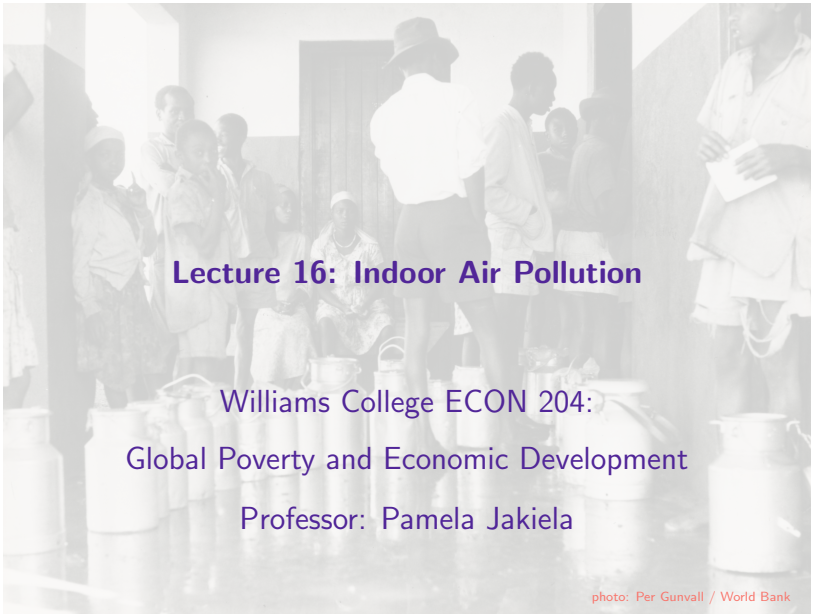


Lecture 16: Indoor Air Pollution

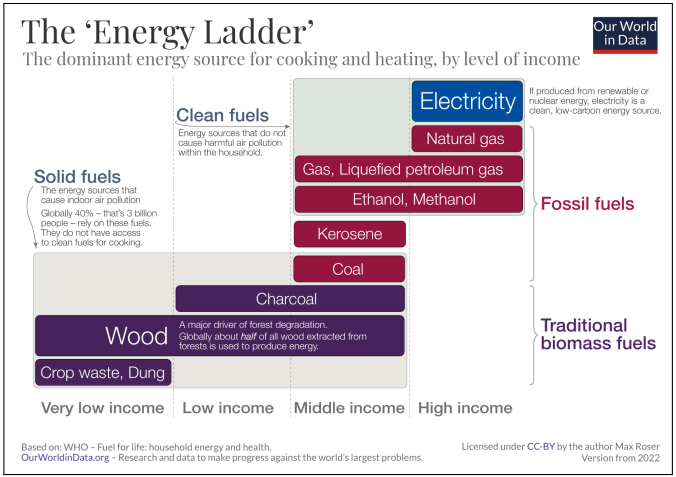
Williams College ECON 204:

Global Poverty and Economic Development

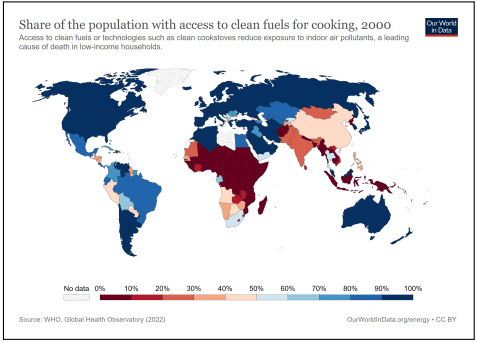
Professor: Pamela Jakiela

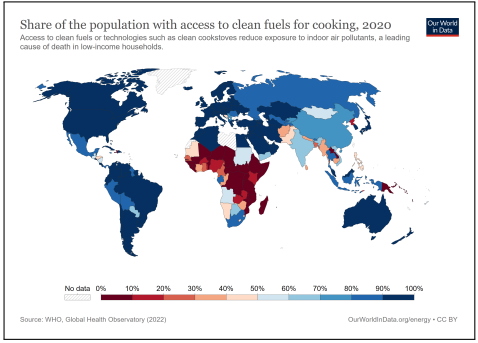
photo: Per Gunvall / World Bank

3 Billion People Use Biomass Fuels for Cooking



3 Billion People Use Biomass Fuels for Cooking





Consequences of the Use of Biomass Fuels for Cooking

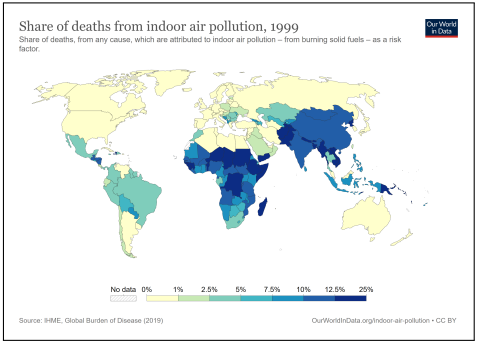
The use of wood as a cooking fuel has serious environmental consequences

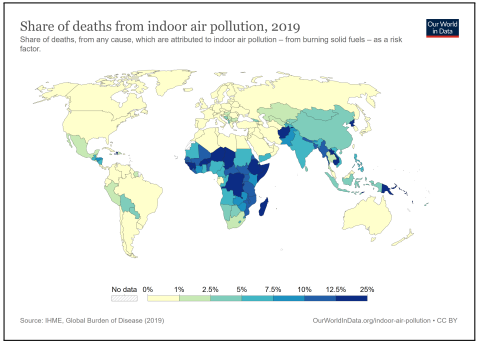
- In African countries, the use of wood for cooking is the main cause of forest degradation
- The use of wood as fuel accounts for between 2 and 7 percent of greenhouse gas emissions

1 in 25 deaths worldwide is due to indoor air pollution

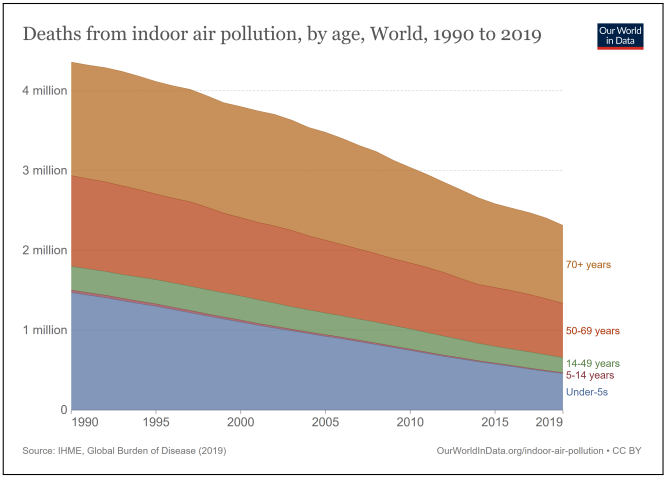
- Indoor air pollution from cooking with biomass fuels is a major risk factor for chronic obstructive pulmonary disease among women and acute respiratory infections in children
- Leads to about 2.3 million deaths per year, mostly among those over 50 and under 5

Indoor Air Pollution Is a Leading Cause of Death in Low-Income Countries





3 Billion People Use Biomass Fuels for Cooking



How to Model Household Purchase Decisions

Many consumption decisions (e.g. lunch) involve immediate costs and benefits

- Utility or welfare if you do not purchase the good: $U_{\text{do not buy}} = 0$
- Utility or welfare if you purchase the good: $U_{\text{buy}} = b - c$
  - b is individual or household valuation of the good
  - c is the cost of purchasing the good, which is often just the price p
- A simple model of demand: purchase a good when $U_{\text{buy}} > U_{\text{do not buy}} \Leftrightarrow c < b$

For many economic decisions, costs and benefits that do not occur simultaneously

- Health, environmental issues etc. often involve delayed costs and benefits
- All durable goods (like stoves) are purchase now, but used over many subsequent periods

Willingness-to-Pay (WTP) for Future Health Benefits

Efficient cookstoves are an **investment good** with immediate costs and future health benefits

- Decision-makers tend to **discount** future costs and benefits relative to immediate payouts

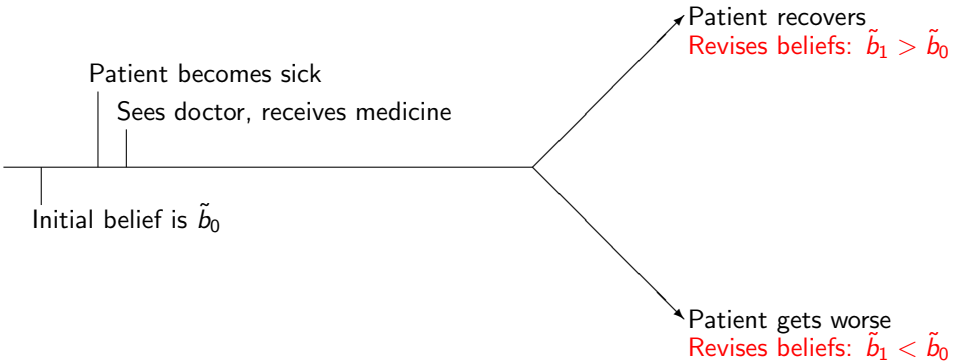
Households will choose to purchase an efficient cookstove whenever:

$$\text{immediate costs} \leq \text{discounted future benefits}$$
$$p \leq d\tilde{b}$$

where:

- $p =$ price of efficient cookstove
- $d =$ discount factor (between 0 and 1)
- $\tilde{b} =$ perceived future benefit from improved health

Learning About Curative Medical Treatment is (Relatively) Easy



Willingness-to-Pay (WTP) for Future Health Benefits

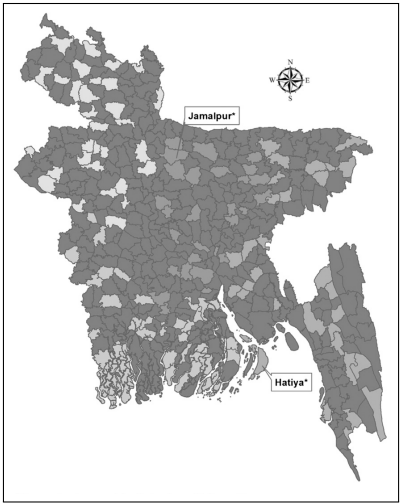
For acute conditions, households learn about costs and benefits of different treatments from medical advice, their own experiences (model), and the experiences of friends, neighbors, etc.

- With preventive health investments, benefits occur long after purchase decision
- Indoor air pollution is one of many risk factors for respiratory diseases
  - Many individuals who do not invest in clean cookstoves will not get sick
  - Some individuals who **do** invest in clean cookstoves will still get sick
- Poor households may not trust information about health benefits of cookstoves

Households' beliefs about $\tilde{b}$ may be below policymakers' beliefs, accurately or not

- What other explanations for "under-adoption" might be missing from the model?

Do Households Underestimate the Benefits from Clean Cookstoves?



Variable of interest	*n*	Mean	SD
People in the household	2,397	5.26	2.24
Occupation of household head			
Agriculture	795	0.33	0.47
Business	470	0.20	0.40
Service	296	0.12	0.33
Labor	352	0.15	0.35
Others	484	0.20	0.40
Education of household head			
Illiterate	988	0.41	0.49
Grades I–V	599	0.25	0.43
Grades V–X	637	0.27	0.44
Grade XI and above	144	0.06	0.24
Others	29	0.01	0.11

Source: Mobarak et al. (2012)

Beliefs About the Benefits from Clean Cookstoves

			Health hazard		
Question	No	Yes	Sweeping dust	Spoiled food	Polluted water
Is smoke from cookstoves harmful to health?	141 (6%)	2,256 (94%)	—	—	—
	[4.9–6.8]	[93–95]	—	—	—
Smoke from cookstoves is more harmful than	—	—			
Smoke from cookstoves is equally harmful as	—	—			
Smoke from cookstoves is less harmful than	—	—			
I do not know	—	—			

Confidence intervals (%) are given in brackets below values.

Source: Mobarak et al. (2012)

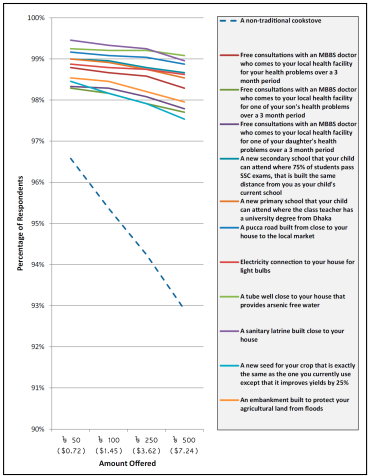
Households' Valuation of Cookstove Attributes

Characteristic	Preference	
	Primary	Secondary
Reduces fuel costs	1,120 (46.7%)	2 (0.1%)
	[43.8–49.6]	[−3.9–4.1]
Needs less time to cook a meal	515 (21.5%)	476 (19.9%)
	[17.9–25.0]	[16.8–23.4]
Uses more types of fuel	346 (14.4%)	114 (4.8%)
	[10.7–18.1]	[0.9–8.7]
Reduces or eliminates smoke in the house	215 (8.9%)	1,031 (43.0%)
	[5.1–12.8]	[39.9–46.0]
Needs less monitoring time while cooking	101 (4.2%)	103 (4.3%)
	[0.3–8.1]	[0.4–8.2]
Has more cooking chambers	75 (3.1%)	111 (4.6%)
	[−0.8–7.1]	[0.7–8.5]
Maintains taste of food	8 (0.3%)	177 (7.4%)
	[−3.7–4.3]	[3.5–11.2]
Portability	5 (0.2%)	141 (5.9%)
	[−3.8–4.2]	[2.00–9.8]

Confidence intervals (%) are given in brackets below values.

Source: Mobarak et al. (2012)

Households' Hypothetical WTP for Clean Cookstoves



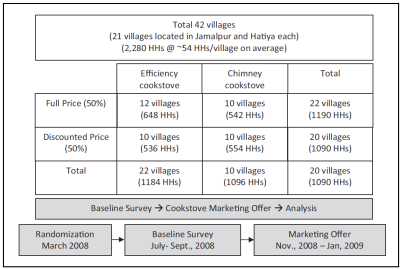
Source: Mobarak et al. (2012)

Infrastructure-related facilities	Amount of cash offered			
	৳50 ($0.72)	৳100 ($1.45)	৳250 ($3.62)	৳500 ($7.24)
A tube well close to your house that provides arsenic-free water	18 (0.7%) [0.4–1.1]	19 (0.8%) [0.4–1.1]	19 (0.8%) [0.4–1.1]	22 (0.9%) [0.5–1.3]
A sanitary latrine built close to your house	13 (0.5%) [0.3–0.8]	16 (0.7%) [0.3–1]	18 (0.8%) [0.4–1.1]	25 (1.1%) [0.6–1.4]
A pucca (all-season) road built from close to your house to the local market	20 (0.8%) [0.5–1.2]	22 (0.9%) [0.5–1.3]	23 (0.9%) [0.6–1.4]	27 (1.1%) [0.7–1.5]
A new secondary school that your child can attend where 75% of students pass Secondary School Certificate examinations and is built the same distance as your child's current school	24 (1%) [0.6–1.4]	25 (1.1%) [0.6–1.4]	29 (1.2%) [0.8–1.6]	32 (1.3%) [0.9–1.8]
Electricity connection to your house for light bulbs	27 (1.1%) [0.7–1.5]	29 (1.2%) [0.8–1.6]	30 (1.2%) [0.8–1.7]	33 (1.4%) [0.9–1.8]
A new primary school that your child can attend where the class teacher has a university degree from Dhaka, Bangladesh	24 (1%) [0.6–1.4]	26 (1.1%) [0.7–1.5]	30 (1.2%) [0.8–1.7]	35 (1.5%) [1–1.9]
Free consultations with an MBBS doctor who comes to your local health facility for your health problems over a 3-mo period	29 (1.2%) [0.8–1.6]	32 (1.3%) [0.9–1.8]	34 (1.4%) [0.9–1.9]	41 (1.7%) [1.2–2.2]
An embankment built to protect your agricultural land from floods	35 (1.5%) [1–2]	37 (1.5%) [1–2]	43 (1.8%) [1.3–2.3]	49 (2.04%) [1.5–2.6]
Free consultations with an MBBS doctor who comes to your local health facility for one of your daughter's health problems over a 3-mo period	40 (1.7%) [1.2–2.2]	41 (1.7%) [1.2–2.2]	46 (1.9%) [1.4–2.5]	53 (2.2%) [1.6–2.8]
Free consultations with an MBBS doctor who comes to your local health facility for one of your son's health problems over a 3-mo period	41 (1.7%) [1.2–2.2]	44 (1.8%) [1.3–2.4]	50 (2.1%) [1.5–2.7]	55 (2.3%) [1.7–2.9]
A new seed for your crop that is exactly the same as the one you currently use except that it improves yields by 25%	37 (1.5%) [1–2]	44 (1.8%) [1.3–2.4]	50 (2.1%) [1.5–2.7]	59 (2.5%) [1.8–3.1]
An improved cookstove	82 (3.4%) [2.7–4.1]	111 (4.6%) [3.8–5.5]	138 (5.8%) [4.8–6.7]	170 (7.1%) [6.1–8.1]

Percentages in the table refer to the percentage of all respondents (2,397) who stated a preference for cash rather than the good described in the first column. Confidence intervals (%) are given in brackets below values. MBBS, bachelor of medicine/bachelor of surgery degree.

Source: Mobarak et al. (2012)

An RCT Measuring Demand for Nontraditional Cookstoves



Source: Mobarak et al. (2012)

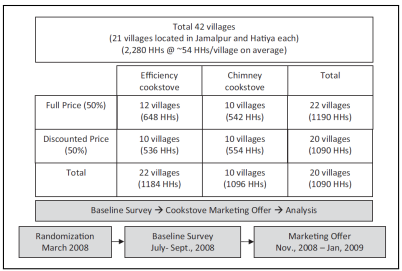
Treatment 1:

Offered **fuel-efficient cookstove** (full price = 400 taka, or about 5 dollars in 2012)

Treatment 2:

Offered smoke-reducing **chimney cookstove** (full price = 750 taka, or just under 10 dollars)

An RCT Measuring Demand for Nontraditional Cookstoves



Source: Mobarak et al. (2012)

Treatment 1:

Offered **fuel-efficient cookstove**

Treatment 2:

Offered smoke-reducing **chimney cookstove**

	Efficiency cookstoves			Chimney cookstoves		
Variable	*n*	Mean	SD	*n*	Mean	SD
Household wealth index*	1,096	0.1	1.2	1,184	0.1	1.2
Household expenditures, ৳	1,095	5,936.8	5,301.4	1,184	5,385.2	5,360.1
Children under age 5 y, *n*	1,096	0.7	0.8	1,183	0.8	0.8
Region (Hatiya)	1,096	0.5	0.5	1,184	0.5	0.5
Females' age, y	1,096	37.7	11.5	1,183	36.1	11.5
Females' education, y	1,096	3.0	3.5	1,183	3.3	3.7
Males' age, y	1,096	45.7	12.7	1,184	44.6	12.9
Males' education, y	1,096	4.1	4.5	1,184	4.2	4.0.61
Females' wages, ৳	1,096	0.3	0.5	1,183	0.2	0.4
Males' wages, ৳	1,096	1.0	0.2	1,184	1.0	0.2
Household members, *n*	1,096	6.5	2.7	1,183	6.5	2.7
Female household members, *n*	1,096	3.4	1.8	1,183	3.3	1.7
Male household members, *n*	1,096	3.2	1.6	1,183	3.1	1.6
Children under age 18 y, *n*	1,096	2.7	1.6	1,183	2.7	1.6
Wage earners, *n*	1,096	2.0	1.1	1,183	1.8	1.0
Household members present, *n*	1,096	5.3	2.1	1,183	5.3	2.1
Family's average monthly income, ৳	1,096	6,123.8	5,032.8	1,183	6,132.1	5,916.4
Pollution in home (1 = not at all to 5 = very polluted)	1,096	2.8	1.13	1,184	2.7	1.07
Women's health index†	1,096	−0.08	1.76	1,184	−0.16	1.83
Children's health index‡	1,096	−0.04	2.09	1,184	−0.1	1.96

*The household wealth index was constructed by using principal component analysis on the basis of five variables: the respondent's self-assessment of the household's affluence on a scale of 1–5 and measures of the four separate categories of household assets—land, vehicles, animals, and cash savings.
†The women's health index was constructed by using principal component analysis on the basis of eight variables, each indicating if the household head's wife has suffered any of the following health problems in the past 30 d: eye problems, diarrhea, difficulty breathing, night sweats, dry cough, cough with sputum, blood in sputum, or fever.
‡The children's health index was constructed by using principal component analysis on the basis of eight variables, each indicating if any child in the household has suffered any of the following health problems in the past 30 d: eye problems, diarrhea, difficulty breathing, night sweats, dry cough, cough with sputum, blood in sputum, or fever.

Source: Mobarak et al. (2012)

An RCT Measuring Demand for Nontraditional Cookstoves

	Efficiency cookstoves			Chimney cookstoves		
Variable	Full price (95% CI)	Half price (95% CI)	Difference (SE)	Full price (95% CI)	Half price (95% CI)	Difference (SE)
Price, ৳	400	200		750	375	
No. of villages	12	10		10	10	
No. of households	648	536		542	554	
Cookstove order rate	0.233	0.485	0.252***	0.314	0.345	0.031
	(0.200–0.266)	(0.443–0.526)	(0.0268)	(0.274–0.353)	(0.305–0.384)	(0.0284)
Cookstove adoption (purchase) rate	0.046	0.162	0.116**	0.02	0.074	0.054**
	(0.030–0.063)	(0.131–0.194)	(0.0452)	(0.008–0.032)	(0.052–0.096)	(0.0245)

*Significance at 90%; **significance at 95%; ***significance at 99%. CI, confidence interval.

Source: Mobarak et al. (2012)

Demand for Nontraditional Cookstoves in Bangladesh: Takeaways

Demand for nontraditional cookstoves is low

- At full price, only 2 percent of HH purchase smoke-reducing chimney cookstoves
- Subsidies increase demand, but it remains low at all price levels
- Many households order a cookstove, but then do not (can not?) purchase it upon delivery

Eliminating indoor air pollution is not a high priority for many poor households

- Spoiled food and polluted water are perceived as bigger health risks
- Households state that they are more willing to pay for latrines, wells, schools, etc.
- Reducing fuel expenditure and cooking time are higher priorities when choosing a stove

What are the implications of these findings for our model of household demand for cookstoves?

Estimating the Impacts of Nontraditional Cookstoves in India

INTERVENTION

Gram Vikas provided the materials and paid for the construction of the stoves. Households provided the mud for the base, labor, and a payment of Rs. 30 (about US$0.75) for the mason who assisted in building and maintaining the stoves. The total cost of the stove was approximately $12.50. Gram Vikas also provided training sessions on proper use and maintenance of the stoves and hired "good users" in each village to help promote the use of the stoves and alert the NGO if any stove was in need of repair.

TREATMENT GROUP

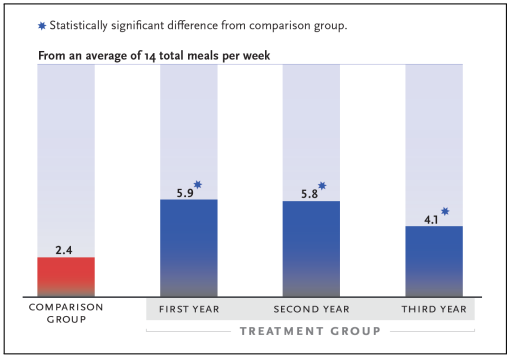
Wave 1 received a stove at the start of the evaluation.
Wave 2 received a stove after two years.

COMPARISON GROUP

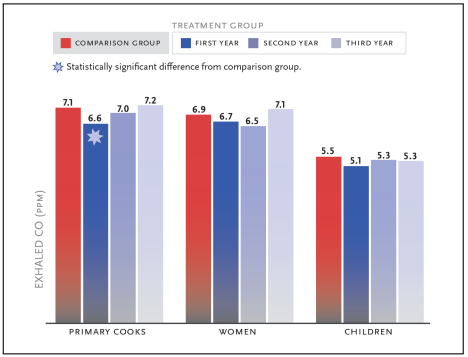
Wave 3 received a stove at the conclusion of the evaluation.

Source: J-PAL (2012)

The Impacts of Nontraditional Cookstoves on Cooking Practices



Source: J-PAL (2012)



Source: J-PAL (2012)

The Impacts of Nontraditional Cookstoves

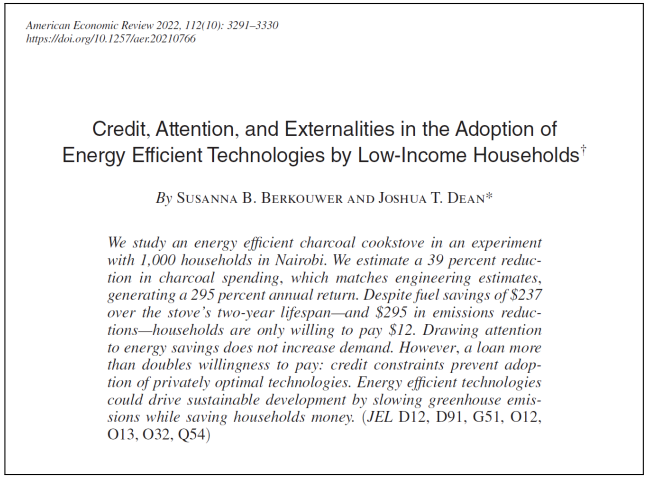
Households accepted the free stoves, but they also continued using their traditional stoves

- Households found that new stoves did not reduce fuel consumption or cooking time
- Households' experience contrary to results from laboratory studies of the modified stoves

Modified stoves required regular maintenance, which was time-consuming for households

- In first year after receiving the modified stoves, treatment households made twice as many stove repairs as households in the control group (12 repairs in treatment vs. 5.5 in control)
- Many households decided not to continue maintaining the new stoves they had received, since they didn't reduce fuel consumption or lead to other detectable short-term benefits

Demand for Stoves that Reduce Charcoal Consumption



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Credit, Attention, and Externalities in the Adoption of Energy Efficient Technologies by Low-Income Households†

By Susanna B. Berkouwer and Joshua T. Dean*

We study an energy efficient charcoal cookstove in an experiment with 1,000 households in Nairobi. We estimate a 39 percent reduction in charcoal spending, which matches engineering estimates, generating a 295 percent annual return. Despite fuel savings of $237 over the stove's two-year lifespan—and $295 in emissions reductions—households are only willing to pay $12. Drawing attention to energy savings does not increase demand. However, a loan more than doubles willingness to pay: credit constraints prevent adoption of privately optimal technologies. Energy efficient technologies could drive sustainable development by slowing greenhouse emissions while saving households money. (*JEL* D12, D91, G51, O12, O13, O32, Q54)

Source: Berkouwer and Dean (2022)

Demand for Stoves that Reduce Charcoal Consumption

Source: Berkouwer and Dean (2022)

Demand for Stoves that Reduce Charcoal Consumption

Source: Berkouwer and Dean (2022)

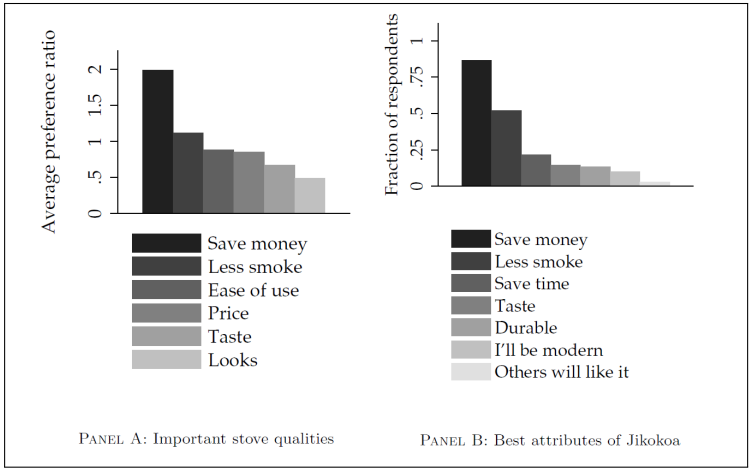
Research Design

Berkouwer and Dean (2022) do three things:

1. Estimate demand for jikokoa stoves in an incentive compatible way
2. Estimate impacts of stoves by offering them to households at randomly-assigned prices
3. Estimate the impact of two interventions on demand for jikokoa stoves
   - Salience treatment emphasizes potential savings on charcoal
   - Credit treatment that offers households a loan to pay for part of the assigned price

Stove is familiar to households, and delivers benefits that they value (savings on charcoal); no attempt to convince households to prioritize future health and environmental benefits

The Valuation of Cookstove Attributes

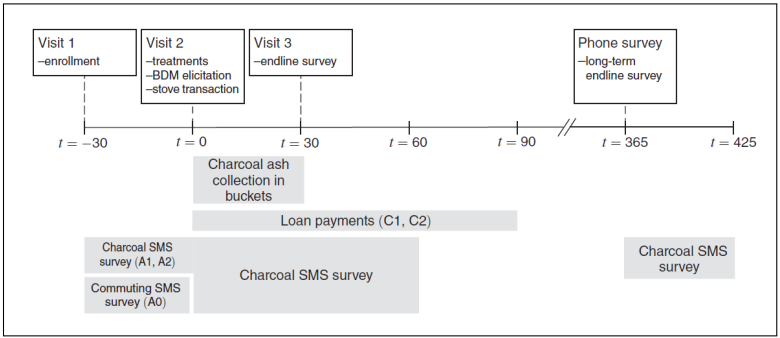


PANEL A: Important stove qualities

PANEL B: Best attributes of Jikokoa

Source: Berkouwer and Dean (2022)

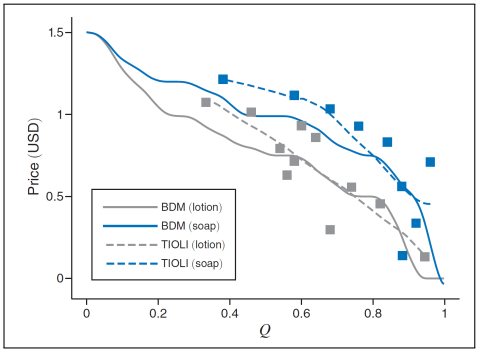
Timeline of Experiment



Source: Berkouwer and Dean (2022)

Measuring Demand

Demand for Soap and Lotion



Source: Berkouwer and Dean (2022)

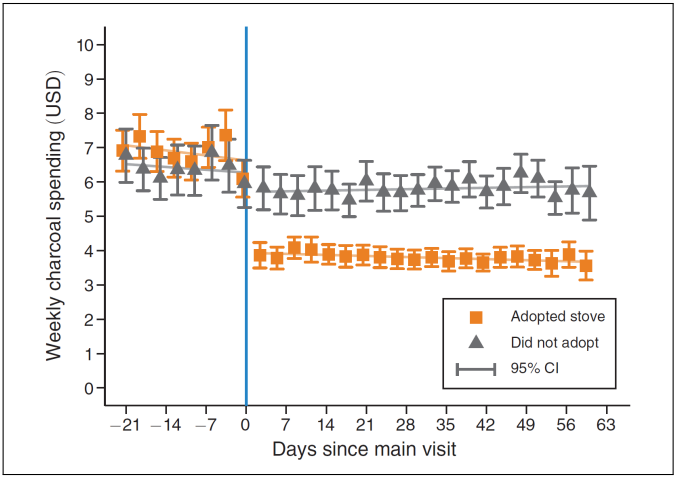
Take-It-Or-Leave-It Offers:

- Randomly assign prices across respondents
- Demand $Q(P)$ is proportion that buy at price P
- Requires a large sample of households

Becker-DeGroot-Marschak (BDM) Mechanism:

- Keep randomly assigned prices secret
- Elicit maximum price HH would pay (e.g. via MPL)
- Conditional on WTP, purchase is random

Buying a Jikokoa Reduces Charcoal Consumption



Source: Berkouwer and Dean (2022)

Buying a Jikokoa Reduces Charcoal Consumption

	OLS	First stage	IV estimate (one-month endline)			IV estimate (one-year endline)	
	USD	Bought stove	USD	IHS(USD)	IHS(kg)	USD	IHS(USD)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BDM Price (USD)	0.01	−0.03					
	(0.01)	(0.00)					
WTP (USD)	−0.01	0.02	−0.00	−0.00	0.00	0.01	0.00
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.02)	(0.00)
Bought cookstove (=1)	−1.89		−2.28	−0.50	−0.48	−2.50	−0.56
	(0.28)		(0.29)	(0.07)	(0.08)	(0.42)	(0.09)
Observations	7,853	913	7,853	7,853	796	6,979	6,979
Control mean	5.72		4.97	2.16	1.55	5.30	2.21
Socioeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data source	SMSs	Midline	SMSs	SMSs	Buckets	SMSs	SMSs

Notes: Results from an instrumental variables (IV) regression that uses the (randomly assigned) BDM price as an instrument for stove adoption to estimate the causal impact of adoption on weekly charcoal expenditures. Columns 1 and 2 present the ordinary least squares (OLS) and first-stage estimates, respectively. Column 3 uses weekly charcoal expenditures in US dollars as the outcome variable. Column 4 uses the inverse hyperbolic sine (IHS) conversion of the US dollar amount. A 0.50 IHS reduction corresponds to a 39 percent reduction relative to the control group. Column 5 uses the IHS of the weight of the charcoal bucket one month after stove adoption as the outcome variable. Columns 6 and 7 conduct the same analyses as columns 3 and 4 respectively, but using data from the SMS survey conducted one year after the main visit. Socioeconomic controls include baseline savings, income, risk aversion, credit constrainedness, number of adults and children. In regressions using SMS data, errors are clustered by respondent. Standard errors in parentheses.

Source: Berkouwer and Dean (2022)

Buying a Jikokoa Reduces Cooking Time and May Improve Health

	WTP (USD)	Minutes cooking per day	Adoptions in network	Health symptoms index (one-month follow-up)			Health symptoms index (one-year follow-up)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health beliefs (index)	−0.01							
	(0.62)							
Savings beliefs (USD)	0.02							
	(0.01)							
Jikokoa (=1)		−56.31	−0.17	−0.52	−0.56	−0.51	−0.56	−0.57
		(14.51)	(0.16)	(0.10)	(0.11)	(0.11)	(0.09)	(0.10)
Continued old stove use (=1)					0.17	0.15		0.05
					(0.09)	(0.09)		(0.10)
Charcoal usage (KG/month)						0.05		
						(0.01)		
Observations	924	924	924	924	924	924	855	855
Control mean	11.88	192.09	0.32	−0.00	−0.00	−0.00	0.00	0.00
Socioeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Column 1 tests whether baseline beliefs about financial and health benefits affect WTP. Columns 2 through 6 present causal estimates of the impact of stove adoption on various outcomes measured one month after adoption, using the randomly assigned price as an instrument for adoption. Adoptions in network indicates whether any of the respondent's friends, family, or neighbors purchased the Jikokoa in the past one month. The health index consists of self-reported health and respiratory symptoms for the primary cookstove user and any children (if applicable). The index is standardized for the control group to have a mean of zero and a standard deviation of one. A higher value indicates more respiratory symptoms, and thus, poorer health. Columns 7 and 8 report health outcomes one year after adoption. Socioeconomic controls include baseline savings, income, risk aversion, credit constrainedness, number of adults and children. Standard errors in parentheses.

Source: Berkouwer and Dean (2022)

Households WTP for the Jikokoa Does Not Reflect Cost Savings

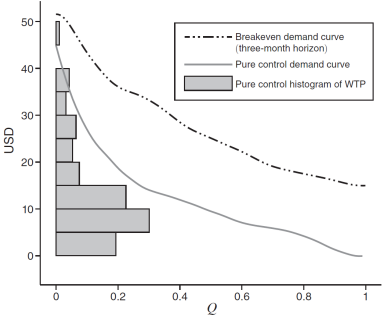


FIGURE 5. UNDERADOPTION OF THE ENERGY EFFICIENT TECHNOLOGY

Notes: The histogram represents WTP elicited through the BDM mechanism for the control group, and the smooth line represents the corresponding demand curve. The dotted line represents the breakeven demand curve for all agents, if agents were willing to pay precisely their savings over a three-month period. The gap between the two curves can be interpreted as underadoption of the energy efficient technology. The breakeven demand curve assumes annualized discount rates $\delta = 0.9$. Online Appendix Figure C8 presents robustness checks for annual discount factors $\delta = 0.5$ and $\delta = 1$.

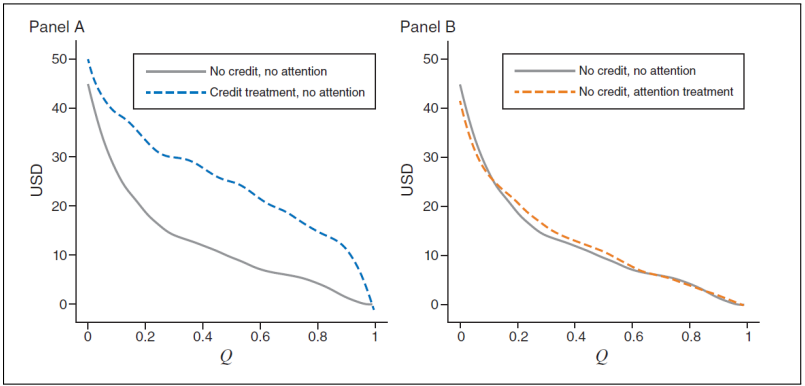
Source: Berkouwer and Dean (2022)

Experimental Treatment Arms

		Credit control	Credit treatment	
			Weekly deadlines	Monthly deadlines
Attention control		96	98	98
Attention treatment	Energy savings	96	97	96
	Energy savings – costs	145	146	146

Source: Berkouwer and Dean (2022)

The Impacts of the Credit and Attention Treatments on WTP



Source: Berkouwer and Dean (2022)

The Impacts of the Credit and Attention Treatments on WTP

	(1)	(2)	(3)	(4)	(5)
Credit	12.54	13.07	11.16	15.02	10.66
	(0.67)	(1.23)	(1.81)	(1.69)	(1.46)
Attention to benefits	0.44	−0.71	−0.52	−0.28	−0.33
	(0.83)	(1.43)	(2.20)	(1.91)	(1.43)
Attention to costs	−0.27	2.50	3.62	1.66	2.40
	(0.77)	(1.31)	(2.14)	(1.65)	(1.30)
Attention to benefits × credit		1.76	1.23	1.51	1.39
		(1.75)	(2.73)	(2.31)	(1.75)
Attention to costs × credit		−4.19	−3.29	−4.83	−2.16
		(1.61)	(2.59)	(2.05)	(1.84)
Time inconsistent					−2.58
					(1.09)
Time inconsistent × credit					4.62
					(1.50)
Attention to costs × time inconsistent × credit					−3.37
					(1.57)
Observations	955	955	411	544	955
Control mean	12.12	12.12	13.14	10.98	13.14
Sample	Full	Full	TI = 0	TI = 1	Full

Notes: This table shows the causal impact of credit (pooling the two credit treatment arms) and attention treatments on WTP elicited during the BDM mechanism. For the "*attention to benefits*" treatment, the indicator variable "attention to benefits" is set to one and the indicator variable "attention to costs" is set to zero. For the "*attention to benefits minus costs*" treatment, both indicator variables are set to one. Agents are defined as exhibiting time inconsistency (TI = 1) if they choose to postpone effort tasks during visit 2. Socioeconomic controls include baseline savings, income, risk aversion, credit constrainedness, number of adults and children. Following Dizon-Ross and Jayachandran (2022) we control for WTP elicited during the practice BDM round (for soap or a bottle of lotion), which improves statistical precision slightly. Standard errors in parentheses.

Source: Berkouwer and Dean (2022)

Indoor Air Pollution and Clean Cookstoves: Takeaways

Households want to adopt cookstoves that reduce fuel/wood/charcoal consumption

- This attribute would have private benefits for households, but also environmental benefits
- Credit constraints may be the main limitation on WTP for more efficient cookstoves
- Reduced cooking time would also attenuate the negative effects of indoor air pollution
- Households are less inclined to pay for cookstoves that only reduce indoor air pollution

Jikokoa developed by a local private company; failed stoves in Orissa developed by an NGO

- Considerable uncertainty about how well many development interventions will work
- Local firms are well-placed to develop innovate solutions that align with local demand
- Credit market failures limit extent to which purely market-based solution can solve problem