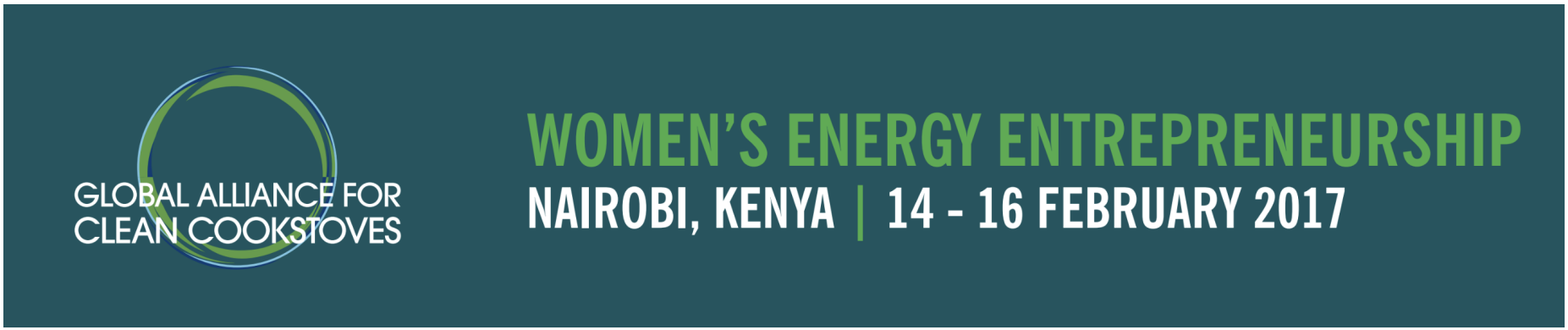
London School of Economics: Environmental Economics

Susanna Berkouwer
(they/them)

The Wharton School, University of Pennsylvania

December 2025

The conference that changed my life:



The conference that changed my life:

Improved charcoal stoves (Berkouwer and Dean; AER 2022)

Electric: Background

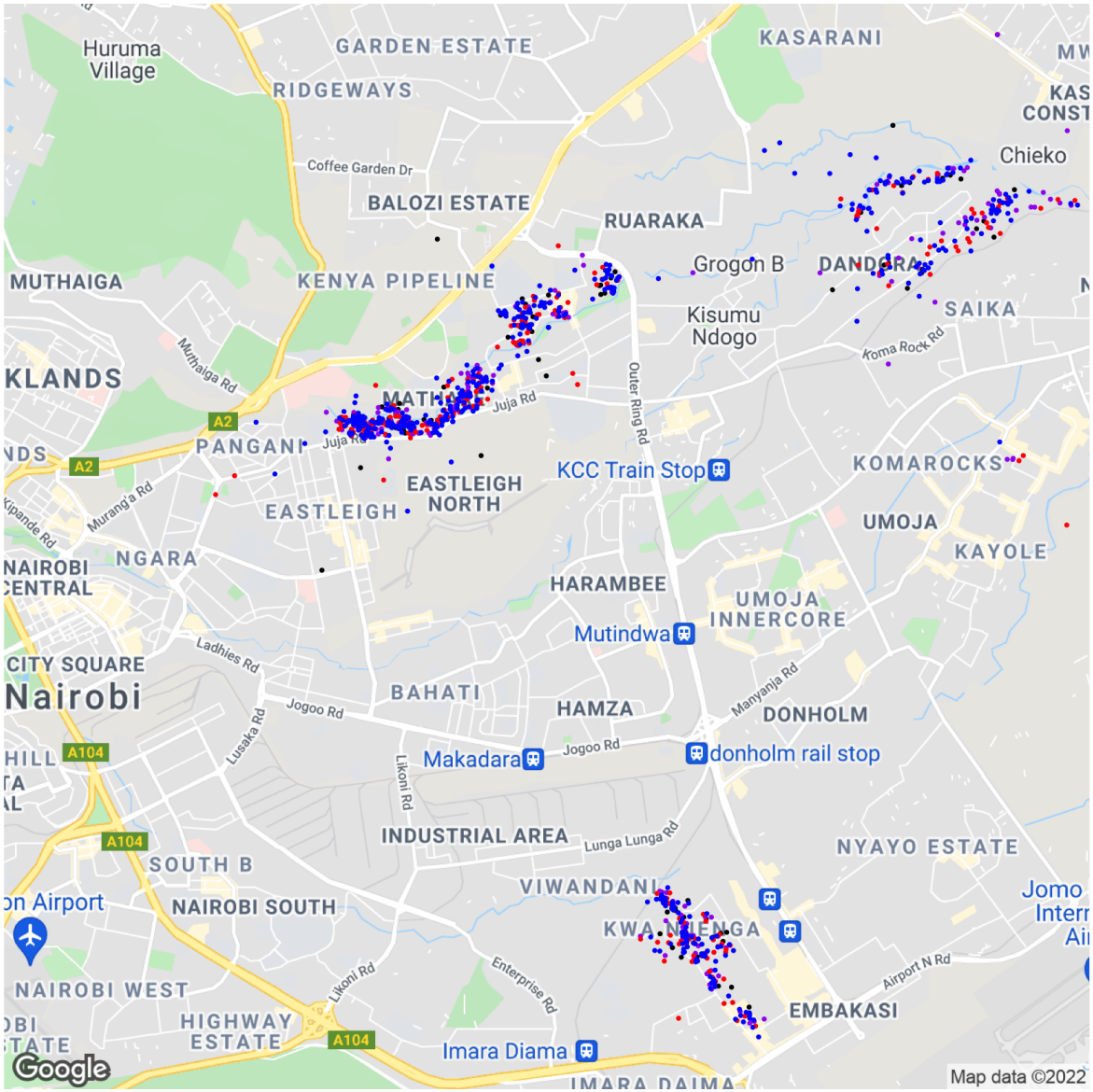
Electric: Empirics

Subsidy efficacy

Future directions of research

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 specific research questions:**
  1. What is willingness-to-pay (WTP) for a more efficient stove?
  2. What are the returns to energy efficiency adoption?
  3. Do behavioral biases affect adoption?
  4. Do liquidity constraints affect adoption?

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  1. What is willingness-to-pay (WTP) for a more efficient stove?
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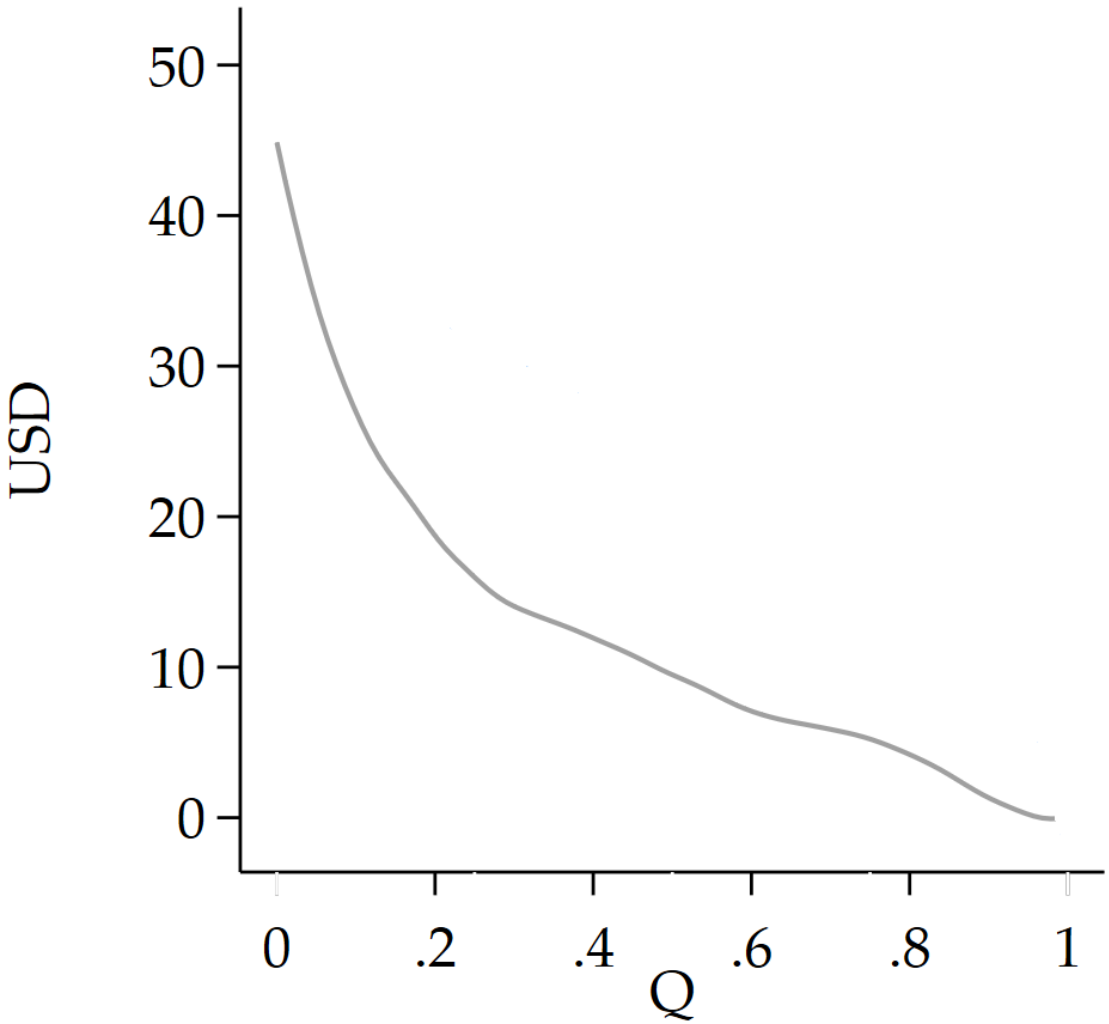
- **Four research strategies:**
  1. Becker-DeGroot-Marschak to elicit WTP
  2. IV using randomly assigned stove prices
  3. Randomly assign loan treatments
  4. Randomly assign attention treatments

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



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

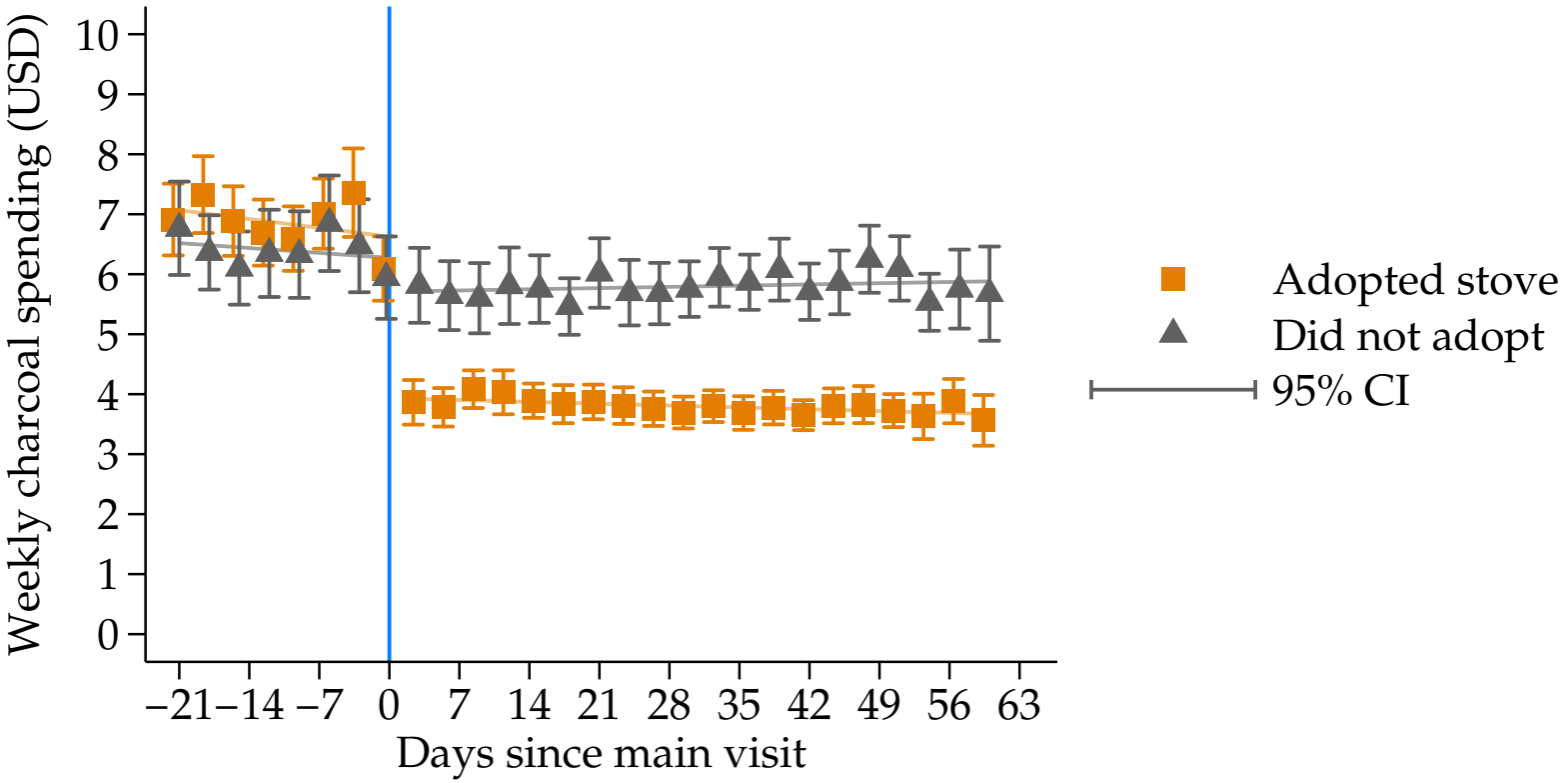
	TECHNOLOGY	PSYCHOLOGY	MARKETS
	What are the private and social benefits?	Do households attend to the potential savings?	Are households credit constrained?
Experimental variation	Stove adoption	Multiple nudges	Access to loan
Measure	Energy expenditures	Willingness -to-pay	Willingness -to-pay

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%)

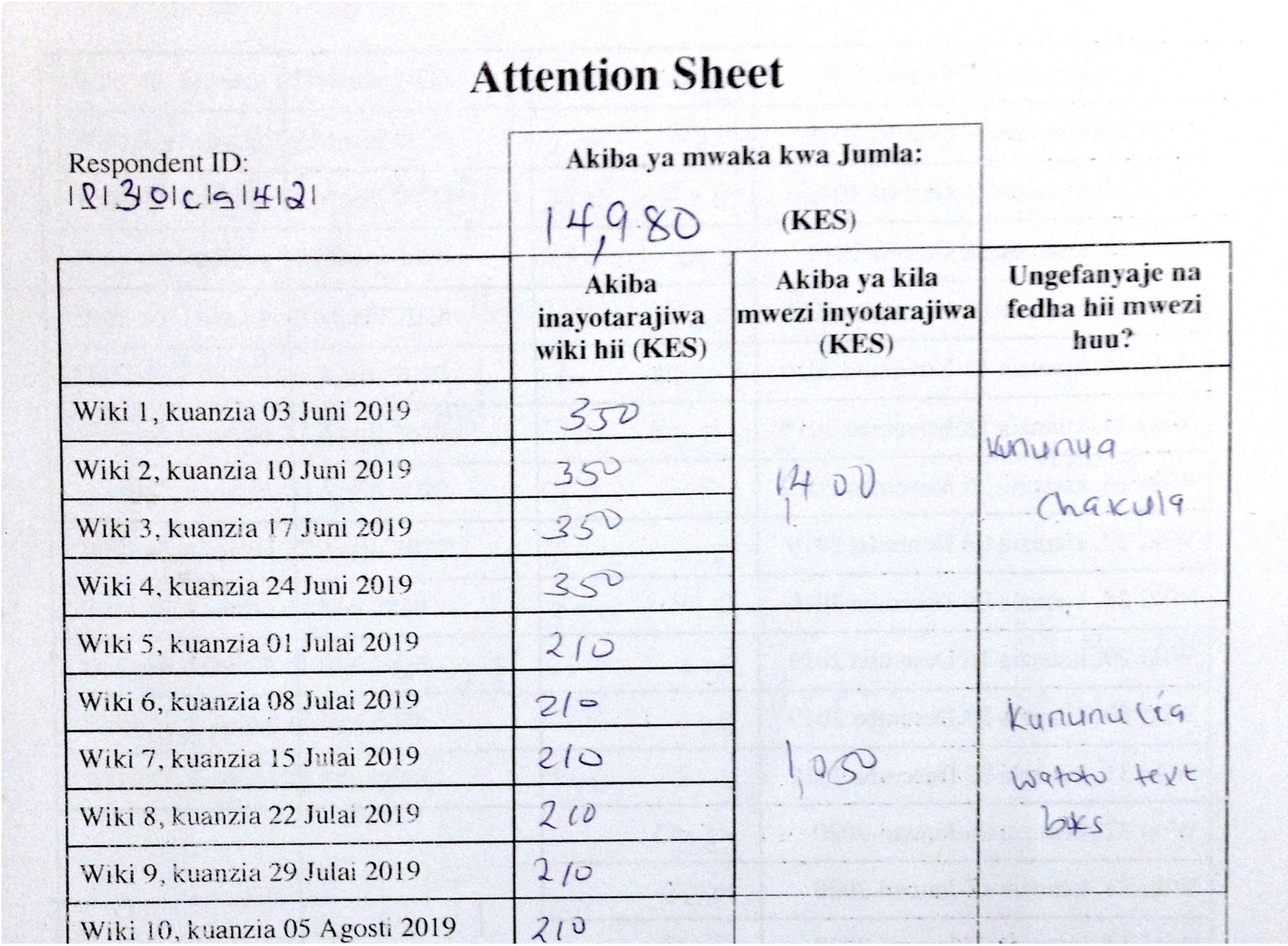
- 576 out of 962 respondents (60%) bought the improved stove



Do people attend to these private benefits?

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

Treatment: Attention to energy savings



Attention Sheet

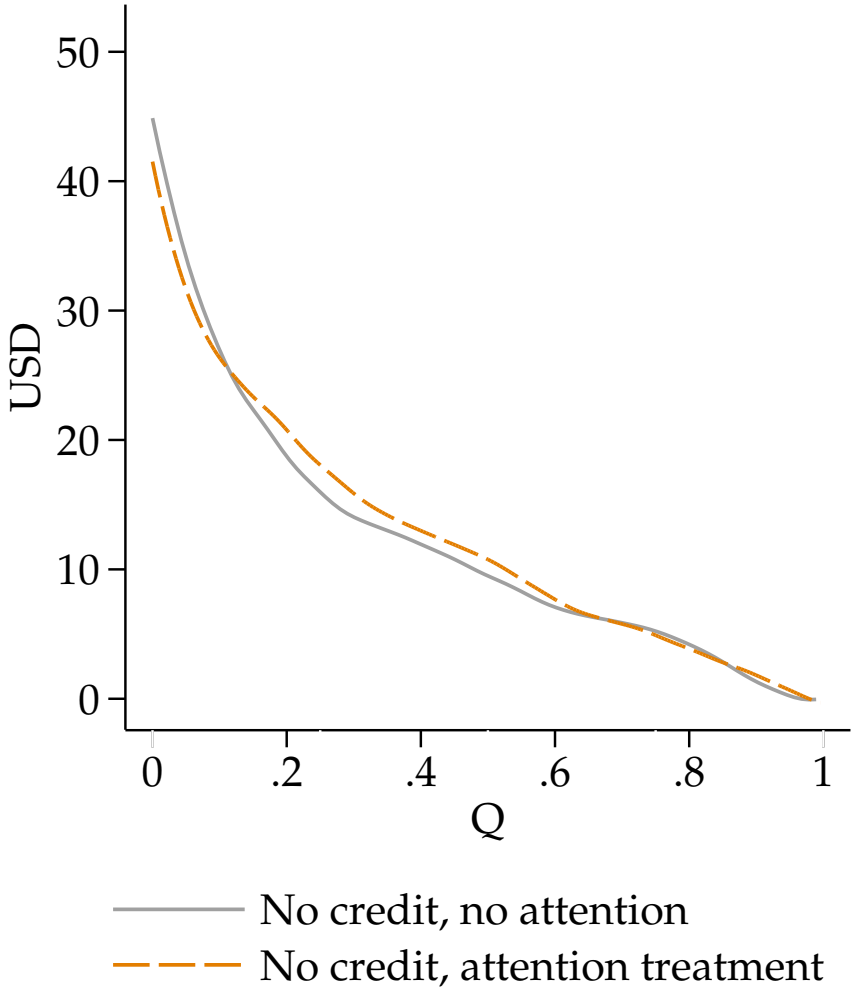
Respondent ID: 1|2|3|0|1|C|9|1|4|2|1

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 bks
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

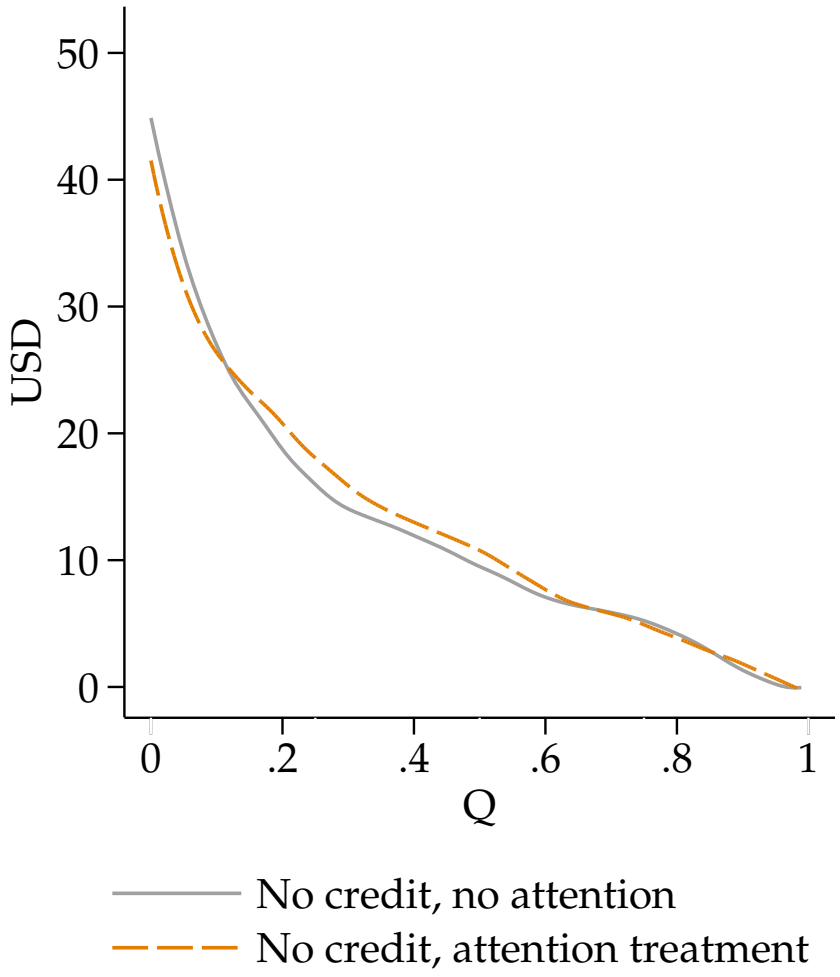
Demand Curve CDF of Willingness to Pay from BDM:

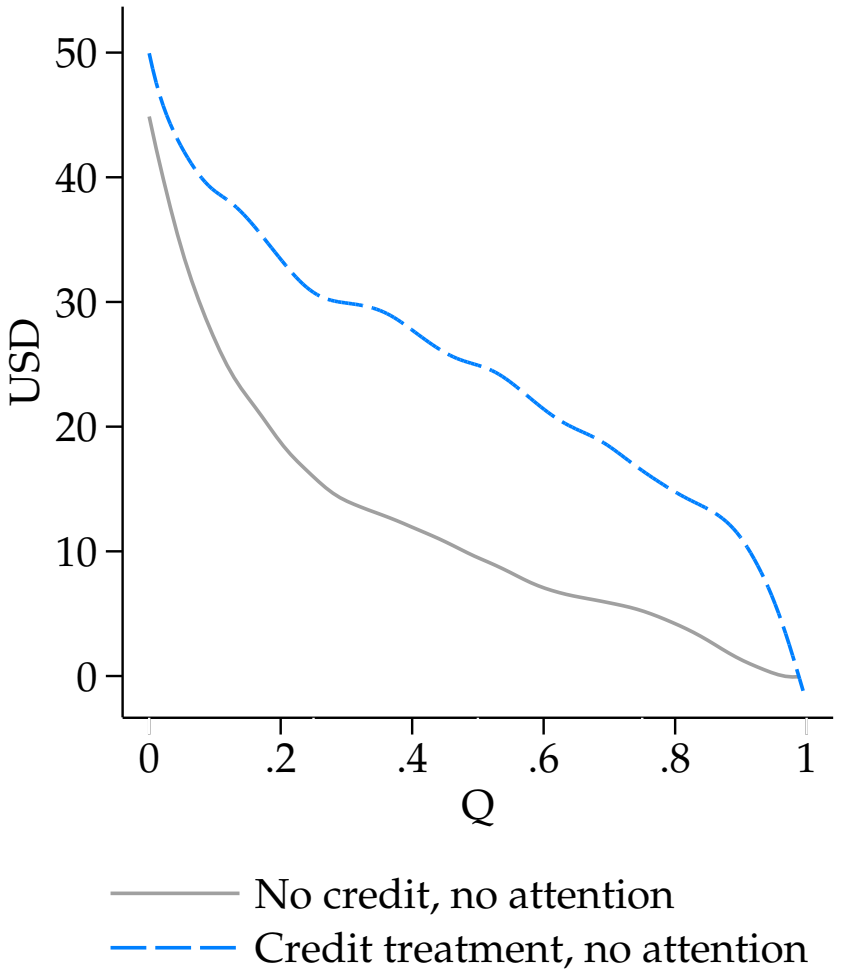


Does financing help?

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





Today

Improved charcoal stoves (Berkouwer and Dean; AER 2022)

Electric: Background

Electric: Empirics

Subsidy efficacy

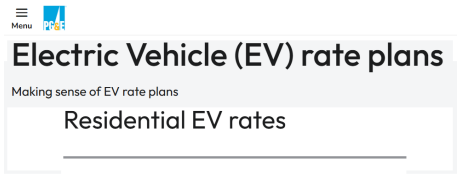
Future directions of research

Green technology subsidies

Green technology subsidies

Marginal cost subsidy

Lowering the electricity cost of using an electric appliance:



Electric Vehicle (EV) rate plans

Making sense of EV rate plans

Residential EV rates

You can lower your energy costs by enrolling in one of our EV rate plans:

- Home Charging EV2-A
- Electric Vehicle Rate Plan EV-B

Volvo Offers Swedish Buyers A Year Of Free Charging To Spark EV Sales

The pilot program will serve as a test for broader rollout across Europe and beyond.

BY NATALIE NEFF

PUBLISHED: OCT 22, 2025 9:00 AM EDT

Business Daily

How new special power tariff has spurred electric vehicle uptake

THURSDAY, DECEMBER 26, 2024 — UPDATED ON MAY 28, 2025 - 5

UMEME Customers Enjoy Cheaper Cooking Tariff Set By ERA

Christopher Kiiza • November 14, 2022 3 minutes read

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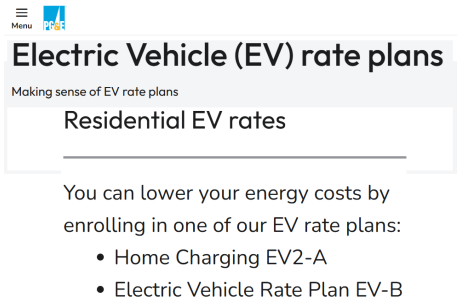
Menu

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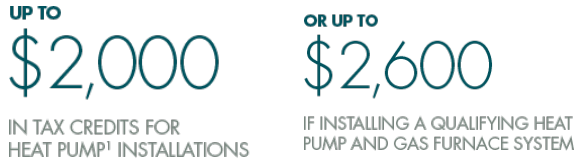
Fixed cost subsidy

Lowering the cost of buying an EV or a heat pump:


UP TO
$2,000
IN TAX CREDITS FOR HEAT PUMP[1] INSTALLATIONS

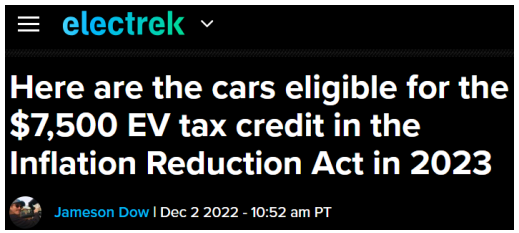
OR UP TO
$2,600
IF INSTALLING A QUALIFYING HEAT PUMP AND GAS FURNACE SYSTEM


Heat pump grant increased to £7,500 by government in efforts to lower pollution and bills

Heat pumps emit far less pollution than gas boilers and can lower bills, but are expensive upfront. The government hopes the scheme will bring the cost of installing a new heat pump in line with that of a gas boiler.

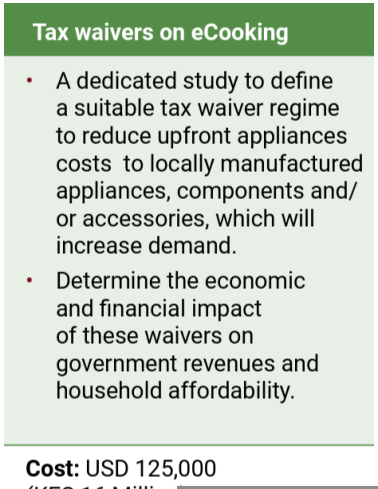
Victoria Seabrook
Climate reporter @SeabrookClimate

Monday 23 October 2023 11:33, UK


electrek

Here are the cars eligible for the $7,500 EV tax credit in the Inflation Reduction Act in 2023

Jameson Dow | Dec 2 2022 - 10:52 am PT


Tax waivers on eCooking

- A dedicated study to define a suitable tax waiver regime to reduce upfront appliances costs to locally manufactured appliances, components and/or accessories, which will increase demand.
- Determine the economic and financial impact of these waivers on government revenues and household affordability.

Cost: USD 125,000 (KES 16 Million

How do demand wedges affect subsidy efficacy?

- **Demand wedge:** $wtp_{observed} < wtp_{efficient}$

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- Examples:
  - Inattention to future benefits (myopia): $wtp_o = (1 - \theta) \cdot wtp_e$
    Dellavigna (2009)

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  - Credit constraints: $wtp_o = \frac{1}{1+r} \cdot wtp_e$ (our setting: $r = 90\%$) Credit
    Hausman (1979): 18%

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    Hausman (1979): 18%
- **Demand wedges often make marginal cost subsidies less effective:** each \$1 in subsidy spending increases wtp_o by less than \$1
  Hausman 1979; Allcott and Wozny 2014; Allcott, Mullainathan, Taubinsky 2014; Palmer, Walls 2015; Allcott, Taubinsky 2015; DeGroote, Verboven 2019; Grigolon, Reynaert, Verboven 2018; Gillingham, Houde, van Benthem 2021

This paper: Demand wedges **increase** fixed cost subsidy efficacy

1. If private benefits (wtp_e) and social benefits are positively correlated, a uniform demand wedge will increase the marginal adopter's positive externality

2. If the demand wedge increases demand elasticity, this reduces subsidy expenditure per marginal adoption

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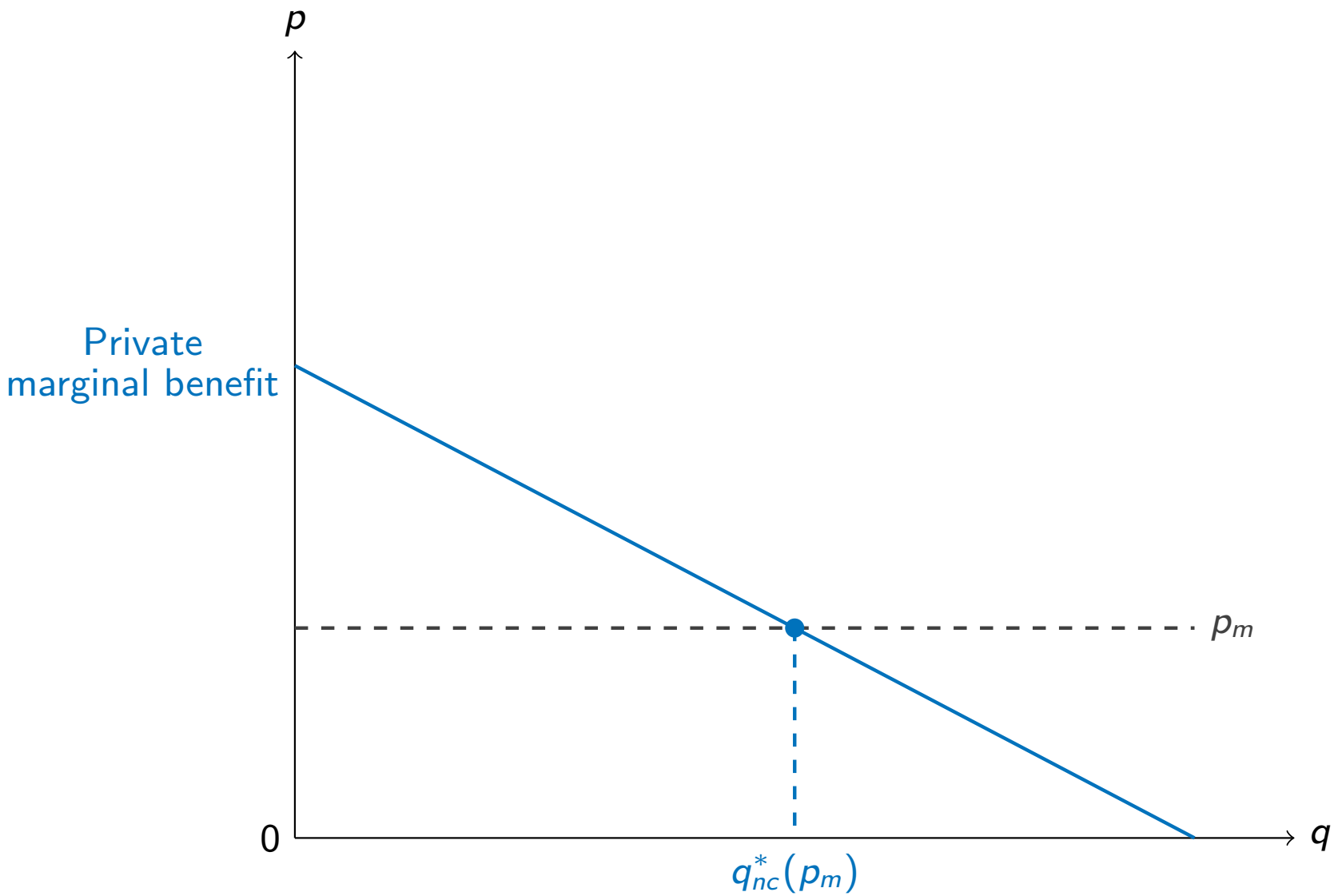
1. If private benefits (wtp_e) and social benefits are positively correlated, a uniform demand wedge will increase the marginal adopter's positive externality

2. If the demand wedge increases demand elasticity, this reduces subsidy expenditure per marginal adoption

3. Can this outweigh the shortcoming of fixed cost subsidies:
no intensive margin incentive, no targeting on the externality?

Graphical intuition: Marginal externality



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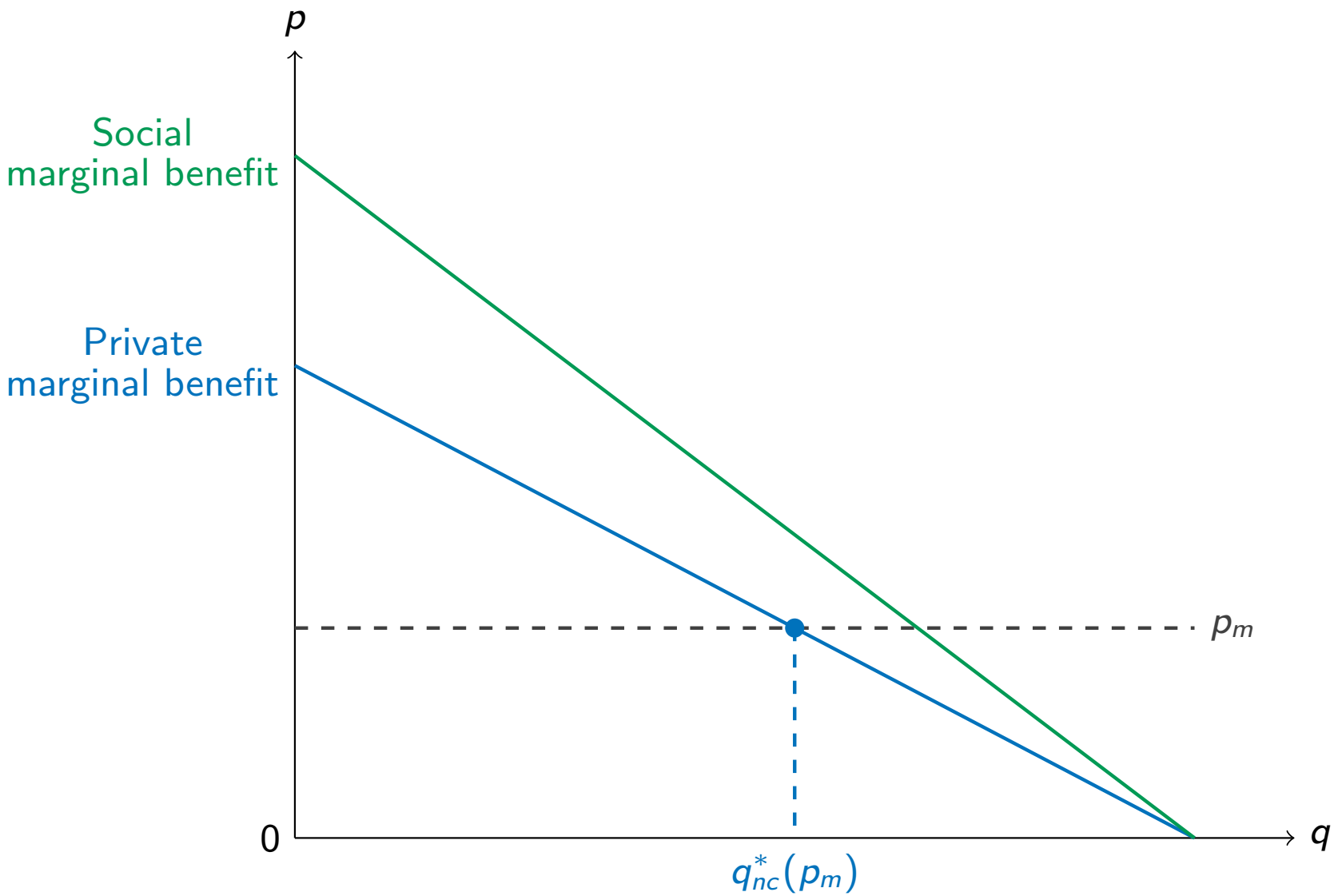

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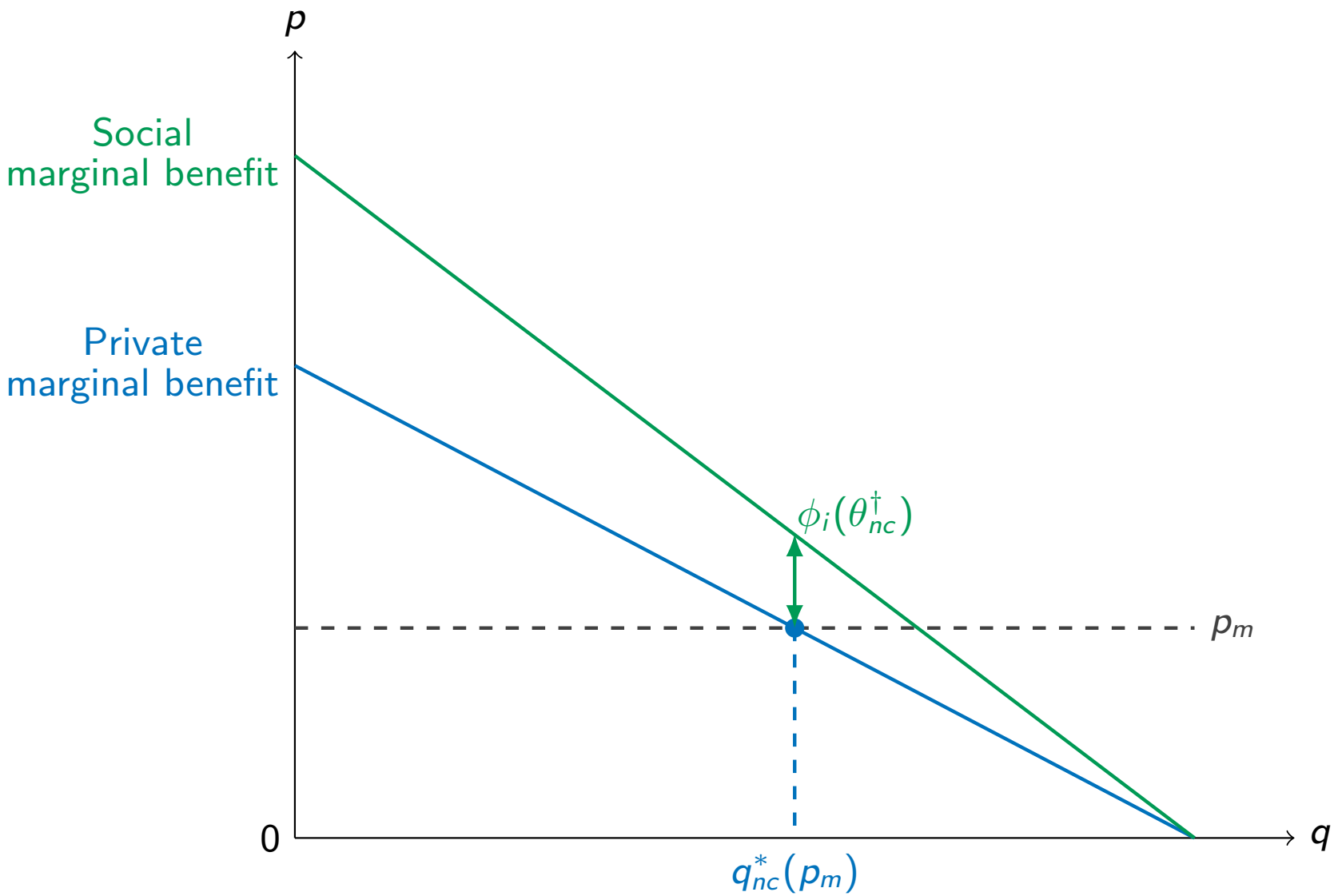

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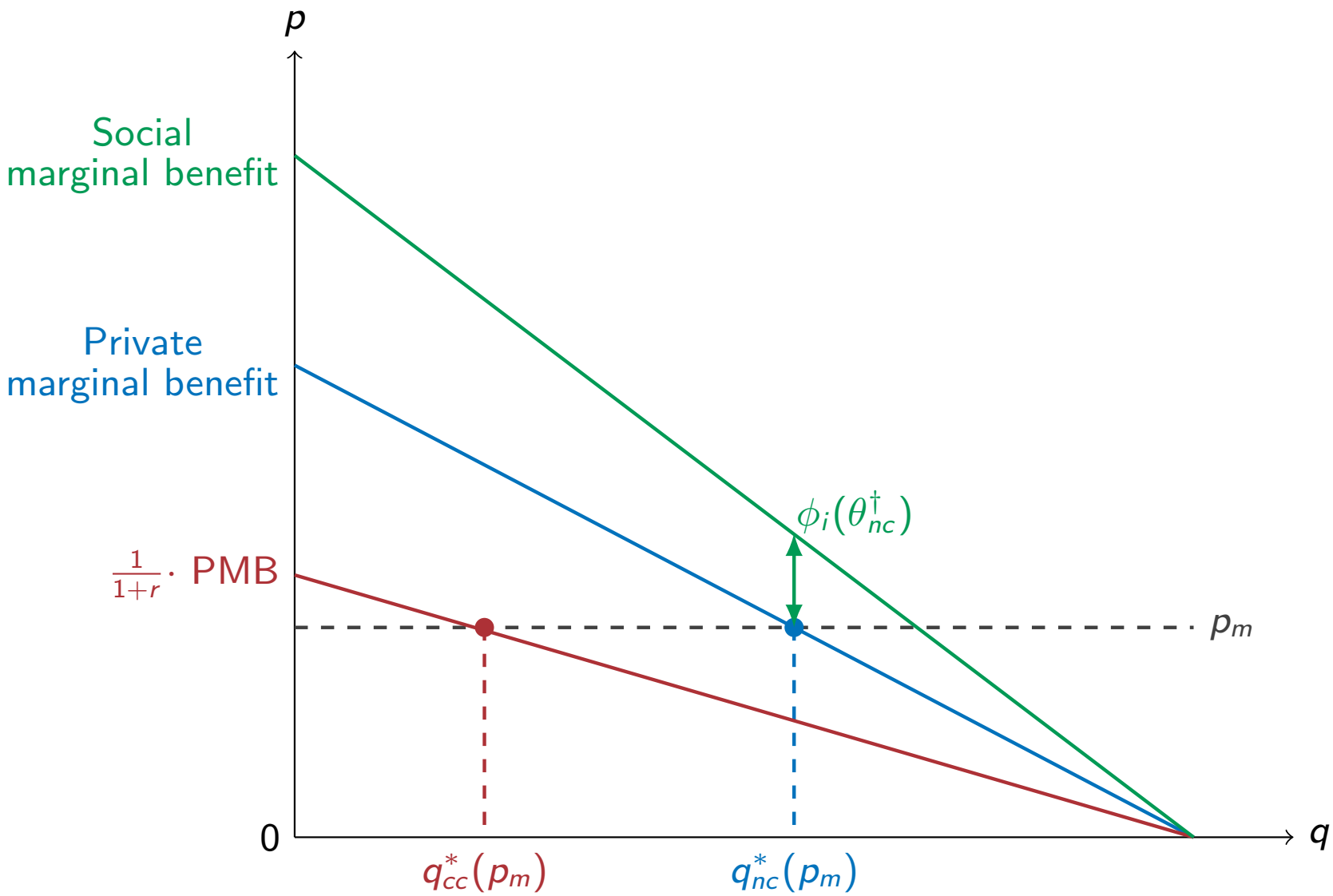
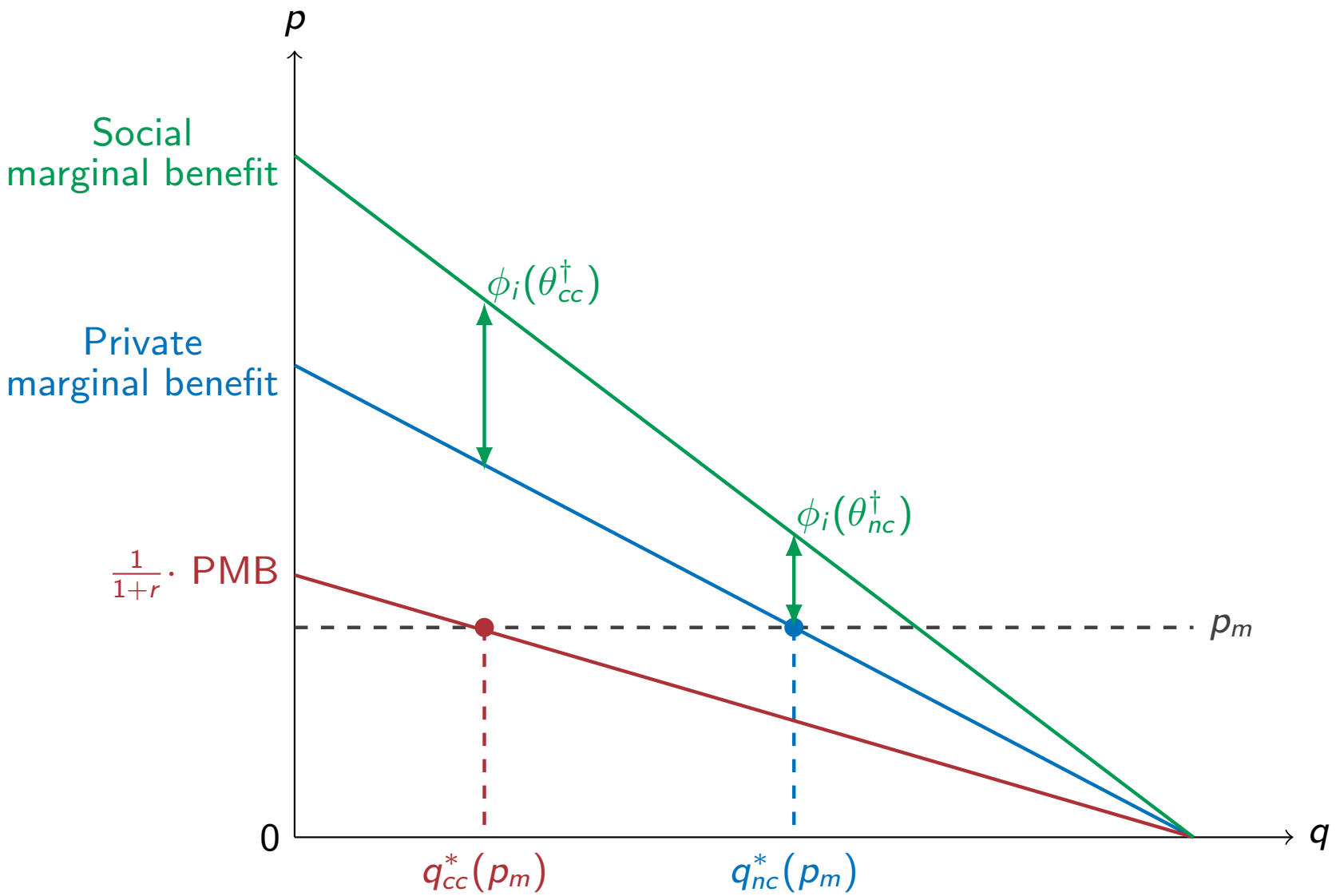


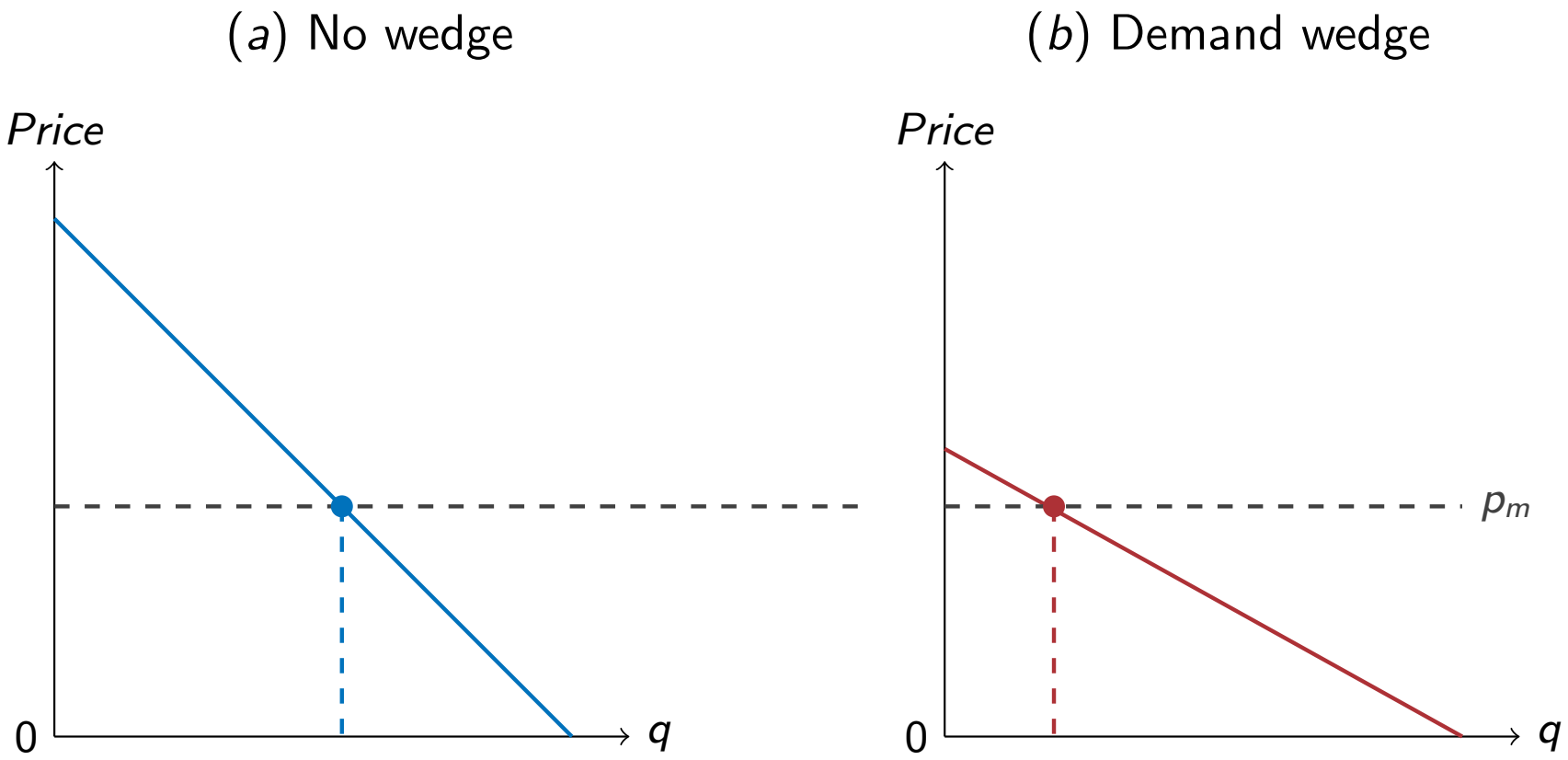
Graphical intuition: Marginal externality

Result 1: Demand wedges increase the marginal adopter's positive externality



Graphical intuition: Cost per marginal adopter

Result 2: Demand wedges increase demand elasticity



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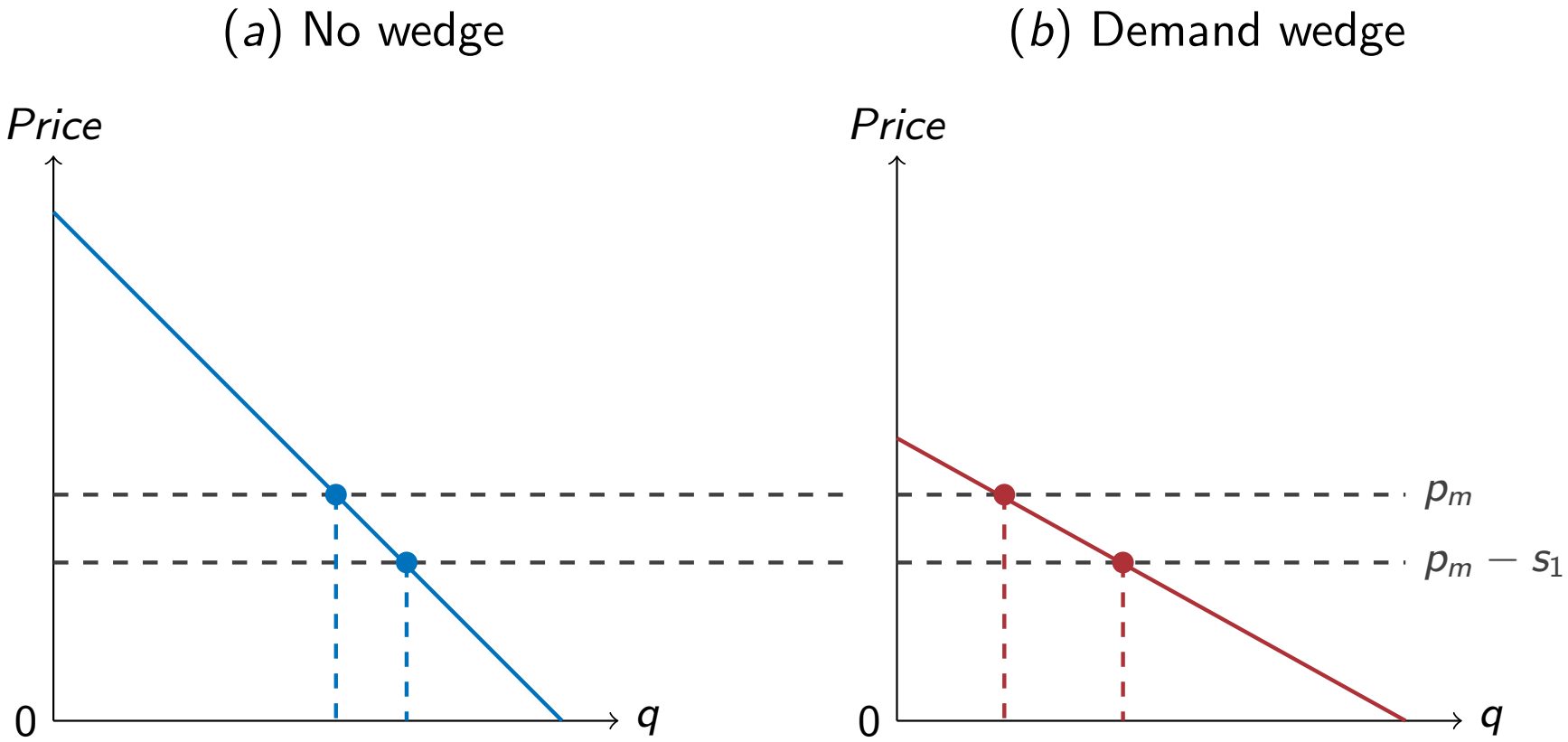

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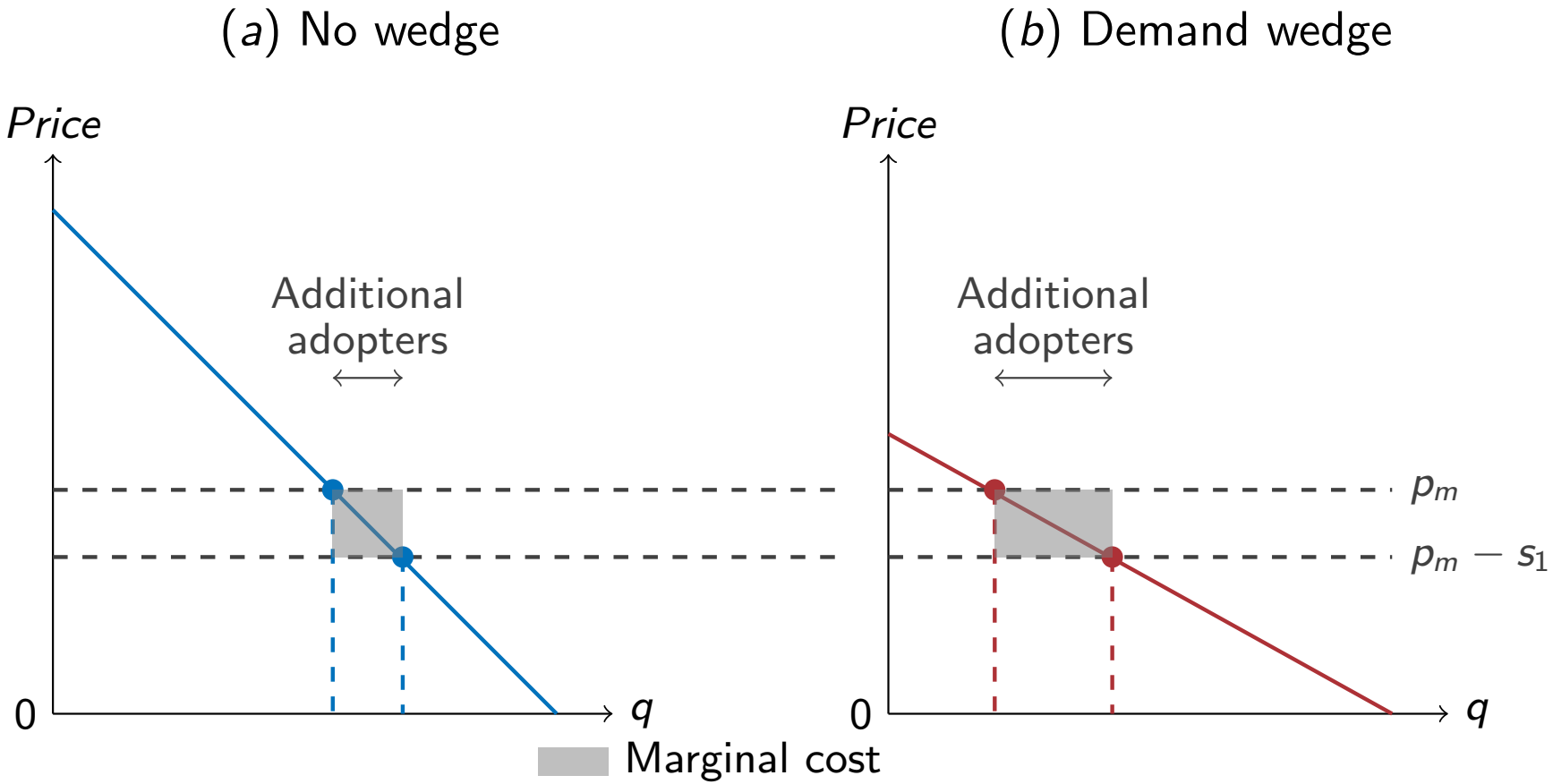
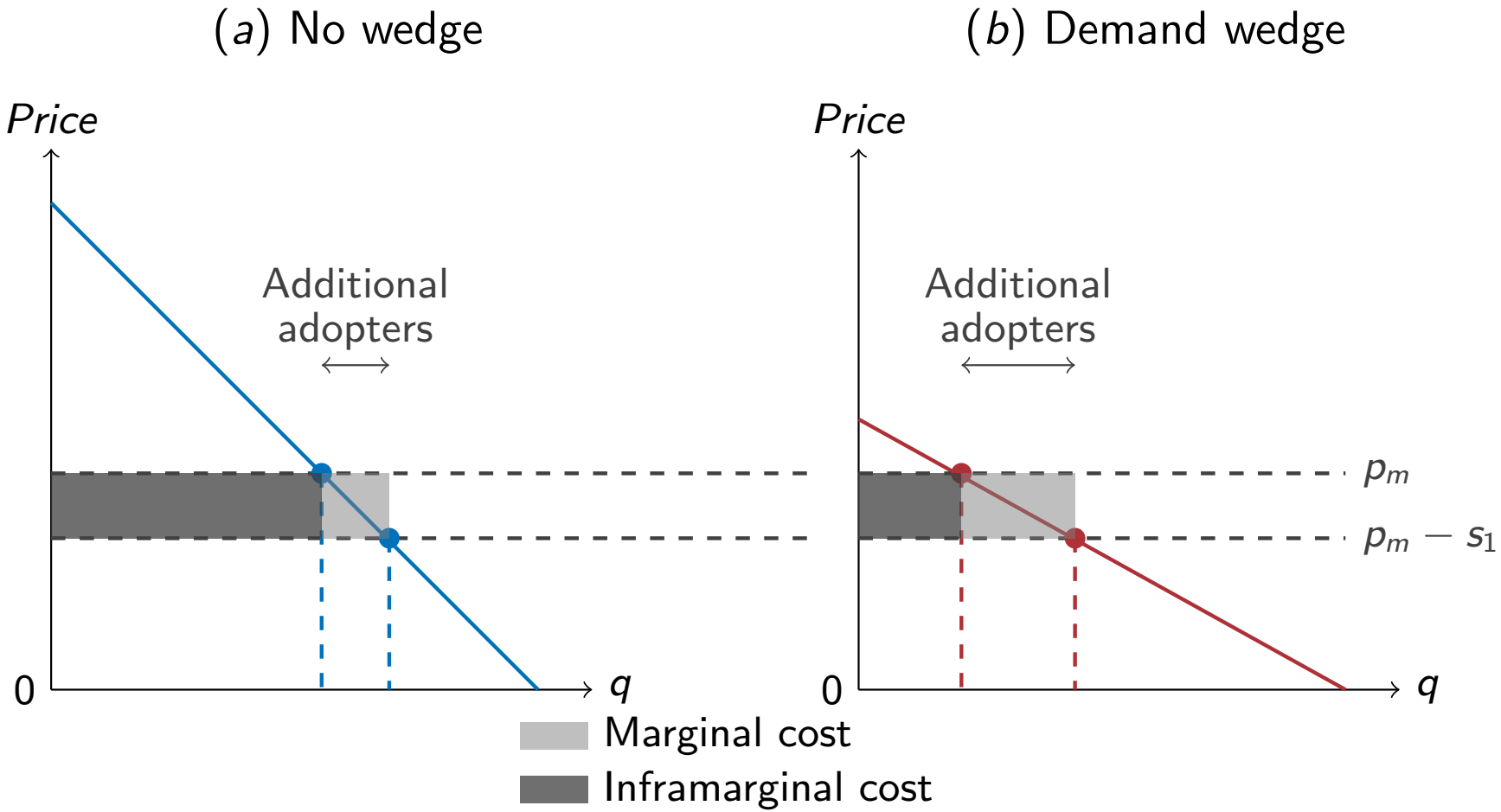


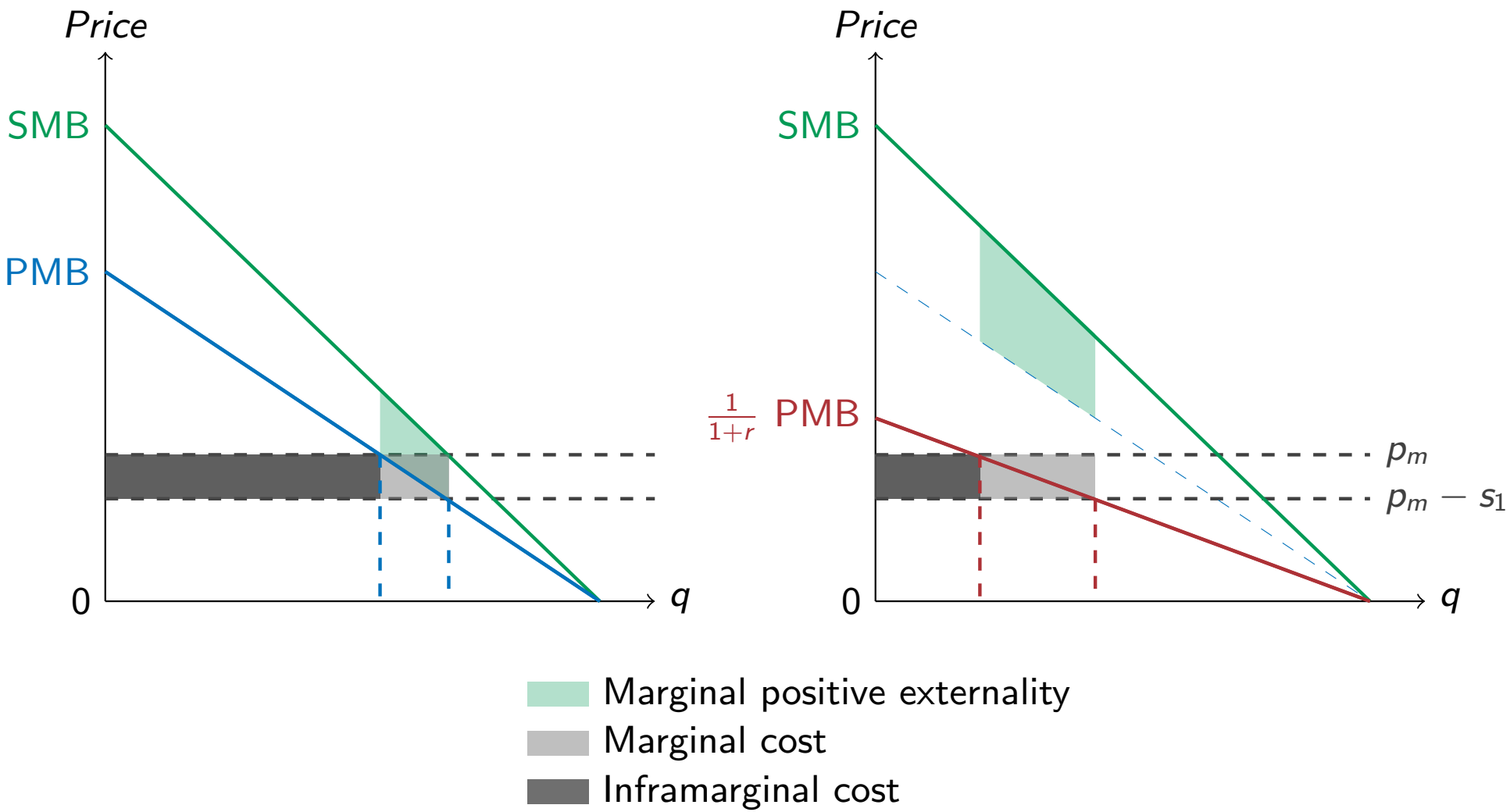
Graphical intuition: Cost per marginal adopter

Result 2: Demand wedges increase demand elasticity

- Elastic demand decreases the cost per marginal adopter



Subsidy efficiency: tCO_2e per dollar



Today

Improved charcoal stoves (Berkouwer and Dean; AER 2022)

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Electric: Empirics

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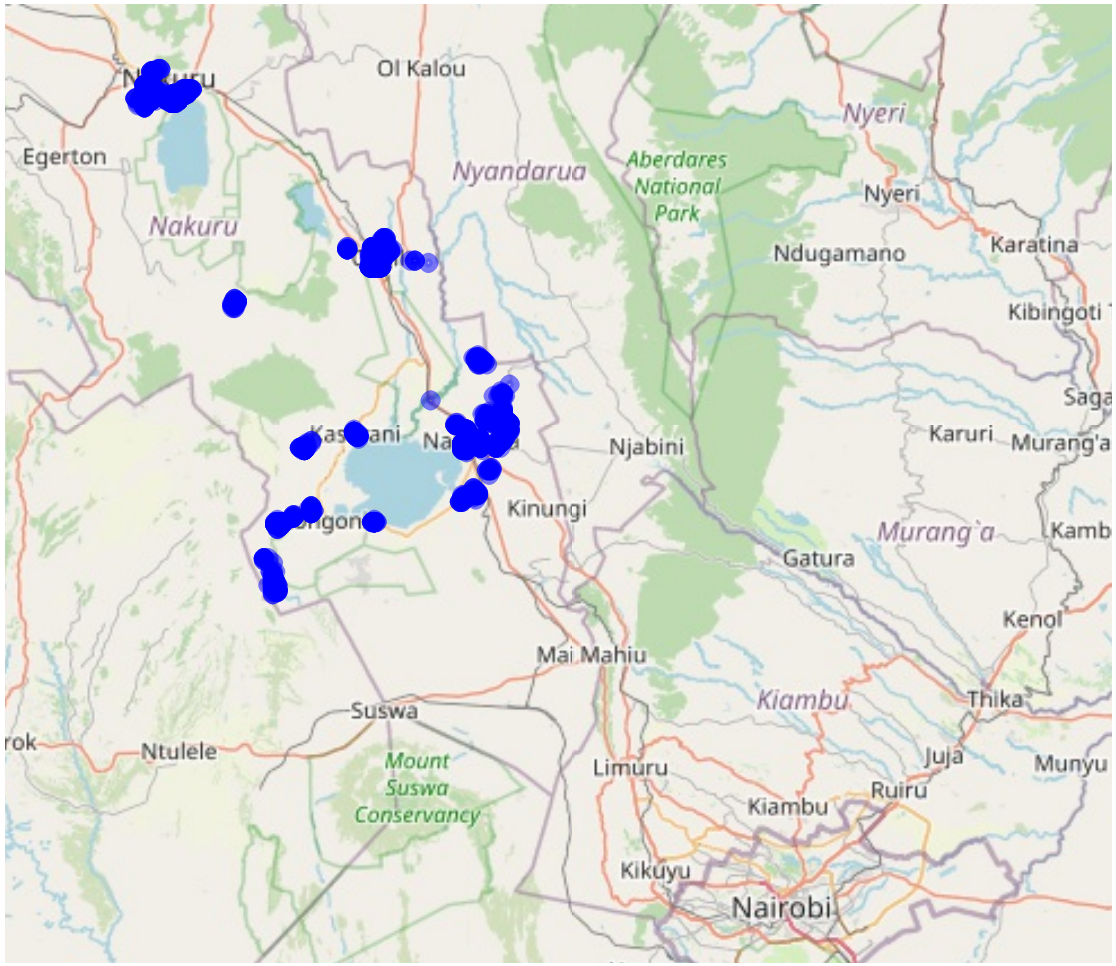
Future directions of research

RCT with 2,100 participants in Nakuru County

Cities of Naivasha, Nakuru, and Gilgil



RCT with 2,100 participants: ECOA induction stove

- Use traditional charcoal cookstove as primary cooking technology
- Have a pre-pay electricity meter

Kenyan Jiko
(instrumented with a SUM)

ECOA

Randomly assigned credit, FC subsidies, MC subsidies

- **Fixed cost subsidies**, down from store price of $82:
  - 46% assigned a price of $20 (86% subsidy)
  - 49% assigned a price of $73 (10% subsidy)

Full sample:
Random fixed cost subsidy of 10% or 86% off the stove price

Randomly assigned credit, FC subsidies, MC subsidies

- **Fixed cost subsidies**, down from store price of $82:
  - 46% assigned a price of $20 (86% subsidy)
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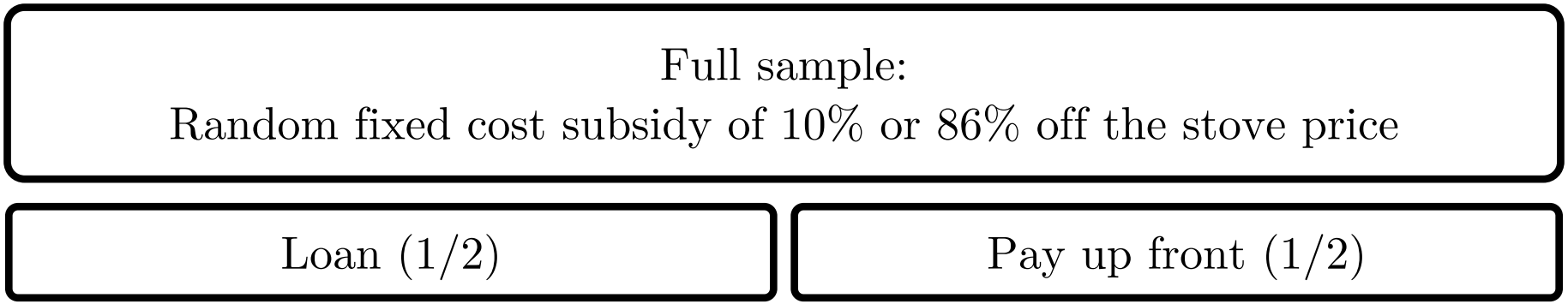
- **Two credit conditions:**
  - **Loan:** $15 down downpayment, three deadlines 1, 2, 3 months later
  - **Upfront:** Pay full P_i today



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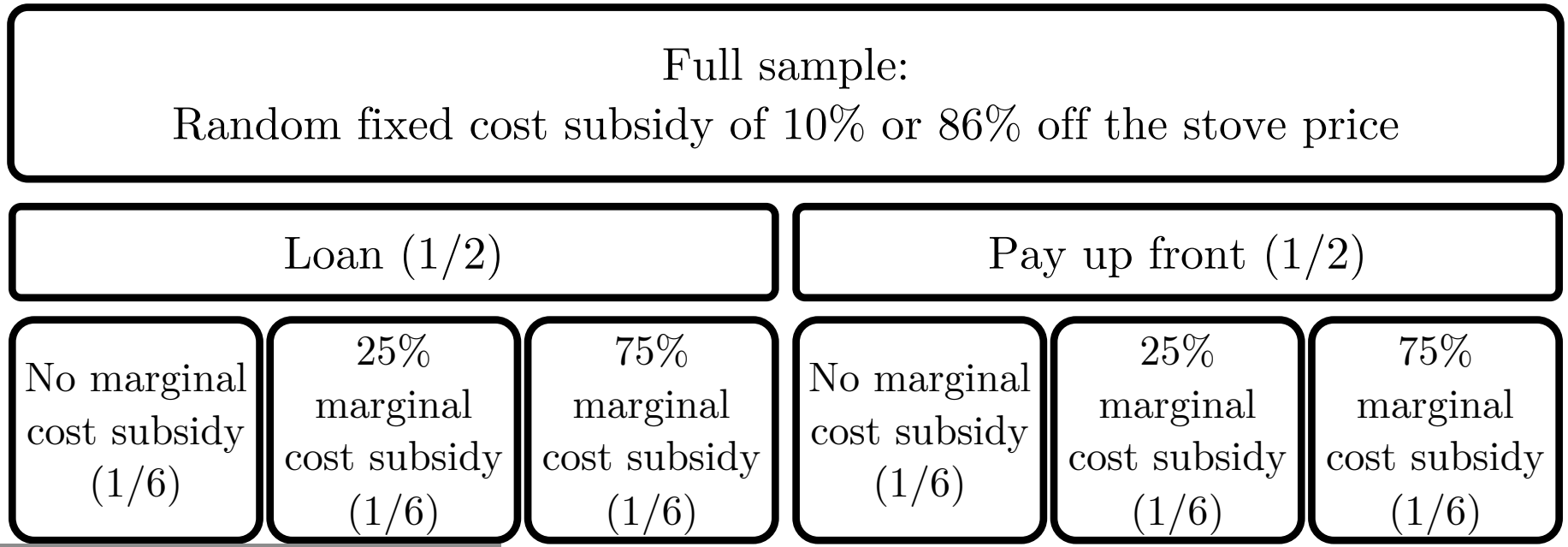
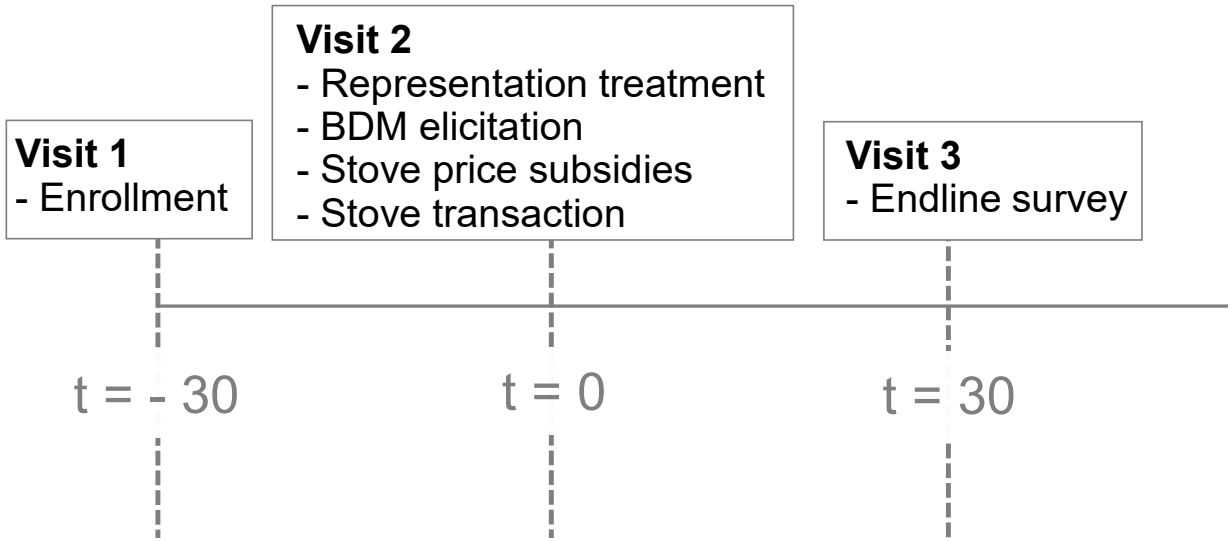
- **Marginal cost subsidies:** one-third each to 0%, 25%, 75%



Implementation Timeline



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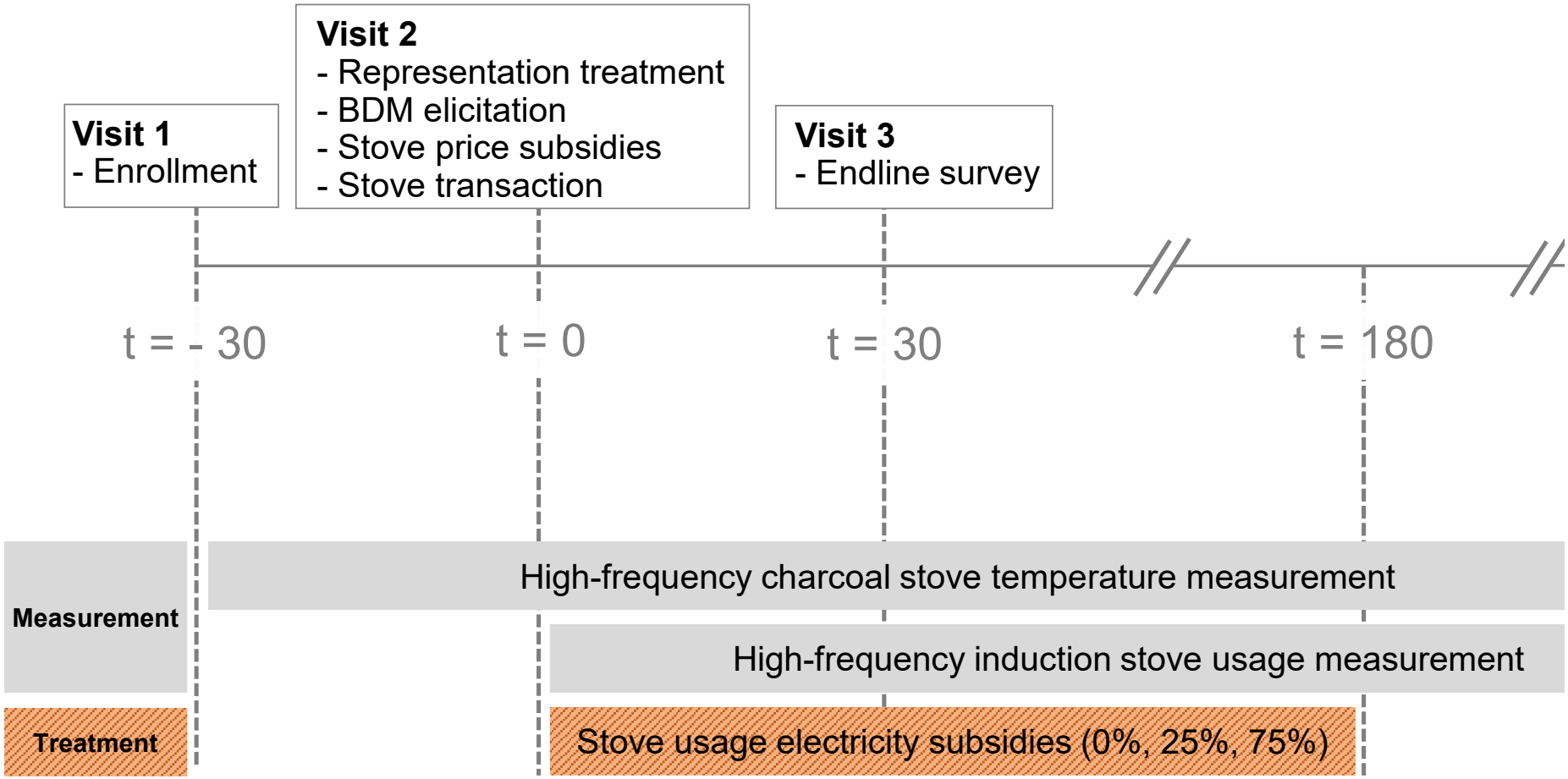
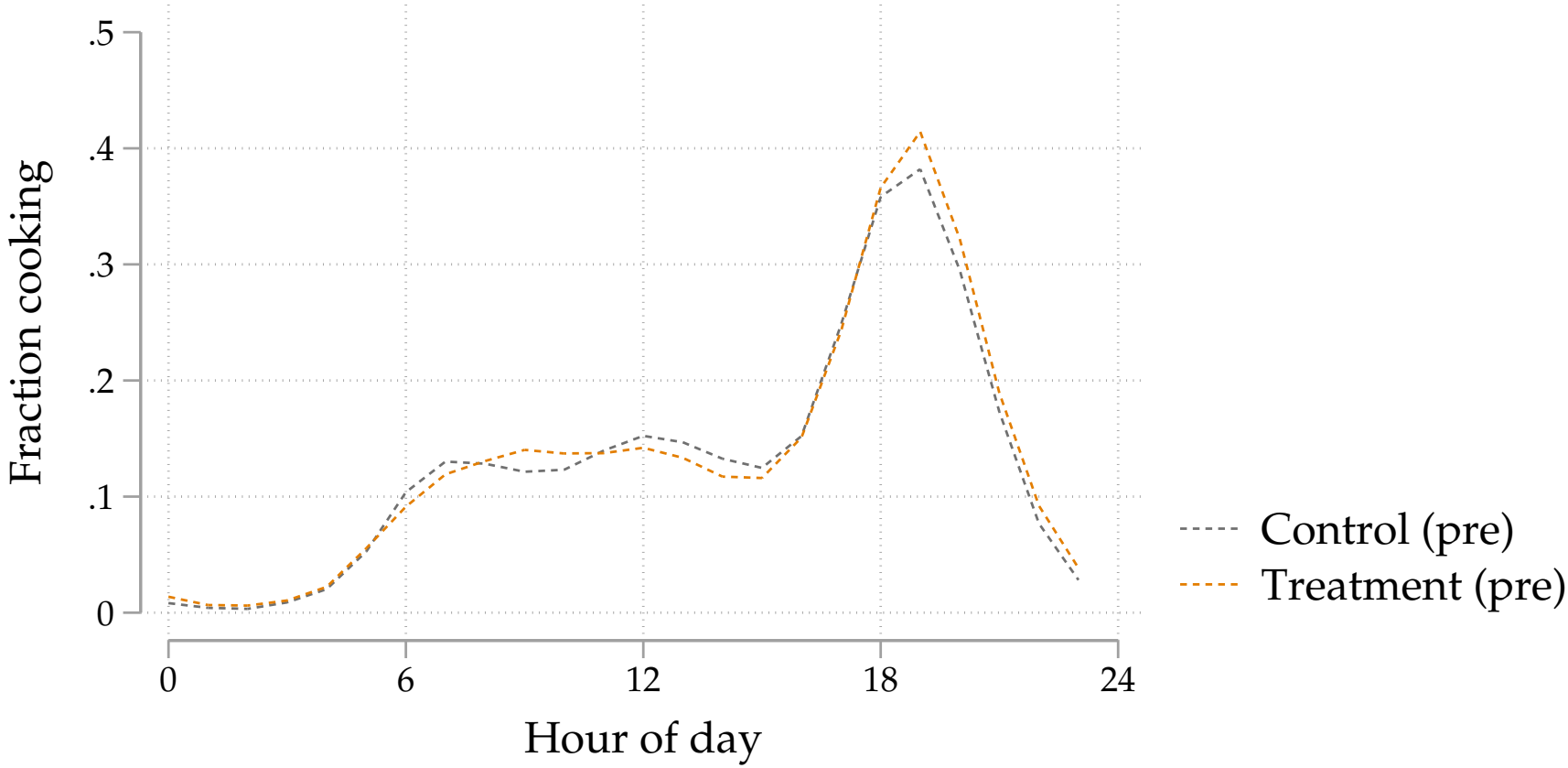


Induction stove adopters use charcoal stoves less



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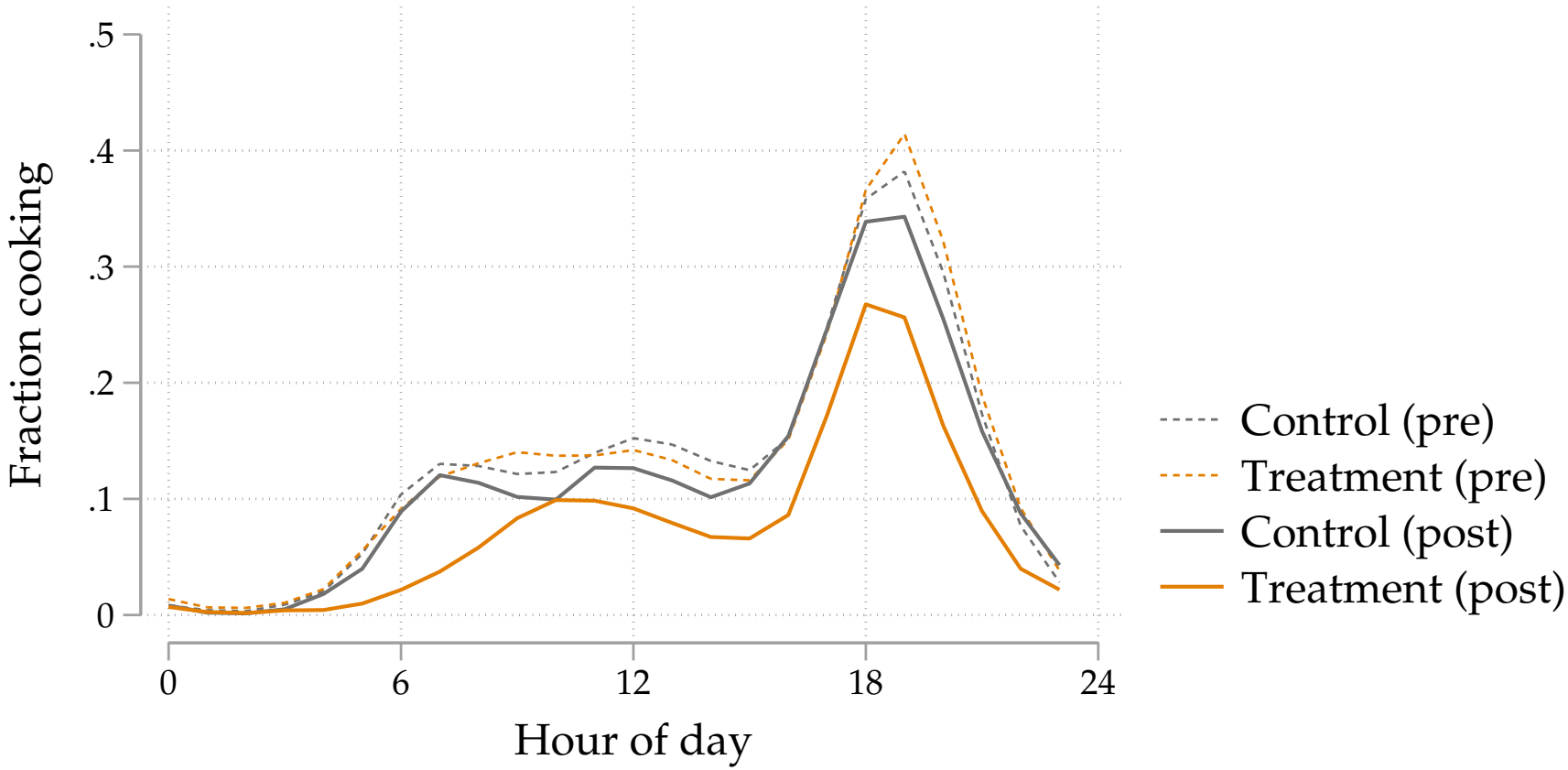


Lower energy spending by $8.9 per month (24%)

Table: IV estimate of induction stove purchase on monthly energy spending (USD)

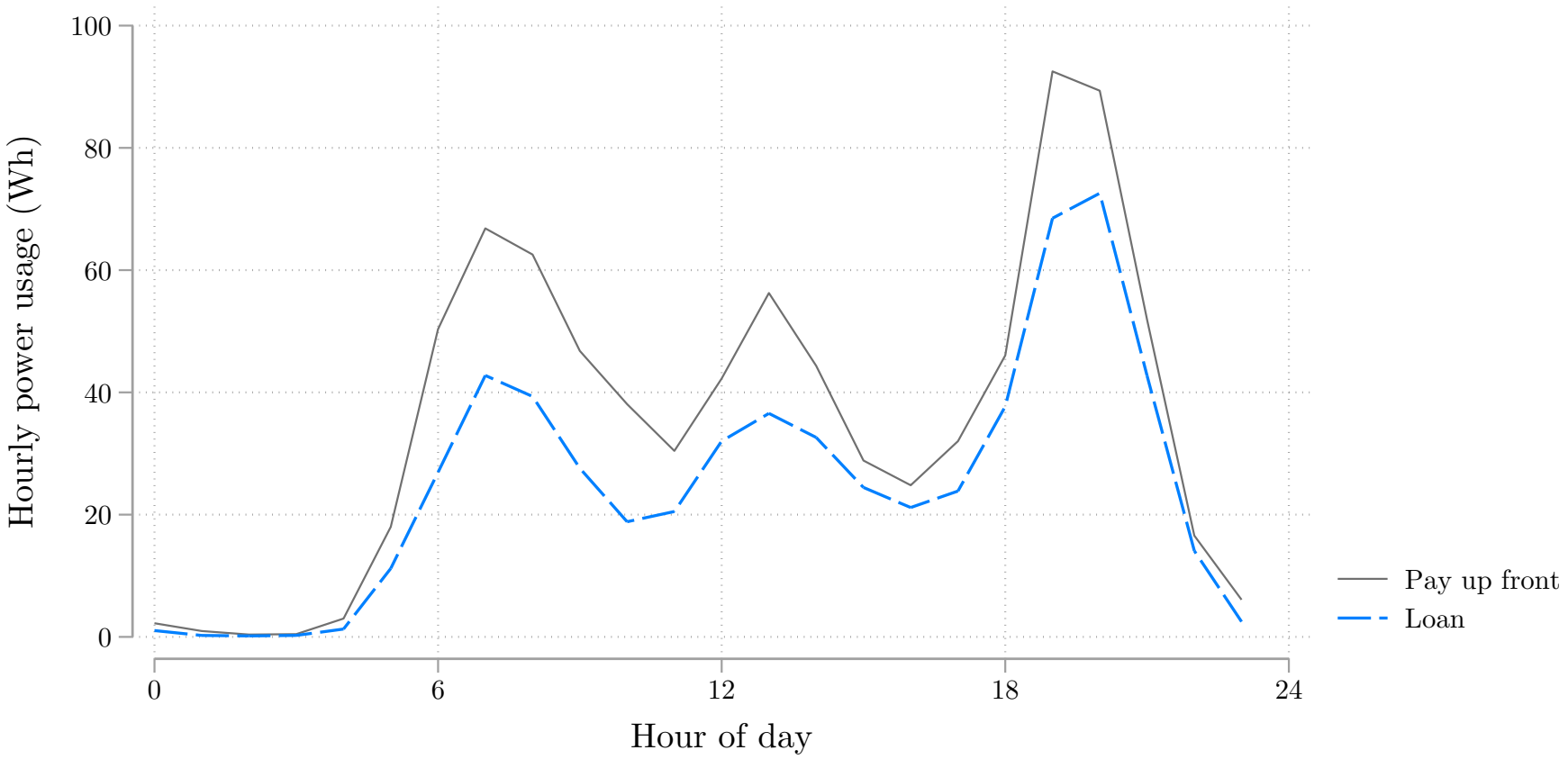
	Charcoal	LPG	Wood	Electricity	Total
Bought ECOA (=1)	-10.1***	-1.0	-0.4**	1.9***	-9.6***
	(0.9)	(0.6)	(0.2)	(0.4)	(1.1)
WTP (USD)	-0.0	0.0	0.0**	0.0***	0.0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Observations	1724	1724	1724	1724	1724
Control Mean	16.2	5.2	0.5	3.1	25.0
F-Stat	93.98	38.78	2.94	60.20	44.32

Lower CO_2e emissions by 3 tCO_2e per year

Table: IV estimate of induction stove purchase on annual emissions (tCO_2e)

	Charcoal	LPG	Electricity	Total
Bought ECOA (=1)	-3.06***	-0.03	0.02***	-3.08***
	(0.27)	(0.02)	(0.00)	(0.27)
WTP (USD)	-0.00	0.00	0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	1724	1724	1724	1724
Control Mean	4.9	0.2	0.0	5.1
F-Stat	93.98	38.78	60.20	92.01

Marginal adopters paying up front use new stoves more



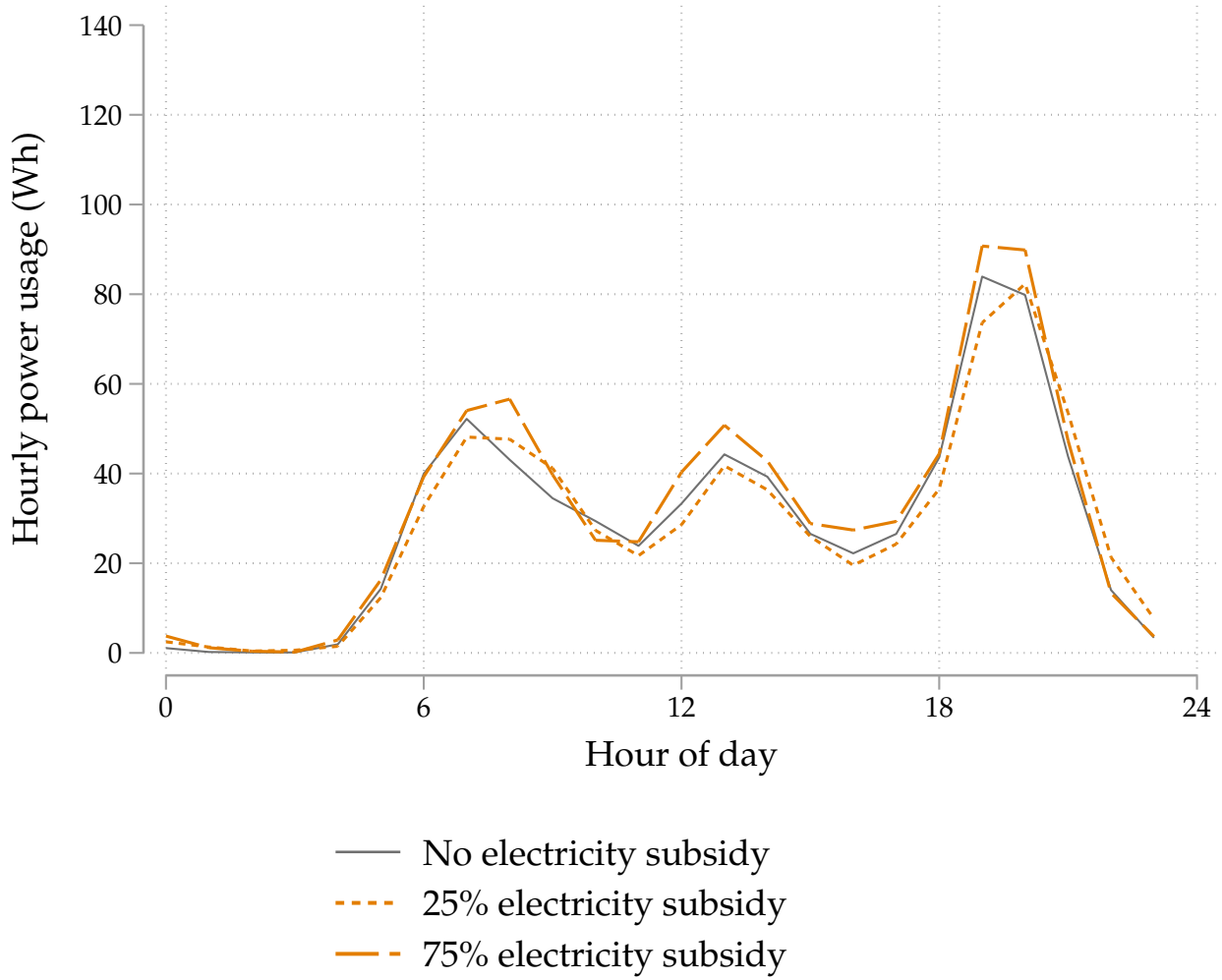
Marginal adopters paying up front abate more

	Charcoal (USD)		Charcoal (CO2)		Total (CO2)	
	(1)	(2)	(3)	(4)	(5)	(6)
Bought ECOA (=1)	-10.6***		-3.2***		-3.2***	
	(0.7)		(0.2)		(0.2)	
ECOA X No credit		-10.6***		-3.2***		-3.2***
		(0.7)		(0.2)		(0.2)
ECOA X Credit	1.6*	-8.9***	0.5*	-2.7***	0.5**	-2.7***
	(0.9)	(0.6)	(0.3)	(0.2)	(0.3)	(0.2)
Credit treatment (=1)	-0.5	-0.5	-0.1	-0.1	-0.2	-0.2
	(1.5)	(1.5)	(0.4)	(0.4)	(0.4)	(0.4)
Observations	717	717	717	717	717	717
Control Mean	15.9	15.9	4.8	4.8	5.0	5.0
Controls	Some	Some	Some	Some	Some	Some
Sample	All	All	All	All	All	All
F-Stat	6.85	6.85	6.85	6.85	6.90	6.90

Note: Instrumental variables regression, with strata and treatment FE and SES controls

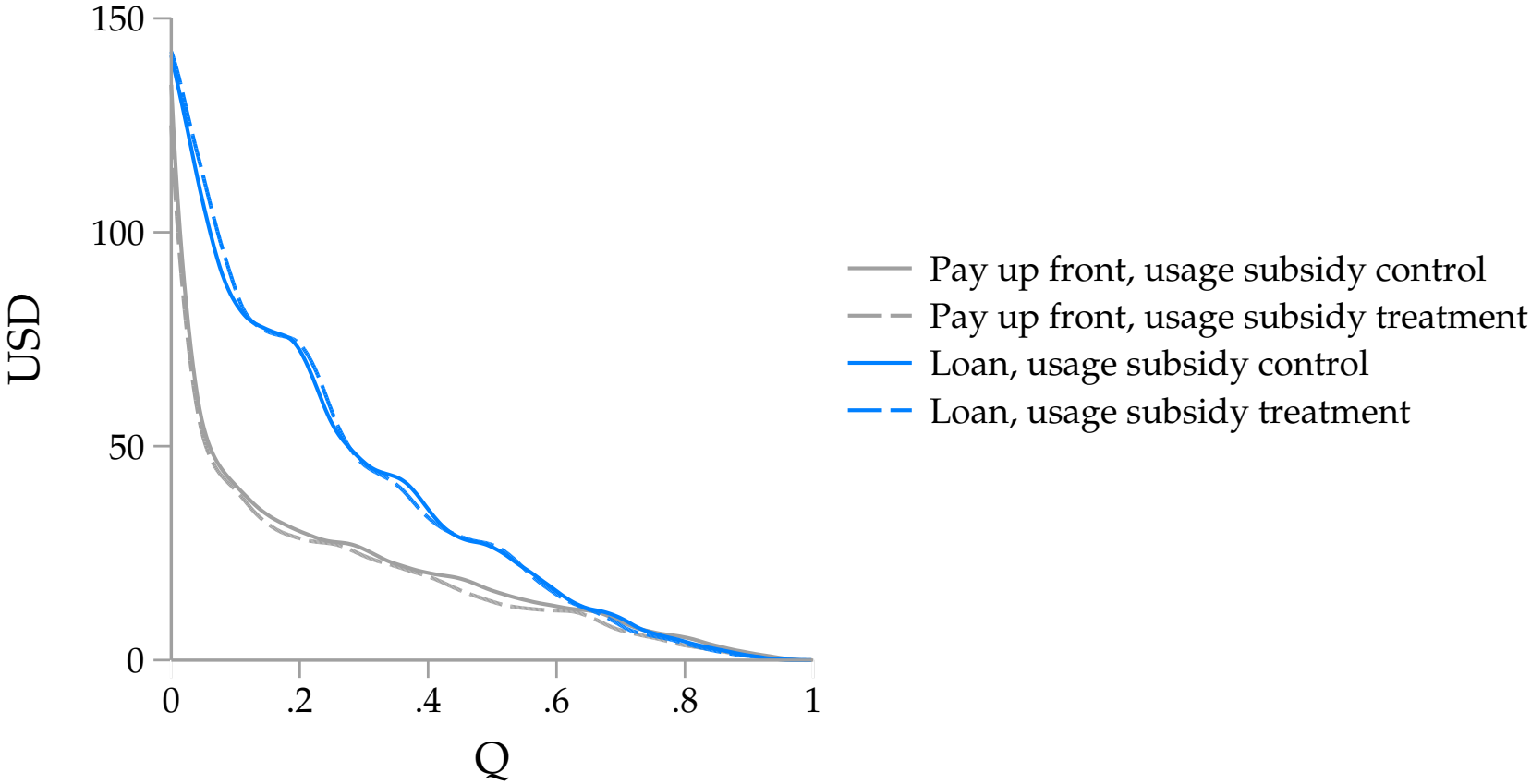
Conversely, intensive margin is very price inelastic

- Cannot distinguish between selection plus direct treatment effect
- Currently running another treatment to measure inattention



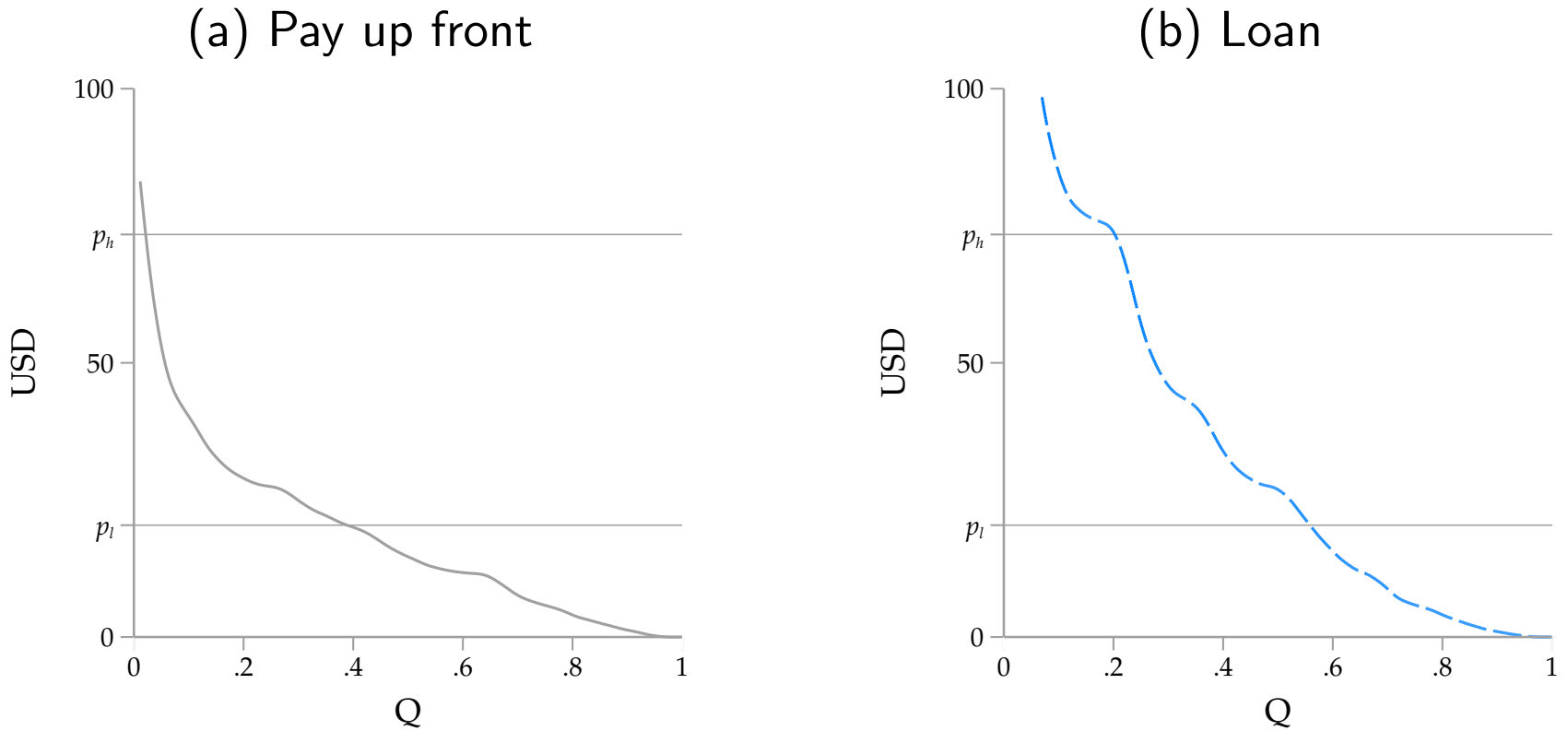
Marginal cost subsidies have no impact on WTP

- Each \$1 of marginal cost subsidy increases WTP by no more than \$0.20



Credit constraints and demand elasticity

- Two subsidy points: $p_h = \$73$ and $p_l = \$20$



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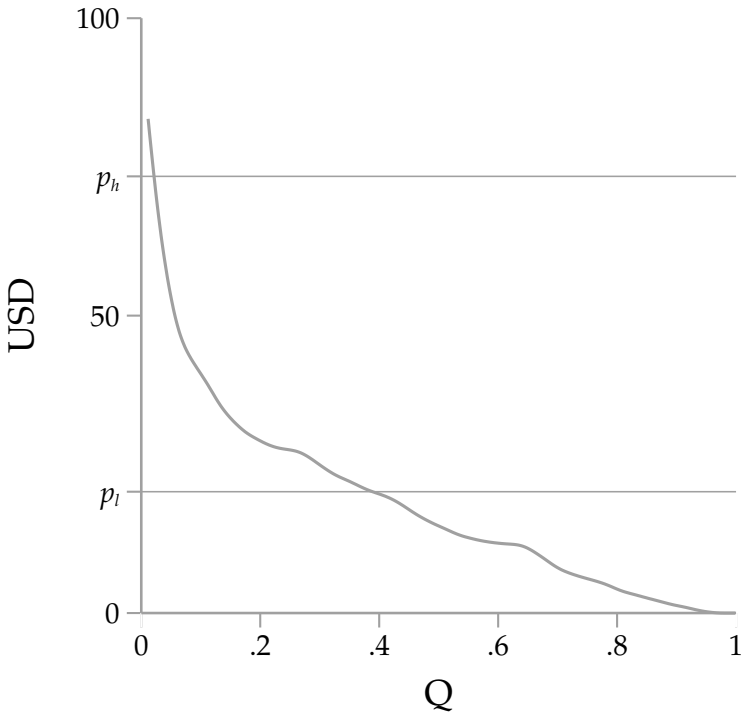
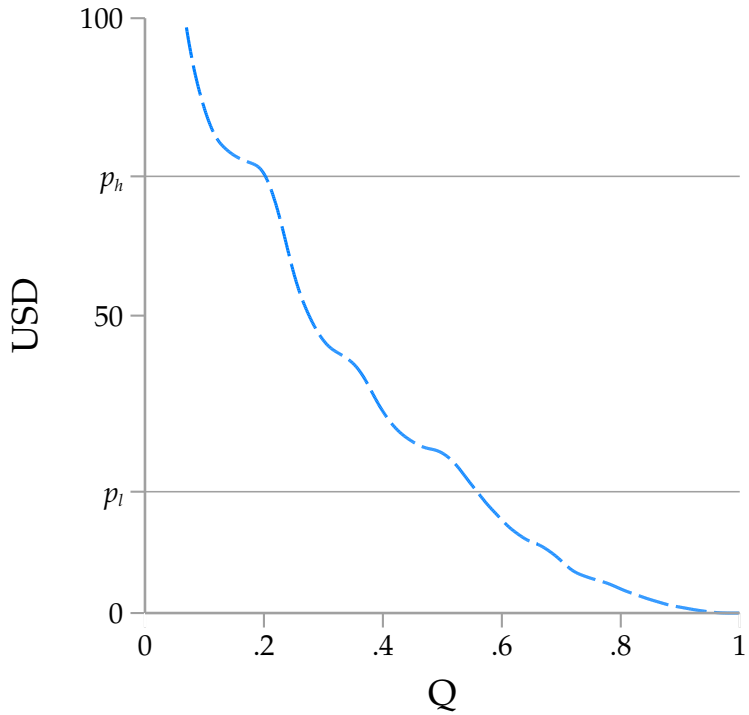
- Two subsidy points: $p_h = \$73$ and $p_l = \$20$
- Point: Loan $\mathcal{E}_D = -2.5$, Pay up front $\mathcal{E}_D = -30.8$
- Log-log: Loan $\mathcal{E}_D = -0.7$, Pay up front $\mathcal{E}_D = -2.0$

(a) Pay up front



(b) Loan



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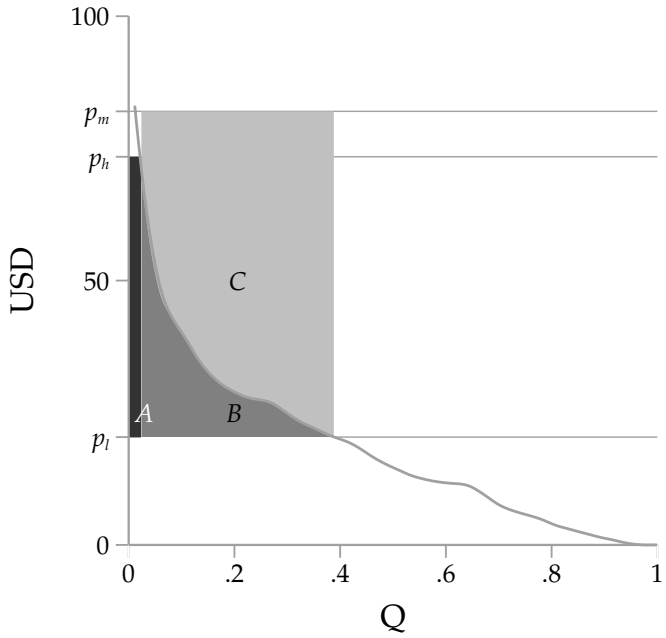

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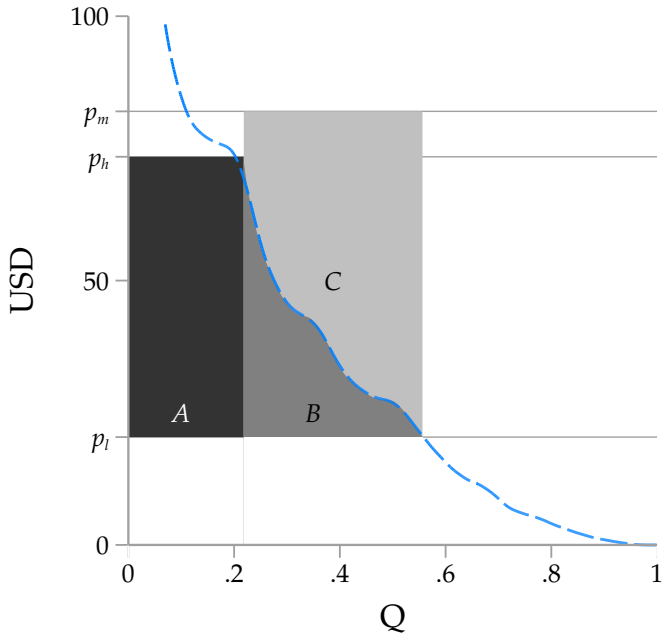

(A) Inframarginal payments to inframarginal buyers
(B) Inframarginal payments to marginal buyers
(C) Marginal payments to marginal buyers

Today

Improved charcoal stoves (Berkouwer and Dean; AER 2022)

Electric: Background

Electric: Empirics

Subsidy efficacy

Future directions of research

Credit constraints increase marginality

	Loan	**Up front**
Extensive margin elasticity to fixed subsidy	$\mathcal{E}_d = -2.5$	$\mathcal{E}_d = -30.8$
Fraction of population that is marginal	34%	37%
Fraction of subsidies cost to inframarginal adopters	38%	6.3%
Subsidy spending per additional adoption	\$99	\$63

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Abatement per marginal adopter	2.6 tCO_2e	3.2 tCO_2e
Abatement cost per tCO_2e after 3 years	**\$12.2**	**\$5.7**

Back of the envelope applications

- Larger demand wedge *e.g. credit constraints*
- Positively correlated private and social benefits, *e.g. fuel efficiency*
- Inelastic intensive margin *e.g. daily routines*

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- 2 billion people cook with biomass
  $\Rightarrow$ Induction stoves: \$6 per tCO_2e
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- 700 million people use kerosene lighting
  $\Rightarrow$ Solar lamps: \$10 per tCO_2e Rom, Pomeranz, Gunther; 2025 WP
- 20 million diesel irrigation pumps in India
- 25 million ICE motorcycles in Africa

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For comparison:

- EV subsidies cost >\$1,000 per tCO_2e *IEA 2024; Muehlegger, Rapson 2023; Hahn, Hendren, Metcalfe, Sprung-Keyser 2025. In U.S., 80% of new cars sold with financing.*

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

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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

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)

Good dishes have multiple ingredients!
DEV/ENV 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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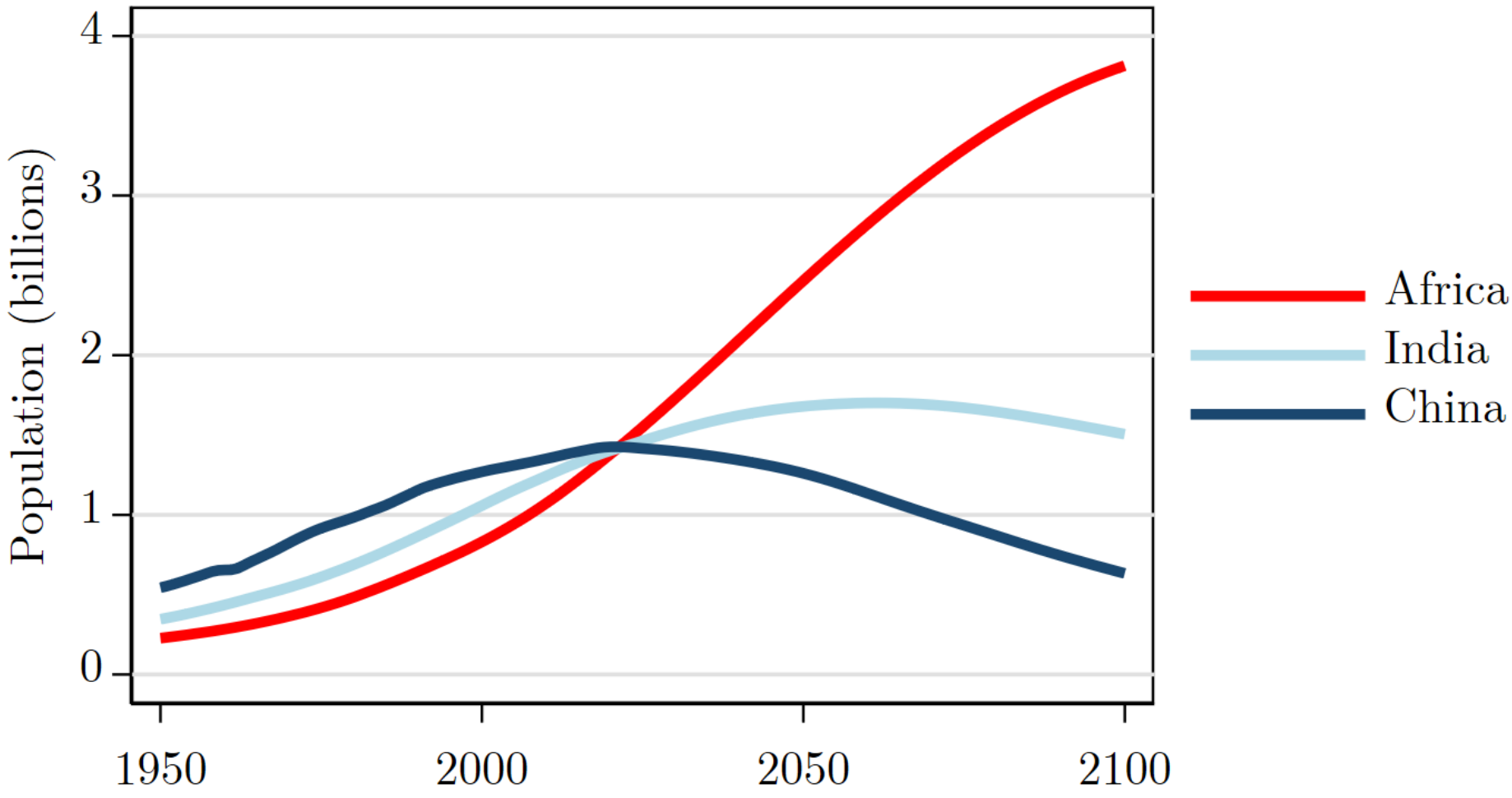
  $\rightarrow$ Distributional consequences
- Tragedy of the commons: common resources

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.

Population in China, India, Africa



Source: UN, World Population Prospects (2024), medium scenario