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The Value and Preferences for Improved Cook Stoves: A Choice Experiment in Ethiopia

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Clean Cooking:
The Value of Clean Cookstoves in Ethiopia

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Where is Ethiopia?

- Ethiopia is In Eastern Africa, in a region that has the highest rates of deforestation in the world
- Nearly 30% of Ethiopians live on less than $0.60 per day

Why do Stoves Matter?

- Traditional stoves are bad for human health: high correlation between traditional stoves use and symptoms of respiratory illness (Duflo, Greenstone, Hanna, 2008)
- There are gender- and age-differentiated hardships and health impacts: women below age 5 and between 30-60 suffer the most (Parikh, 2011)
- Bad for the environment: deforestation and forest degradation for firewood
- New stove technology provides a win-win solution for development and the environment (Simon, Bumpus & Mann, 2012)

Previous Literature

- Characteristics like income, education and urban location are positively correlated with clean stove adoption in most studies (Takama, Tsephel, Johnson, 2012)
- In Ethiopia, adoption rates have steadily increased over time; economic factors are important determinants of adoption behavior (Beyene & Koch, 2013)
- In Mexico, community pressures can create incentives for adoption of clean fuel (Blackman & Bannister, 1998)

Research Questions

- How do Ethiopians value new, clean stove technology?
- How do different demographic characteristics affect someone's marginal willingness to pay (MWTP) for this technology?
- How does gender composition of a household affect MWTP?

Data and Methods

Choice Experiment Surveys

- Stated preference valuation tool to find WTP
- Estimates values of individual features

Survey attributes

- Durability of stove
- Time reduction
- Fuel reduction
- Smoke reduction
- Cost

} Each with 3 or 4 levels

Choice Experiment Survey Example

Choice experiment for stove adoption

Ver No:__1__ QNo:_1___

Attributes	Alternative 1	Alternative 2	Status Quo
Durability of stove	1-5 years	6-10 years	No improved stove
Amount of cooking time reduced	50% reduction	25% reduction	No reduction
Reduction in amount of fuel wood used	50% reduction	25% reduction	No reduction
Reduction of smoke	50% reduction	25% reduction	No reduction
Cost of improved stove	100 birr	300 birr	No payment but no improved stove
Please tick/mark (√) only one	❐	❐	❐

The Survey Instrument

- Demographic Information
- Stove/fuel use information
- Seven choice questions

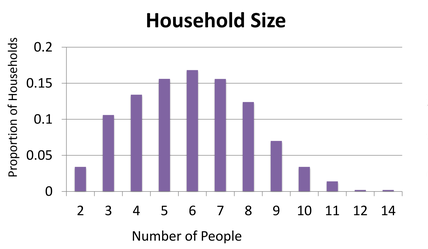
Survey Distribution

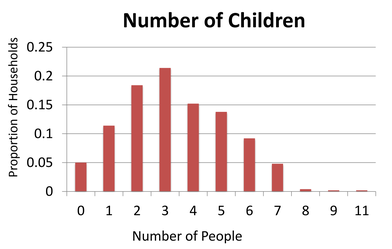
- 504 households surveyed
- 36 different sites chosen using stratified-proportionate random sampling
- Sites located in 3 different regions that represent 80% of Ethiopia's population and 70% of Ethiopia's land

The Models

- Conditional Logit model (CL): $V_j = \sum_{k=1}^{K} \beta_k x_{kj} + \beta_p p_j + \varepsilon_j$ which provides limited analysis of unobserved heterogeneity
- and Mixed Multinomial Logit model (MMNL) to account for preference heterogeneity: (with cost as a non-random independent variable) $U_j^i = \sum_{k=1}^{K} \beta_{ki} x_{kj} + \beta_{pi} p_{ij} + \varepsilon_{ij}$
- in which the marginal willingness to pay equals the coefficient of the attribute divided by the coefficient of the cost term: $MWTP_k = -\frac{\beta_k}{\beta_p}$
- including coefficients for each attribute, and an interaction term for *durability*cost*

Household Characteristics

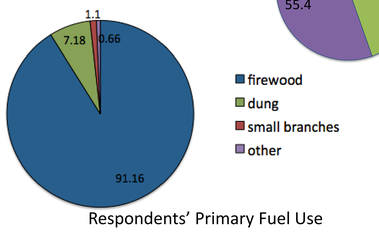




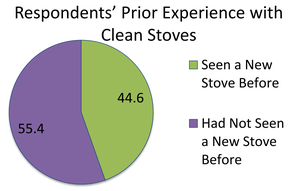
Experience with Clean Stoves

Top ranked benefits of new stoves:

1. Reduce burden on women and children
2. Better indoor air quality
3. Reduced cooking time
4. Helping the forest
5. Reducing climate change



Respondents' Primary Fuel Use



Results

The most important attributes in determining choice:

CL: Durability and fuel reduction are

MMNL: Smoke and fuel reduction in the basic model; durability in the interaction model

Coefficients from CL and MMNL Models

	Conditional Logit	Conditional Logit with Dur*Cost	Mixed Multinomial Logit		Mixed Multinomial Logit with Dur*Cost	
	Coeff (SE)	Coeff (SE)	Coeff (SE)	Significant SD	Coeff (SE)	Significant SD
Durability	0.0311 (0.00771)***	0.186 (0.0173)***	0.0332 (0.00974)***	Yes	0.269 (0.0242)***	
Time reduction	0.0184 (0.00193)***	0.0210 (0.00192)***	0.0213 (0.00227)***	Yes	0.0275 (0.00250)***	Yes
Fuel reduction	0.0282 (0.00152)***	0.0258 (0.00155)***	0.0339 (0.00253)***	Yes	0.0359 (0.00300)***	Yes
Smoke reduction	0.0262 (0.00287)***	0.00717 (0.003343)*	0.0382 (0.00376)***		0.0124 (0.00441)**	
Cost	0.00150 (0.000637)*	0.00845 (0.000973)***	0.00300 (0.000753)***		0.0129 (0.00126)***	
Durability*Cost Interaction		-0.000885 (0.0000877)***			-0.00132 (0.000124)***	Yes

$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
n = 9036

The positive cost coefficient means that people want more expensive stoves, but the interaction term suggests that cost and durability were substitutes for one another

MWTP for Attributes, for Demographic Groups

	Basic model		Dur*cost Interaction		≤ 3 kids		> 3 kids	
	CL	MMNL	CL	MMNL	CL	MMNL	CL	MMNL
Durability	20.74	11.05*	102.2*	89.20**	71.10	12.08	12.29	10.94
Time reduction	12.24*	7.085***	11.55*	9.132***	47.45	9.886*	6.304*	5.293**
Fuel reduction	18.81*	11.29***	14.20**	11.92***	77.86	17.25*	8.932**	7.679**
Smoke reduction	17.46*	12.71***	3.945	4.10*	64.99	17.83*	9.805**	9.581***
Durability*Cost Interaction			-.487**	-.438***				
Observations	9036	9036	9036	9036	5058	5058	3978	3978

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	≤ 50% female		> 50% female		≤ 50% daughters		> 50% daughters	
	CL	MMNL	CL	MMNL	CL	MMNL	CL	MMNL
Durability	31.19	15.16	12.11	8.073	56.59	20.02	7.935	5.587
Time reduction	17.09	8.402*	8.165	5.862*	26.57	10.06	7.117*	5.249**
Fuel reduction	27.13	14.19*	11.86*	8.716**	46.34	18.23*	8.975**	6.814***
Smoke reduction	28.37	18.40**	8.391*	7.464**	44.23	21.07*	7.941*	7.477***
Durability*Cost Interaction								
Observations	6030	6030	3006	3006	5598	5598	3438	3438

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Overall, households with fewer kids and fewer females are willing to pay more for new stoves

Durability and smoke reduction are most commonly the attributes with the highest MWTP, with fuel reduction close behind. MWTP for time reduction is consistently lower than the other attributes

Conclusions

- Ethiopians are willing to pay a considerable amount for new stoves
- Household demographics and gender composition significantly affect MWTP for new stove technology. Households with many children or females are less likely to put a high value on a stove because they have more people who can take care of the cooking
- People who had seen stoves before had higher WTP, so stove distribution and use should be widely advertised
- Cost and durability are substitutes: People think that a more expensive stove will be of higher quality
- Clean stove availability is the main reason why people have not adopted the new technology

Acknowledgements

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