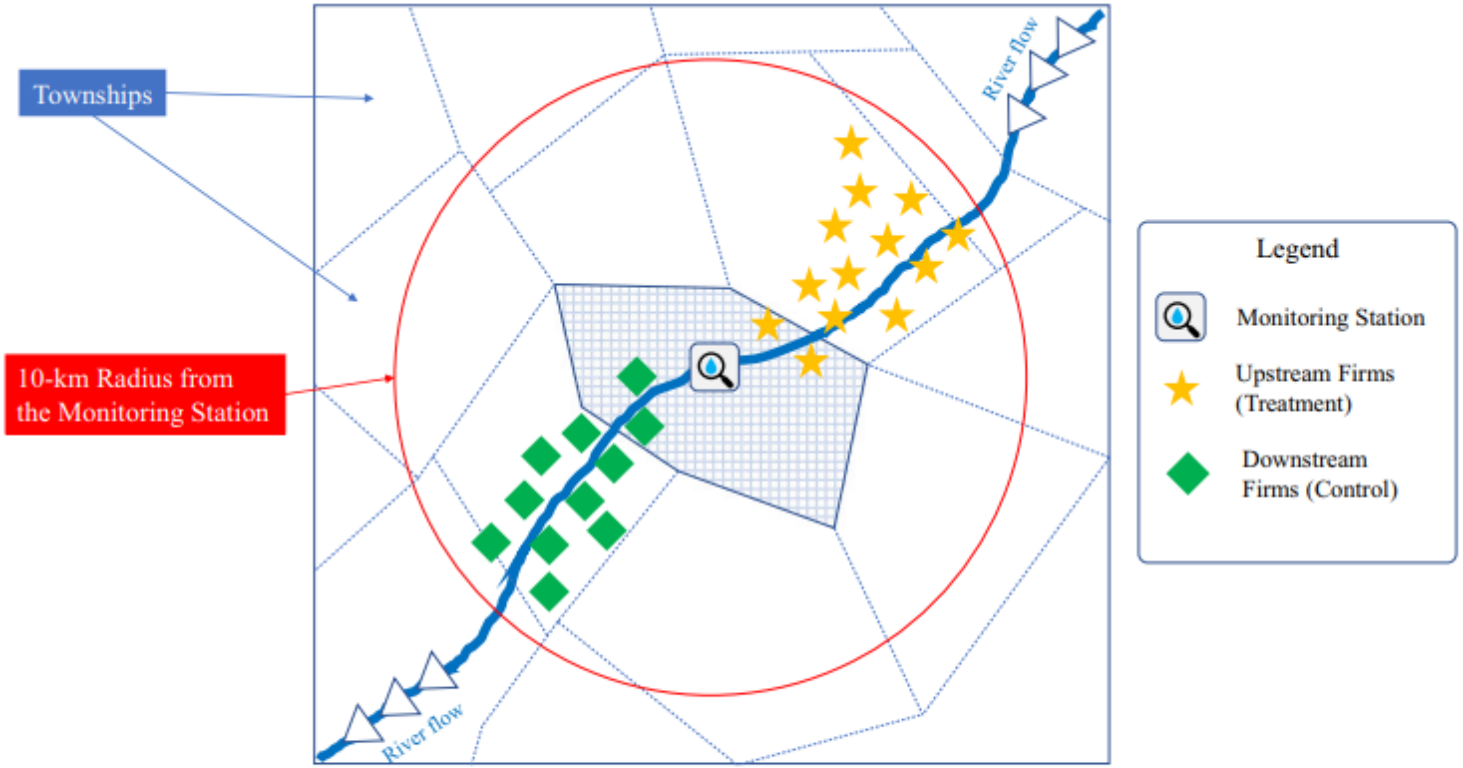


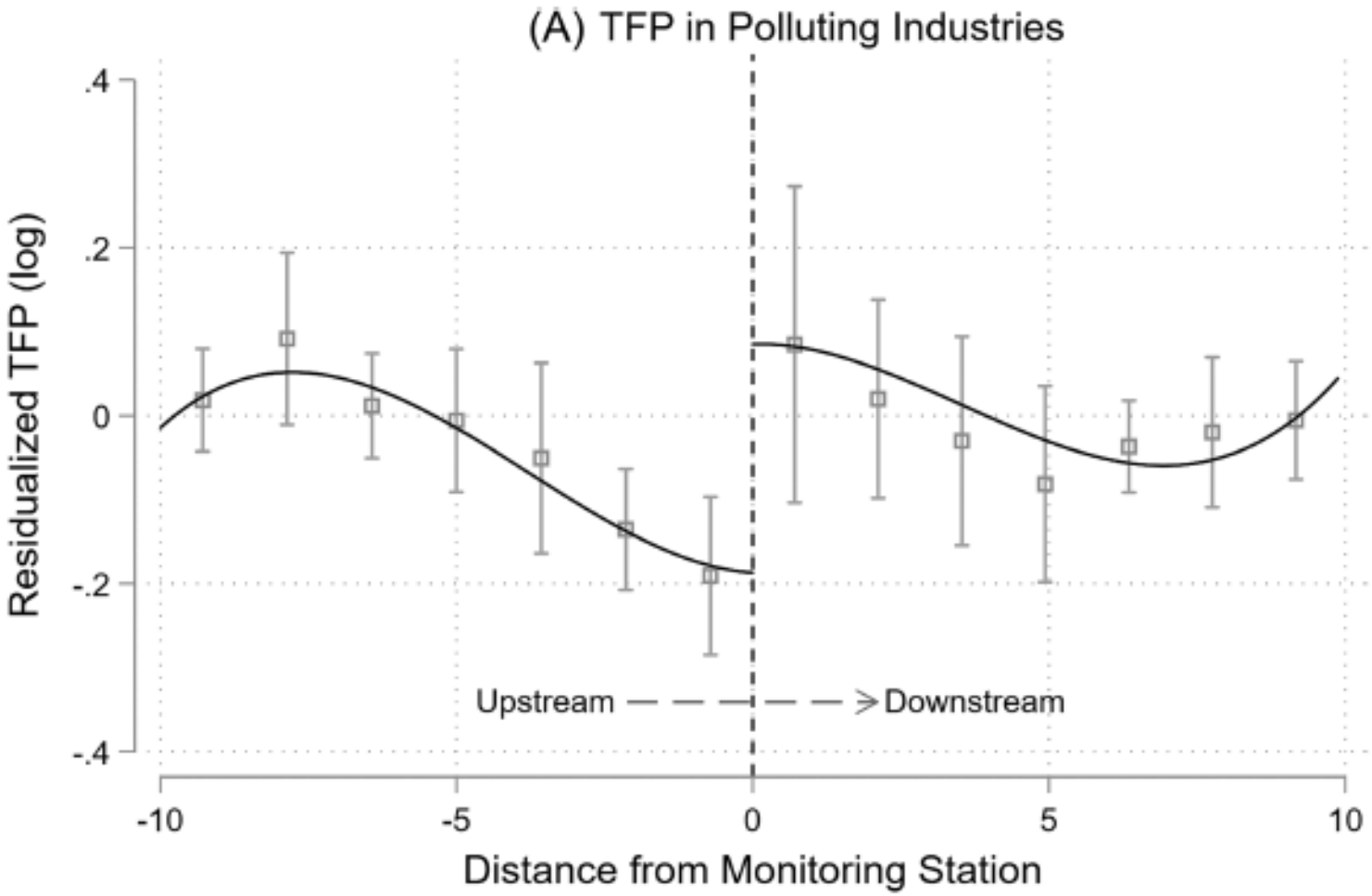
Figure II

Illustrating the Identification Strategy

This figure illustrates our identification strategy. We compare firms located immediately upstream of a monitoring station to those located immediately downstream of a monitoring station.

t

Outcome variable: TFP



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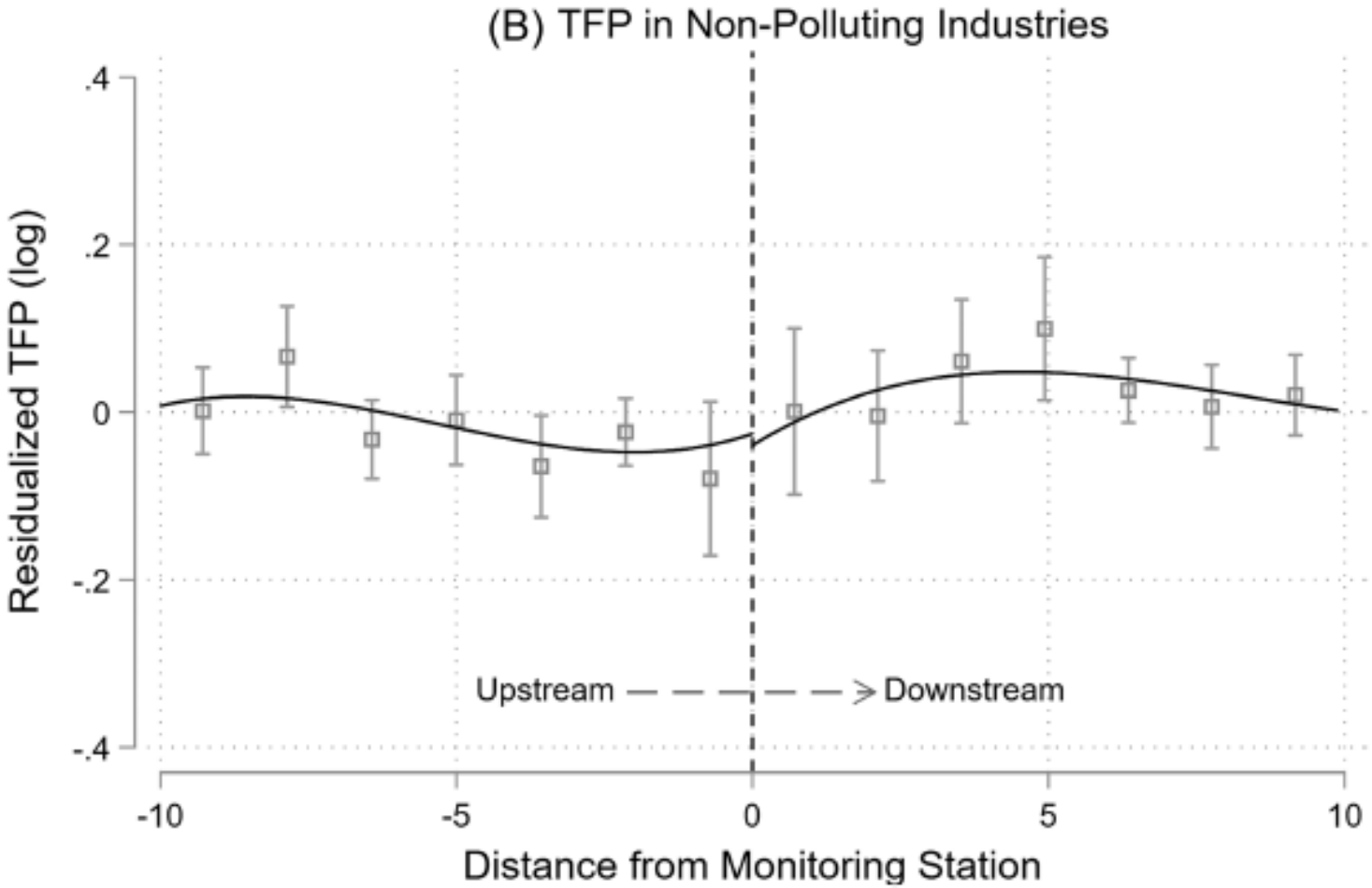

Discussion

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- What are the implications?

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- Is the regulation inefficient?

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6. ... many more!

Lots of cool papers in this space! (Spot a pattern?)

- Does regulatory discretion improve or undermine regulatory effectiveness?
  → Experiment + structural model in India (Esther Duflo, Michael Greenstone, Rohini Pande, Nicholas Ryan; Econometrica 2018)
- Do Indian politicians reward voters by under-charging them for electricity?
  → Statistical test + close election RD (Meera Mahadevan; AER R&R)
- How does corruption affect vehicle emissions tests (smog checks) in Mexico?
  → Experiment + structural model in India (Paulina Oliva; JPE 2015)
- Does World Bank conditionality affect electricity infrastructure construction?
  → Quasi-random variation + RCT in Kenya (Catherine Wolfram, Edward Miguel, Eric Hsu, and Susanna Berkouwer; WP 2022)

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Infrastructure: Research questions

Research topics

Research topics

What is infrastructure?

Sections

The Washington Post
Democracy Dies in Darkness

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Opinion: Home health care belongs in the infrastructure package. We all pay for it anyway.

By Helaine Olen
Columnist | + Follow

July 7, 2021 at 4:36 p.m. EDT

Research topics

What is infrastructure?

- Electricity networks
- Dams
- Roads
- Railways
- Airports
- Ports
- Etc.
- Etc.
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Infrastructure: Research questions

- What are the costs of infrastructure?
  - What are the externalities (environmental)?
  - How large are inefficiencies?
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Shaun McRae (AER 2015)

"Infrastructure Quality and the Subsidy Trap"

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  - Why do households not pay for electricity? ($\rightarrow$ poor quality)
  - Why do utilities under-invest in infrastructure? ($\rightarrow$ doesn't increase revenue)
  - Why do governments continue funding utilities? ($\rightarrow$ prevent civil unrest)

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Concerns? What would you do differently?

First: estimate key parameters

Table 4—Price Elasticities, Income Elasticities, and Outage Effects

	Price elasticities[a]		Income elasticities		Outage effect[b]	
	Mean	Median	Mean	Median	Mean	Median
All households	−0.32	−0.18	0.06	0.05	−0.165	−0.151
Stratum 1	−0.13	−0.09	0.07	0.05	−0.132	−0.126
Stratum 2	−0.22	−0.14	0.06	0.04	−0.147	−0.136
Stratum 3	−0.47	−0.43	0.06	0.05	−0.181	−0.171
Stratum 4	−0.68	−0.64	0.08	0.07	−0.230	−0.218
Stratum 5	−0.73	−0.70	0.09	0.08	−0.270	−0.257
Stratum 6	−0.62	−0.61	0.10	0.10	−0.332	−0.324

Notes:

[a] Price and income elasticities are computed from 50 draws of the ϵ and η for each observation in the sample, calculating the predicted change in consumption from a 1 percent increase in both steps on the price schedule and a 1 percent increase in income, respectively. For the summary statistics, price elasticities are truncated at −2 and 0, and income elasticities are truncated at −1 and 2.

[b] Outage effect shows the mean change in electricity demand, in kWh, as a result of a one hour supply outage.

Result: counterfactual simulations

Table 6—Analysis of Upgrade Decision for Existing Subsidy Program

	Scenario[a]			County examples[b]	
	Mean+ loss	Av. Strat. 1	Part pay	Low profit	High profit
Consumption (kWh/month)					
Before upgrade	125	125	125	190	80
Price effect	−12	−12	−12	−17	−11
Reliability effect	6	6	6	−3	10
After upgrade	119	119	119	169	80
Billed quantity (kWh/month)					
Before upgrade	192	183	192	290	123
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Pre-upgrade Profit[c] ($/month)					
Stratum 1 subsidy (A+B+E+F+G+H+I+J)	8.25	7.52	8.25	8.01	9.12
Social Energy subsidy	3.72	3.56	3.72	5.63	2.38
User revenue	0.00	0.00	0.82	0.00	0.00
Cost of electricity consumed (A+B+E)	−5.18	−5.18	−5.18	−7.93	−3.10
Cost of line losses (F)	−2.74	−2.74	−2.74	−4.20	−1.64
Total (G+H+I+J)	4.05	3.16	4.87	1.51	6.76
Post-upgrade Profit ($/month)					
Stratum 1 subsidy (A+G)	6.05	6.05	6.05	7.01	5.96
Social Energy subsidy	0.00	0.00	0.00	0.00	0.00
User revenue (K)	6.58	6.58	5.92	8.66	5.96
Cost of electricity consumed (A)	−4.94	−4.94	−4.94	−7.08	−3.10
Cost of line losses (B)	−1.03	−1.03	−1.03	−1.48	−0.65
Total (G+K−B)	6.67	6.67	6.01	7.11	8.17

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Change in profit ($/month) (K−B−H−I−J)	2.62	3.50	1.14	5.60	1.41
Capital cost ($/month)	5.65	5.65	5.65	5.65	5.65

Discussion

- What is the market failure?

Discussion

- What is the market failure?
- Are government subsidies inefficient?
- Is electricity a human right? The vicious non-payment cycle
  $\rightarrow$ Robin Burgess, Michael Greenstone, Nicholas Ryan, Anant Sudarshan; Journal of Economic Literature 2020

Infrastructure is hard to study!

Structural models:

- How does transmission infrastructure affect electricity market competition?
  $\rightarrow$ Nicholas Ryan (AEJ Micro 2021)

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Instrumental Variables approaches:

- How do hydropower plants affect economic development?
  → Instrument: simulated topographical model (Molly Lipscomb, A. Mushfiq Mobarak, Tania Barhamn; AEJ Applied 2013)
- How does rural electrification affect employment?
  → Instrument: topography (hilliness) (Taryn Dinkelman; AER 2011)

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Other random variation:

- What are the costs and benefits of rural electrification?
  → RCT (Ken Lee, Edward Miguel, Catherine Wolfram; JPE 2020)
- How do grid investments affect voltage quality and business outcomes?
  → Quasi-random variation (Susanna Berkouwer, Steven Puller, and Catherine Wolfram; Ongoing)

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Future directions of research

Future directions of environmental & development economics research:

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SI 2023 Environmental & Energy Economics

Ray of Hope? China and the Rise of Solar Energy

Ignacio Banares-Sanchez, London School of Economics
Robin Burgess, London School of Economics
Dávid László, London School of Economics
Pol Simpson, London School of Economics
John Van Reenen, London School of Economics and NBER
Yifan Wang, London School of Economics

Firm Adaptation in Production Networks: Evidence from Extreme Weather Events in Pakistan

Clare A. Balboni, Massachusetts Institute of Technology and NBER
Johannes Boehm, Sciences Po
Mazhar Waseem, University of Manchester

Forecasts: Consumption, Production, and Behavioral Responses

Husnain F. Ahmad, Sewanee: The University of the South
Matthew D. Gibson, Williams College
Muhammad Fatiq Nadeem, University of California, Santa Barbara
Sanval Nasim, Colby College
Arman B. Rezaee, University of California, Davis

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The Benefits and Costs of Emissions Trading: Experimental Evidence from a New Market for Industrial Particulate Emissions

Michael Greenstone, University of Chicago and NBER
Rohini Pande, Yale University and NBER
Nicholas Ryan, Yale University and NBER
Anant Sudarshan, University of Chicago

Carbon Leakage within Firm Ownership Networks: Evidence from China's Regional Carbon Market Pilots

Jingbo Cui, Duke Kunshan University
Chunhua Wang, Shanghai Jiao Tong University
Zhenxuan Wang, Duke University
Junjie Zhang, Duke Kunshan University
Yang Zheng, London School of Economics and Political Sciences

The Development-Biodiversity Tradeoff in India's Forests

Raahil Madhok, University of British Columbia

Labor Disutility in a Warmer World: The Impact of Climate Change on the Global Workforce

Ashwin Rode, University of Chicago
Tamma A. Carleton, University of California, Santa Barbara and NBER
Michael Greenstone, University of Chicago and NBER
Solomon M. Hsiang, University of California, Berkeley and NBER
Andrew Hultgren, University of Illinois at Urbana-Champaign
Amir Jina, University of Chicago and NBER
Robert E. Kopp, Rutgers University

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SI Development Economics

Search Costs, Intermediation, and Trade: Experimental Evidence from Ugandan Agricultural Markets

Lauren F. Bergquist, Yale University and NBER
Craig McIntosh, University of California at San Diego
Meredith Startz, Dartmouth College and NBER

Complementary Inputs and Industrial Development: Can Lower Electricity Prices Improve Energy Efficiency?

Gregor Singer, London School of Economics

Transhumant Pastoralism, Climate Change and Conflict in Africa

Eoin F. McGuirk, Tufts University and NBER
Nathan Nunn, University of British Columbia and NBER

Money (Not) to Burn: Payments for Ecosystem Services to Reduce Crop Residue Burning

Kelsey Jack, University of California, Santa Barbara and NBER
Seema Jayachandran, Princeton University and NBER
Namrata Kala, Massachusetts Institute of Technology and NBER
Rohini Pande, Yale University and NBER

The Real Effects of Climate Change in the Poorest Countries: Evidence from the Permanent Shrinking of Lake Chad

Remi Jedwab, George Washington University
Federico Haslop, George Washington University
Roman Zarate, The World Bank
Carlos Rodriguez-Castelan, The World Bank

Lots and lots and lots of dishes to be invented!

- **Applied econometrics:** e.g. Instrumental Variables, Difference-in-Differences, Randomized Controlled Trial, Regression Discontinuity (sometimes spatial); natural/quasi-random variation
- **Labor:** e.g. wages, management, incentives, productivity
- **IO:** e.g. regulation of agricultural markets
- **Public:** e.g. weak tax enforcement or collection
- **Political economy:** e.g. politics of groundwater allocation, power outages, grid expansion, bill (non-)payment, enforcement

Check people's syllabi for more reading:

- Seema Jayachandran (2022) Annual Review of Economics
  "How economic development influences the environment"
- Louis Preonas @ Maryland AREC:
  AREC 845 - Environment and Development Economics
- Fiona Burlig @ Chicago Harris:
  PPHA 346 - Program Evaluation (Sections 2 & 3)

Send me an e-mail if you want to chat!

sberkou@wharton.upenn.edu