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The effect of marketing messages and payment over time on willingness to pay for fuel-efficient cookstoves

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ABSTRACT

Smoke from inefficient biomass cookstoves contributes to global climate change and kills approximately four million people per year. Cooking technologies, such as manufactured fuel-efficient cookstoves, that mitigate the negative effects of traditional cookstoves exist, but adoption rates are low. The international development community debates whether this low adoption of fuel-efficient cookstoves is due to a lack of adequate product information or due to household financial constraints. We ran Vickery second-price auctions in rural Uganda to elicit willingness to pay for fuel-efficient cookstoves, comparing the effect of informational marketing messages and time payments on willingness to pay. A randomized trial tested the following marketing messages: "This stove can improve health," "This stove can save time and money," and both messages combined. None of the messages consistently increased willingness to pay. In a second experiment we compared willingness to pay for two different contracts, one with payment due within a week and one with equal installment payments over 4 weeks. Consistent with household financial constraints, time payments raised willingness to pay by 40%.

1. Introduction

Traditional biomass cookstoves cause significant environmental degradation (Arnold et al., 2006), contribute to global climate change (Bailis et al., 2005; Bond et al., 2004), and cause an estimated 4 million deaths a year (Lim et al., 2012). Fuel-efficient cookstoves, depending on quality and construction, have the potential to reduce household air pollution substantially and improve the health of cooks and children. Further, fuel-efficient cookstoves can significantly reduce consumption of biomass fuels, which can reduce deforestation and environmental degradation (Bensch and Peters, 2013). Fuel savings can decrease household expenditure on fuel and/or reduce time spent collecting fuel. Because of these benefits, fuel-efficient cookstoves have a long history within the development community. While there have been some successes (Smith et al., 1993), most regions continue to adopt efficient stoves at "puzzlingly low rates" (Mobarak et al., 2012; see also World Bank, 2011; Lewis and Pattanayak, 2012).

Past stove projects have frequently provided sizeable subsidies for fuel-efficient cookstoves. While subsidies can sometimes be appropriate (Cohen and Dupas, 2010), the market for efficient stoves will grow more rapidly if stoves sell at or near

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market prices. The Global Alliance for Clean Cookstoves posits that willingness to pay is reduced by (among other factors) "low awareness of health, economic, and time-savings benefits" and by limited access to finance (Global Alliance for Clean Cookstoves, 2011).

We conducted a randomized controlled trial to test how willingness to pay for a fuel-efficient cookstoves varies with (1) marketing messages related to "low awareness of health, economic, and time-savings benefits" and (2) sales offers that address household financial constraints. Neither the marketing message "the stove can improve health" nor the message "the stove can save time and money" consistently increased willingness to pay. This result is counter to the common assumption that increased social marketing could increase adoption (Lewis and Pattanayak, 2012) but consistent with other studies finding modest effects of informational interventions on health behaviors (Albert et al., 2010; Luo et al., 2012; Madajewicz et al., 2007; Meredith et al., 2013). Using a within-subjects comparison, we tested the effect of time payments on willingness to pay. Allowing consumers to pay in four equal payments over 4 weeks raised willingness to pay for a fuel-efficient cookstove by about 40% ($p < 0.01$).

The findings of this study may have implications for products other than cookstoves. Millions of lives could be saved each year by adoption of health technologies, such as water filters, private latrines, and insecticide-treated bed nets. Understanding the constraints on adoption could increase the uptake for all of these important products.

2. Theory and related literature

The constraints that decrease willingness to pay and impede take-up of products similar to fuel-efficient cookstoves have been demonstrated by several studies. Poor households may lack information on the benefits and durability of the product (Conley and Udry, 2001; Feder and Slade, 1984; Giné and Yang, 2009). Consumers may also be liquidity- or credit-constrained (Cole et al., 2013; Giné et al., 2008; Tarozzi et al., 2014). In this section we first model how poor information affects willingness to pay and then model how liquidity constraints affect willingness to pay.

2.1. Modeling poor information

Assume a consumer has income y_t each period over an infinite number of years. She has to purchase Q_t units of energy each period to run her traditional cookstove (with the price of energy normalized to unity) and she receives utility from non-energy consumption c_t. She can borrow or save with a gross rate of return $R = 1 + r > 1$, and her subjective discount rate is δ (<1).

The consumer maximizes the present value of utility as

$$\sum_{t=0}^{\infty} u(c_t)\delta^t, \tag{1}$$

subject to a lifetime budget constraint that the present value of consumption is not more than her income:

$$\sum_{t=0}^{\infty} \frac{(Q_t + c_t)}{R^t} = \sum_{t=0}^{\infty} \frac{y_t}{R^t}. \tag{2}$$

Without loss of generality, normalize her utility without the cookstove, $u(y - Q)$ as zero. Assume an improved cooking technology comes on the market that increases the combustion efficiency, thereby lowering the fuel needed and exposure to household air pollution. The new appliance costs P in the first period and uses φQ of energy each period until the appliance dies, with $0 < \varphi < 1$. The appliance has a per-period exponential death rate ψ, with $0 < \psi < 1$ and upon the appliance's death, the consumer can return to her old technology at zero cost.

With perfect capital markets the consumer's willingness to pay for the new appliance is the expected present value of lower spending on energy during the lifetime of the appliance:

$$p^* \leq \sum_{t=0}^{\infty} \frac{((1-\varphi)Q_t(1-\psi)^t)}{R^t} = \frac{(1-\varphi)QR}{(R+\psi-1)}. \tag{3}$$

Call the critical price p^*, which defines the efficient willingness to pay (we assume indifferent consumers purchase the appliance). As expected, willingness to pay is higher if the appliance is very efficient (low φ), the household uses a lot of energy (high Q), the appliance usually lasts a long time (low ψ), and if other investment opportunities are poor (low R).

However, consider the market imperfection that the consumer lacks information on product benefits or doubts the firm's claims about energy savings. Assume the consumer is unsure of energy savings and discounts the firm's true claim by a factor $\gamma < 1$. The consumer continues to purchase if the price is below the present value of expected savings, but those savings are now discounted by γ. Thus, the highest willingness to pay with uncertain savings is

$$p^{us} = \gamma p^*. \tag{4}$$

Now assume the consumer is offered credible information on the product's energy savings through effective marketing messaging. As a result, assume the consumer's beliefs align with the product's true savings (that is, energy use falls to φQ

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