

# What Impedes Efficient Adoption of Products? Evidence from Randomized Variation in Sales Offers for Improved Cookstoves in Uganda

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*The product adoption puzzle—the failure of consumers to adopt a product with benefits far greater than its costs—has consistently challenged improved cookstove programs. Some consumers decline to adopt health benefiting and fuel saving new stoves even when the cost of an efficient cookstove can be recovered from just a few months of fuel savings. Likely explanations for this behavior—present bias, liquidity constraints, and poor information on fuel savings and stove durability—can be countered with an optimal contract combining a free trial, time payments, and the right to return the stove. We conducted two experiments utilizing this optimal contract in Uganda—one in urban Kampala with an efficient charcoal-burning stove and one in rural Mbarara with an improved wood stove. In both randomized trials, this offer dramatically increased uptake of the efficient stove—in urban Kampala from 4% to 46% and in rural Mbarara from 5% to 57%. We provide additional evidence that both liquidity constraints and imperfect information were important barriers to adoption.*

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## 1. Introduction

Half the world cooks on inefficient stoves that burn solid fuels such as wood and charcoal. Inefficient cookstoves harm child and maternal health and contribute to deforestation and global climate change. Household air pollution accounts for an estimated 4 million deaths a year- 3.5 due to direct exposure and 0.5 million deaths from outdoor air pollution attributed to the impact of household emissions on ambient air quality (Lim *et al.*, 2012). The high cost of buying or gathering fuel means that inefficient stoves also deepen poverty. The costs of gathering fuel can be high, particularly for women and girls, and contribute to low education outcomes.

If markets worked well, even a poor person would pay for an improved cookstove if the fuel savings quickly exceeded the stove cost. But in most nations, few households adopt improved cookstoves, even when the stove can quickly pay for itself (Global Alliance for Clean Cookstoves, 2011).<sup>1</sup> We hypothesize that familiar barriers that impede take-up of other cost-effective products also affect uptake of cookstoves (Mobarak and Miller, 2012): Poor households may be liquidity- or credit-constrained (Gine *et al.*, 2008; Cole *et al.*, 2010; Tarozzi *et al.*, 2011), lack information on the benefits and durability of the stoves (Feder & Slade, 1984; Conley & Udry, 2001; Gine & Yang, 2009), may suffer from self-control problems, also called “present bias” (Banerjee & Mullainathan, 2010; Duflo *et al.*, 2010), or may be too risk adverse to experiment with new technology (Foster & Rosenzweig, 1995; Conley & Udry, 2010; Bryan *et al.*, 2011).

If the new cookstove saves fuel, pays for itself in fuel savings, is compatible with local cooking practices, and is durable, then a sales offer combining a free trial period, time payments, and the right to return the stove and stop future payments at any time might lower these barriers. Consumers in the United States and other developed markets might colloquially refer to such an arrangement as a free trial followed by rent-to-own. In less developed markets, however, these sales terms are less established and we thus refer to this offer as a “novel” one to distinguish it from the “traditional” cash-and-carry offer.

The novel offer is well suited to selling improved stoves, especially for customers who purchase their own fuel. To assist customers facing liquidity constraints, the initial time payment

<sup>1</sup> It is less mysterious why families do not adopt stoves that require a lot of maintenance (Duflo, Hanna, and Kremer, 2012), are the wrong size (Beltramo and Levine, 2013), or do not serve all the purposes of a traditional fire such as creating smoke to keep away bugs (Victor, 2011).

can be set so that customers can pay it largely or entirely from fuel savings they have already accrued during the free trial. If those savings are too low, the consumer can return the stove. This process repeats, so recent fuel savings contribute to subsequent time payments and, if the stove breaks, the consumer returns it and owes nothing more. With this “pay-what-you-have-saved” combination of a free trial and rent-to-own, the customer bears almost no risk if the product does not work as advertised.

This paper reports the results from two field experiments, study 1 in urban Uganda and study 2 in rural Uganda, comparing uptake from a traditional cash-and-carry sales offer to uptake of the novel offer of a free trial followed by rent-to-own. These experiments further assess the role of the hypothesized barriers to adoption including liquidity constraints, present bias which can limit attention to fuel savings, and lack of information about, or confidence in, the benefits of the improved cookstoves.

The novel offer increased sales substantially. In urban Kampala (study 1), uptake of an efficient charcoal-burning stove was 4% with the traditional offer (even though we gave families a week to raise the funds, if needed). Uptake (not counting returns) increased to 45% with the novel offer.

Results were similar in rural Uganda (study 2). Uptake of an efficient wood-burning stove was 5% with the traditional offer (after participants were given one week to raise funds), and rose to 57% with the novel offer. This replication is important because publication bias and (often unconscious) specification searches by authors have fueled a debate about whether “Most Published Research Findings Are False” (Ioannidis, 2005). Importantly, even when published medical findings are correct in sign, 98% of very large effects (*e.g.*, odds ratio  $> 5$ , as we found in study 1) become substantially smaller when replicated (Pereira, *et al.*, 2012). Thus, because our replication provides a second instance of results similar in magnitude, it increases our confidence in the internal validity of the results (Moonesinghe, *et al.*, 2007).

The replication was also important because the efficient charcoal-burning stove we offered in urban areas saved consumers money, while the efficient wood-burning stove we offered in rural areas largely saved women and children time they would have spent gathering fuel. Because it is not clear that men (who traditionally manage most money in rural Uganda) would be able or willing to pay to save the time of other family members, the similar effect of

the novel offer across both the urban and rural experiments increases our confidence in the external validity (that is, generalizability) of our results.

The success of the novel sales offer depends on the stoves being appealing to consumers. If return rates of novel offer stoves are a good proxy for the stoves' appeal, then the small percentage of households returning the stoves at the end of the free trial (6% in urban areas and 1% in rural) suggests that the stoves were well suited for their customers' needs. Encouragingly, the return rate remained low over the life of the time payments; in each experiment over 90% of those who accepted the free trial followed by rent-to-own kept the stove. Low return rates and qualitative evidence of both rural and urban consumers' satisfaction with the stoves suggest they were both appropriate products for their settings.

The novel sales offer removes risks from consumers, but at the expense of increasing default risk borne by the seller. The default rate by consumers is surprisingly low. Urban buyers paid over 97% of the money they owed and rural buyers paid over 99%.

The remainder of the paper proceeds as follows. Section 2 provides a review of the related literature. We provide a brief overview of Uganda in Section 3. Methods are described in Section 4, and findings are laid out in Section 5. Section 6 summarizes our conclusions and Section 7 discusses the implications of our results for theories of consumer decision-making and the barriers impeding efficient decisions. We also briefly discuss several implications of the results of optimal contracts for those distributing durable goods in poor regions.

## **2. Theory and Literature Review**

### *Theory of Barriers*

Due to the over 4 million deaths attributed globally to household air pollution, improved cookstoves are increasingly seen as an important tool to improve respiratory health (Global Burden of Disease, 2012). Inefficient cookstoves also contribute to deforestation (United Nations Convention to Combat Desertification, 2010) that contributes to global climate change. By one estimate household energy use in Africa is on track to produce 6.7 billion tons of carbon by 2050 (Bailis, *et al.*, 2005). The success of the sizeable ongoing investment in disseminating efficient cookstoves hinges on understanding and overcoming the key barriers to adoption.

We focus on three sets of barriers that can be addressed by novel sales contracts. We hypothesize that consumers may not purchase an improved cookstove because they are liquidity constrained and/or present biased, lack confidence the new stove will save them fuel and/or cook well, and are skeptical about the new stove's durability.

Though poor people have less of most things, in well-functioning markets they should *not* have less of goods that can make them less poor. Web Appendix 1 presents an illustrative model of the decision to purchase an improved appliance with perfect information and capital markets. We then model four market imperfections that can impede adoption: imperfect information about energy savings, imperfect information about the durability of the new appliance, liquidity constraints and present bias. Here we present a verbal overview of the model's results.

### *Liquidity Constraints and Present Bias*

Evidence exists that many consumers in poor nations face liquidity constraints and present bias and thus find it difficult to come up with the entire purchase price of a durable good in one lump sum (Banerjee, 2003; Mullainathan and Shafir, 2009; O'Donahue and Rabin, 1999). For such consumers, time payments can be a solution. We therefore hypothesize that a sales offer with time payments will increase sales, especially for consumers with liquidity constraints and/or present bias.

A free trial permits consumers to enjoy a benefit today, but not pay until the trial is over. We further hypothesize that, when a free trial is added to the sales offer, adoption of the stove will increase more amongst consumers who show present bias than amongst consumers who do not.

### *Concerns about Fuel Savings and Product Effectiveness*

Consumers are subject to many marketing messages and most learn that not all salespeople can be trusted. Many consumers may, therefore, not believe the claimed fuel savings from an improved cookstove.

For such consumers, a free trial can be a credible signal that the stove will, in fact, save fuel (Moorthy and Srinivasan, 1995; Shieh, 1996). Davis, *et al.* (1995) emphasize that money-

back guarantees increase consumers' willingness to try unfamiliar products when they are unsure of the benefits.<sup>2</sup> In our setting, the free trial period gives consumers a chance to experience the fuel savings and to determine if the improved cookstove fits their cooking style and other needs; that is, we treat stoves as “experience goods”.<sup>3</sup> It is possible the trial period may also activate norms of reciprocity, which could increase uptake and repayment (Cialdini, 2006).<sup>4</sup> All of these forces lead us to hypothesize that a free trial increases sales, especially among consumers who don't trust salespeople. Because fuel savings are roughly proportional to baseline fuel use, we also expect higher adoption for those with higher baseline fuel expenditures and those with larger families.

### *Concerns about Durability*

Even in rich nations, many “consumer durables” are not very durable. Consumers in poor nations face the problem of low-quality merchandise even more frequently. For such consumers, adding the option to return the stove at any time during the time payments can be a solution, reducing the risk that the stove is not durable and, thus, will not deliver the promised savings (Davis *et al.*, 1995). These forces lead us to hypothesize that adoption will be higher when consumers are offered the right to return, and that this effect will be strongest among consumers with greater concerns about durability.

### *Potential Weaknesses of the New Offer*

In advance of this research we recognized several potential weaknesses of the new offer. Return rates with the new sales offer will be high if the stove frequently breaks (especially if consumers are careless with it during the free trial), if the stove requires shifting cooking patterns from traditional practices, if it does not save much fuel, or if many consumers cannot detect the true fuel savings. Receipt of payments will be low if consumers decide to keep the stove and not pay for it (consumer moral hazard), if they move frequently or are frequently not at home. Low

<sup>2</sup> See also Grossman (1981), who shows theoretically that a money-back guarantee can reduce adverse selection and increase trade and efficiency.

<sup>3</sup> An experience good is a product or service where product characteristics, such as quality or price, are difficult to observe in advance, but can be ascertained upon consumption.

<sup>4</sup> We thank Adam Galinsky for identifying reciprocity as a possible motive.

payments are particularly likely if there is adverse selection among consumers, so that those consumers least likely to pay for the stove are more likely to accept the offer of a free trial and time payments.<sup>5</sup>

### *Related Sales Offers*

Many retailers have successfully offered combinations of a free trial period, time payments, and the right to return. For example, Eli Terry, an American door-to-door salesman in the early 1800s, combined a free trial and time payments to sell what was then an unfamiliar consumer durable, a household clock (Scull and Fuller, 1967).

Time payments tied to energy savings have been used in the United States by companies that improve heating and air conditioning efficiency in buildings. The logic of these offers is similar to that of our offer: with no upfront payment, the money to pay for the service comes from fuel savings occurring as a result of the energy system improvements.

Time payments are core elements of the microfinance revolution. Energypedia (2011) and MicroEnergy International (2008) discuss linking microfinance with projects that sell improved cookstoves.

Rent-to-own is a familiar method of selling to poor consumers in the United States (see Lacko, McKernan, and Hastak, 2000 and the citations in footnote 2 of Nehf, 1991). Rent-to-own is much less common in poor nations, but examples exist (*e.g.*, Rent-to-Own Africa, 2011).

### **3. Brief Overview of Uganda**

Uganda is one of the poorest nations in the world, with an infant mortality rate of 65 per 1000 live births, 67% literacy (58% for women), and GNI per capita of \$1,320 (World Bank, 2011; purchasing price parity 2011 international US \$). Pneumonia, which has been directly linked to household air pollution from cookstoves (Smith, Sivertsen, *et. al.*, 2009) causes 11% of under-five mortality in Uganda (WHO, 2009).

The use of solid fuel in Uganda is almost universal, with 96% of households using solid fuel for cooking. The portion of rural households using solid fuels, 98%, is higher than that of

<sup>5</sup> We thank Andy Weiss for pointing out this possible adverse selection.

urban households, -85%. About 28% of rural and 49% of urban households do most of their cooking outdoors. Wood is the fuel used for cooking in 85% of rural households, and charcoal is the fuel used in 68% of urban households (Uganda Bureau of Statistics and ICF International, Calverton, 2011).

Rural households are poorer than their urban counterparts. For example, 5% of rural and 55% of urban households have electricity. Similarly, 81% of rural and 19% of urban households have floors of earth or dung (Uganda Bureau of Statistics (UBOS) and ICF International Inc. 2012).

#### **4. Methods**

##### *Design of Study 1*

Study 1 took place in Kampala, the capital and largest city of Uganda during October through December of 2010. Kampala had a population of about 1.4 million in 2008 (Uganda Bureau of Statistics, cited in Citypopulation.de, 2008). The majority of Kampala's households cook with a traditional charcoal stove (pictured in Web Appendix 2, Figure 2A), and most cook out of doors, unless it is raining.

Our intervention marketed the Ugastove charcoal stove, which a Ugandan-owned company fabricates by hand in Kampala. The main fuel saving innovations of the Ugastove are the cylindrical sheet metal frame and surrounding heat-insulating ceramic insert. These features reduce the amount of charcoal needed compared to stoves without the insert (Web Appendix 2, Figure 2B). The Ugastove was selected based on evidence that the Ugastove reduces fuel use when tested in controlled settings (Wang *et al.*, 2009). Further, it is the first stove to pass the voluntary carbon market's "Gold Standard", based on kitchen performance tests (Evans, 2008). Partly because the price is subsidized by carbon credits, the retail price was between \$6 and \$10, depending on stove size. The Ugastove carries a one year warranty against manufacturing defects. Warranty claims for the Ugastove can be filed by returning the stove to the factory or to the retailer where they originally purchased the stove at the buyer's expense. This shipping cost, combined with a general lack of knowledge of and trust in warranty service in Uganda, suggests that the warranty has little value to most consumers.



For both studies, the Centre for Integrated Research and Community Development (CIRCODU), an NGO based in Kampala that specializes in market research related to household energy, served as the in-country data collection and sales team partner. To avoid selection bias of customers most likely to respond to a particular sales offer in study 1, an enumerators' salary was independent of number of sales.

Beginning with a list of all parishes in Kampala provided by the Ugandan Bureau of Statistics, CIRCODU's local staff categorized about 30% of them as "low income", 60% as "middle income," and 10% as "wealthy," based on their personal knowledge of the city. Over the course of the study, the enumerators visited about 200 parishes, which covered virtually all of those considered "middle income" or "low income," excluding only a few informal settlements where many people cook with wood and waste. Wealthy areas were excluded since their residents mainly cook with gas stoves.

We had four study arms, each offering a separate sales offer:

1. Traditional offer: Consumers were given the opportunity to purchase the stove at a take-it-or-leave-it price, hereforth referred to as the cash-and-carry offer. Consumers were told if they needed to gather funds or check with family members they could take a week to decide and pay. In such cases the enumerator returned one week later to collect payment and deliver the stove.
2. Free trial offer: The enumerator left the stove and returned in one week for payment. If the consumer did not want to keep the stove it could be returned without payment.
3. Time payments offer: Consumers were given the opportunity to purchase the stove with four equal sized weekly installments. This offer included the right to return the stove before all scheduled payments were due, in which case future payments were canceled (as with rent-to-own). As with the traditional offer, the enumerator offered to return in a week to deliver the stove and collect the first time payment.
4. "Novel offer": Consumers were offered a one-week free trial followed by the opportunity to purchase the stove through four equal sized weekly installments (and the right-to-return, as with the time payments offer).

The price of the stove for all offers, irrespective of the payment plan, was the standard market price of \$6 to \$10, depending on the size. Thus, our time payment financing had an implicit interest rate of zero percent.

We randomized offers at the neighborhood level to avoid upsetting customers who heard that their neighbors received a better deal.<sup>6</sup> Thus, each household we approached within a neighborhood received the same one of four sales offers. To achieve balance across our study arms, we stratified on CIRDOCU's socioeconomic categorizations of the parishes (low/middle income). In addition, each offer was presented approximately the same number of times by each enumerator, and was presented with a similar breakdown in terms of the time of day, day of week, and time of year.

In each neighborhood, sales teams of two enumerators marketed the stoves to ten households in which an adult was home. Enumerators gave presentations to approximately every sixth household, so that each consumer approached had not seen or heard the enumerators give presentations to their neighbors. To reduce socioeconomic similarity within a neighborhood, after five households the team returned to the car and drove approximately one kilometer.

At each home, the sales team gave a marketing presentation about the stove and presented the sales offer that had been randomly assigned to that neighborhood. After gathering some basic information pertaining to the household's cooking and purchasing behavior, enumerators next recorded the homeowners' purchasing decision. (See Web Appendices 3 and 4 for the sales script and corresponding survey.) If the household received and accepted a traditional or time-payment offer, the salespeople collected the first payment. If the consumers asked to defer the traditional payment or the first time payment, the salespeople left with the stove and said they would return in a week to deliver the stove and collect payment.

For some neighborhoods where we were making the traditional offer we did not make the traditional cash-and-carry offer. Instead, we measured willingness-to-pay using an incentive-compatible Becker-DeGroot-Marschak (BDM) procedure.

In the BDM procedure the enumerators showed each participant a sealed envelope and explained that the price of the stove was set at random by the enumerators' manager and is now hidden within the envelope. The enumerators asked the participant the highest price she would agree to pay, explaining she could purchase the stove at the envelope price if the maximum

<sup>6</sup> Generally, each unique zone/parish was considered a different neighborhood. However, a couple of parishes were too small to keep as separate neighborhoods, and so were combined to form one neighborhood. We did this to provide sufficient separation such that consumers from different neighborhoods would be unlikely to communicate regularly (*e.g.*, would probably attend different churches, schools, shops, etc.). We also segmented some parishes into two different "neighborhoods" to allow a larger sample size within Kampala, provided that we could maintain distinct neighborhoods with little communication with adjacent neighborhoods.

willingness to pay she stated was at least as large as the (unknown) price inside the envelope; if the willingness to pay she stated was below the envelope price we would not be able to sell her the stove.

Because stated willingness to pay affects whether someone can purchase a product, but *not* how much she pays, this procedure provides incentives for respondents to report truthfully their willingness to pay (at least if participants understand and believe all the instructions). That is, it is not in the best interests of a respondent to name a higher price than what the product is worth to her, because she may end up agreeing to pay more than her actual willingness to pay. Similarly, if a participant understates her true willingness to pay, she might lose the opportunity to buy the stove at a price she was, in fact, willing to pay. The BDM procedure permits much more accurate measures of a demand curve than just randomly varying the price of a cash-and-carry offer.

We allowed participants to ask any questions prior to participating in the BDM procedure to ensure their understanding. We also explained to participants that they would have up to seven days to gather funds if needed.

After consumers made their purchasing decision, enumerators thanked them for their time and offered a small gift (a bar of soap) in exchange for answering a few more questions. This short survey covered liquidity constraints, trust, and concerns and experience with product durability. (See Web Appendix 4 for survey.)

Over the following months, the enumerators recorded customers' payments, return rates, warranty repair rates, and default rates.

### *Measures of Barriers*

Using our survey responses, we characterized participating consumers according to whether they appeared to face our hypothesized barriers.

*Liquidity constraints.* We classified consumers as liquidity-constrained if they reported that they had wanted to borrow money in the last three months and had either been denied a loan or had not even sought one for fear of being refused.

*Present bias.* To measure present bias we asked two items about simulated inter-temporal choices:

- “If a trusted relative wanted to give you a gift, would you choose 6,000 Ugandan shillings (UGX) [~\$3U.S.] now or 36,000 UGX [\$18] in 1 month?”
- “If a trusted relative wanted to give you a gift, would you choose 6,000 UGX [~\$3U.S.] in 3 months or 36,000 UGX [~\$18U.S.] in 4 months?”

If respondents have time-consistent preferences, they will give the equivalent response to both questions. Other researchers have found frequent preference reversals, with respondents choosing the option of immediate payout, but otherwise being willing to postpone payments if both options are delayed (see Benhabib *et al.*, 2010 and citations therein). If a consumer chose 36,000 UGX in four months over 6,000 UGX in three months but preferred a 6,000 immediate payout over 36,000 in one month, we coded her as *present biased*.

We classified consumers as having “concerns about salespersons honesty” if any of the following were true:

- The consumer replied with "Never trust" to the question, "How much did you trust that salesperson/those salespeople [who have visited you in the past]?" (conditional on having been visited by door-to-door salespersons in past).
- The consumer replied three or fewer to the question, "Out of 10 salespersons, how many would you say that you would trust?" (conditional on having been visited by door-to-door salespersons in past).
- The consumer replied with "Yes, all" or "Yes, most" to the question, "In your experience, do most salespersons promise more than their products deliver?"

*Concern about fuel savings.* Our survey also included one item that inquired directly about the consumer’s trust in Ugastove’s fuel savings: “Do you believe that this stove will save you half of your current charcoal expenditures?” (Coded 1 = “Definitely yes” to 5 = “Definitely no”).

*Concern about product durability.* We classified consumers as having “concerns about product durability” if they reported that most or all of the products that they purchase break soon after purchase. Specifically related to the Ugastove we also asked agreement with: “This stove will probably last three years or more.”

## *Design of Study 2*

Study 2 took place in rural areas around the western city of Mbarara in March through May of 2012. We selected the Mbarara region because it was rural, almost all families cook on a traditional three-stone fire, (see Web Appendix 2, Figure 2C) it is less than a day's travel from Kampala, and because local leaders indicate that families in this region spent more time gathering wood than in other regions meeting the above criteria. (Wood was more scarce in some northern parts of Uganda, but those districts proved to far of a distance with poor road infrastructure for us to work in.)

Almost all families cook on a traditional three-stone fire, usually located within a cooking hut (see Web Appendix 2, Figure 2C).

We studied available efficient stoves and selected the wood-burning Envirofit G3300 (Web Appendix 2, Figure 2D). Participants in our feasibility stage liked the Envirofit G3300 because it used little wood, produced little smoke, was portable, lit fast, and the flame was concentrated making the stove both safer and faster in cooking time than a three-stone fire (Web Appendix 5, Feasibility Report). The Envirofit is a “rocket” stove, which (when operated correctly) achieves efficient combustion of fuel by creating a good air flow into the fire, burning fuel at a controlled rate, completely burning volatiles, and directing the heat upward to the cooking surface. The manufacturer reported that in laboratory tests the Envirofit reduced fuel 50% and particulate matter 51% (relative to a three-stone fire). The manufacturer also reported a product lifespan of 5 years (Web Appendix 5), which is backed by a one year warranty. Each household was informed in Study 2 that to file a warranty claim they should first speak with the parish level focal point person. The focal point person then was to call CIRCODU who would then call local distribution partner UpEnergy in Kampala. UpEnergy would then contact Envirofit. As with the Ugastove, it is feasible that some consumers largely discounted the value of the warranty due the high transaction and shipping costs of filing a claim from rural Uganda.

We identified 24 rural parishes in Mbarara district with a total estimated population of 120,000–151,000 residents (a parish is an administrative unit that covers a handful of villages

and typically has about 5000–6300 residents) in the district. We randomly selected 10 parishes to receive the traditional sales offer and 14 to receive the novel sales offer.<sup>7</sup>

With the help of the local Community Development Officer, a quasi-governmental official who specializes in mobilizing local communities, we recruited a focal point person in each parish. The focal point person gathered roughly 60 people to a sales meeting on a day we specified.

At the sales meeting we presented the stove, discussed its benefits relative to the traditional stove, and presented the appropriate sales offer. The stove presentation included a cooking demonstration (which may reduce the value of the free trial). We also conducted a small survey of all participants focused on household cooking and socio-economic indicators.

Participants at traditional offer meetings were given the opportunity to purchase the stove that day for cash. As in Study 1, we also offered participants time to gather funds and/or discuss the purchase with their family and return to purchase the stove at a second meeting held about 10 days later.

Participants at meetings given the novel offer were given the opportunity to sign up for a free trial. At the end of the free trial, they could return the stove with no obligation or, if they liked the stove, they could purchase it in four even weekly payments. Households who accepted a free trial received their stove on average 3 weeks after the sales meeting. It is possible that this delay in initiating the free trial lowered demand for the stove slightly.

We gave households a one-week grace period (if needed) once during four weekly time payments. While we instructed the focal point people to collect the time payments for stoves weekly, in practice they provided more flexibility in timing of payments; for example, collecting one scheduled payment in two installments.

Based on an early study on willingness to pay in our study zone, we initially set the price at \$12U.S. (30,000 UGX).<sup>8</sup> Our goal was to have uptake with the traditional offer near 5% (the rate in study 1) to maximize comparability and to ensure sufficient statistical power. After one week of meetings (balanced between traditional—average of 63 participants per meeting—and

<sup>7</sup> The sample size is based on detectable effect size power calculations of 10% uptake in traditional offer parishes and 40% uptake in novel offer parishes.

<sup>8</sup> The exchange rate used: 2,515 Uganda shillings to 1 US\$ was based on the U.S. Treasury official exchange rate <http://www.fms.treas.gov/intn.html> (March 31, 2012 Official Exchange Rate US Treasury).

novel offers—average of 74 participants) uptake at meetings receiving the traditional offer was higher than we anticipated (35%). Thus, we raised the price at both traditional and novel offer meetings to \$16 (40,000 UGX). While some households stated unhappiness in meetings the following week (where the focal point people had mistakenly reported the lower price when they invited participants), we do not believe the price biased our results substantially.

### *Measures of Barriers*

As in study 1, we tested whether our consumers faced our hypothesized barriers based on survey responses.

*Liquidity constraints.* We tested whether consumers were liquidity-constrained by asking if they set any money set aside in case of an emergency and about their ownership of livestock and household assets. (See survey in web appendix 6.)

*Impatience.* To measure impatience (which is not the same as present bias, measured in study 1), we asked three questions about simulated intertemporal choices:

- “If you had a choice between getting 20,000 UGX (~\$8U.S.) today, or 40,000 UGX (~\$16U.S.) a year from now, which would you choose?”
- “What if you had a choice between receiving 20,000 UGX (~\$8U.S.) today, or 30,000 UGX (~\$12U.S.) in a month from now?”
- “Now what if you had a choice between receiving 20,000 UGX (~\$8U.S.) today, or 25,000 UGX (~\$10U.S.) in a week from now?”

As in Study 1, if a consumer chooses any of the immediate payments we code her as *impatient*.

Table 1 summarizes the main differences between Studies 1 and 2.

## **5. Results**

### *Descriptive Statistics and Validity of the Experiments*

*Study 1:* Baseline median weekly consumption of charcoal was \$2.20, with an interquartile range of \$1.60 to \$3.20. Households (defined as the number the respondent regularly cooks for) have a median size of five with an interquartile range of three to six.

Subjects self-report low rates of liquidity constraint. Only 4% report that they wanted to borrow money in the last three months and were either denied a loan or did not ask for one for fear of being refused.

In contrast, they self-report very high rates of impatience and/or present bias, with 63% preferring an immediate payout of \$3 over a payout of \$18 in six months (that is, preferring 6,000 Ugandan shillings immediately to 36,000 shillings later). Almost half these respondents (29% of the entire sample) showed extreme present bias, as they also preferred \$3 in three months to \$18 in four months.

Consumers also showed high concerns about salesperson honesty, with 85% meeting one or more of our criteria: “never trusting” door-to-door salespeople, saying that three or fewer out of 10 salespeople are trustworthy, and/or saying that all or most salespeople promise more than their products deliver.

A smaller but still substantial group of respondents had strong concerns about the durability of products they purchase, with 21% reporting that most or all of the products they purchase break soon after they have bought them.

*Study 2:* Households report both buying and collecting wood—80% report gathering wood last month and 69% report buying cooking wood last month. Households (defined as the number the respondent regularly cooks for) have a median size of 6 with an interquartile range of 4 to 7. At baseline 88% of our sample report the primary cook in the household is the wife and 89% report the primary household fuel used is wood.

73% of our participants report being in a monogamous marriage, 5% in a polygamous marriage, 12% widowed, 7% single, and 3% divorced or separated. The primary livelihood activity is farming and raising livestock; 37% own cows, goats, sheep, and/or pigs.

The majority of participants own a radio (91%) and a mobile phone (73%), while only 11% own a television. Almost half (46%) own a bicycle, 21% own a motorcycle, and 2% own a car (Web Appendix 7 shows outlines construction of the Asset Index)

Less than a quarter (23%) of households set aside money for an emergency, although 78% belong to a rotating savings and credit organization. Participants self-report high rates of impatience. Specifically, 83% prefer \$8 now to \$10 in a week, 83% prefer \$8 now to \$12 in a month, and an even higher share (88%) prefer \$8 now over \$16 in one year.



### *Validity of the Experiments*

In study 1 the several experimental arms are balanced on baseline measures including household size, charcoal expenditures, and prior experience with an improved cookstove (see Table 2A). In a multinomial logit, these measures are jointly not statistically significant in predicting the experimental arm. Put more simply, our randomization worked correctly and yields samples that are not statistically different.

In study 2 participants who received the cash-and-carry offer and those who received the novel offer are balanced on all baseline measures outlined above except with respect to self-reported gathering of wood. 83% of households report collecting wood in novel offer parishes, which is higher than the 73% in traditional offer parishes (Table 2B).

### *Effects of Sales Offers on Uptake in Study 1*

The main results of study 1 are in Table 3, which shows rates of adoption and payment for each sales offer.

*Traditional Offer:* Even given the choice of buying the stove that day or in a week, only 4% of the households offered the traditional sales offer (N=570 offers) wanted to purchase the stove at the regular price (pooling data from sales with a posted price and with the Becker-DeGroot-Marschak price elicitation procedure). For those given the traditional offer followed by the BDM procedure, the entire demand curve is shown in Figure 1. To get 45% uptake (as we did with the novel offer), the price on the traditional offer would need to decline by half.

Of the subsample offered a posted price (equal to the retail price), 6% accepted. 3% of those with the BDM procedure stated they were willing to pay at least the retail price for the stove. The difference in take-up rate across the two procedures is not statistically significant (chi-squared=2.0, P=0.15). At the same time, the slightly lower willingness to pay reported with BDM than in the take-it-or-leave-it traditional offer is consistent with the notion that consumers shaved their stated willingness to pay relative to their actual willingness to pay (Berry, Fisher, and Guiteras, 2011). Even if we assume stated willingness to pay averaged 10% below true willingness to pay, the uptake rate at the retail price would be unchanged.

*Novel Offer:* We were concerned that people might not understand or trust the novel sales offer. In fact, 48% percent of households to whom the offer was made (166 out of 355) accepted it.

We were concerned that consumers might return the stove because they did not like it, it did not save much fuel, or they could not detect the fuel savings. In fact, only 6% of those who accepted a free trial (9 out of 166) returned the stove. In a few cases, this was because the consumer could not afford a payment, not because she did not like the stove. (We allowed one grace period to consumers who missed a payment.)

Thus, after returns, the novel offer led to sales at 46% of homes (157 sales from 355 offers). To achieve the same uptake with the traditional offer, we would have had to drop prices by roughly 62%; that is, to a price barely more than that of a traditional stove.

The novel offer removes risk for consumers, but (as noted above) the seller bears risks that consumers might steal the stove, move away, or be hard to find at home. However, we received 97.1% of the expected revenue. Our revenue loss was distributed among 7% of those accepting the novel offer who failed to make all the payments, most often because no one was home during the regular collection visit and one or more follow-ups. We do not know what share of these households moved away. In a few cases, the consumer was home but did not intend to pay. These defaults always occurred after some payments had been made; 82% of those who failed to complete all payments made half or more of them.

In the United States, rent-to-own consumers frequently make late payments (Lacko, McKernan, and Hastak, 2000). We were worried late payments might be common and it would take many more visits to collect payments. (We charged no late fee.) Eleven percent of some customers who took our novel offer required more than four collection visits to make all payments. These cases were a mixture of nobody being home and of someone home but lacking funds at the final scheduled collection visit. To our surprise, a much larger share of customers completed their payments early: 35% of those who completed payments.

#### *Composition of the Novel Offer*

We were interested in finding out which of the possible barriers our novel offer addressed. If the main problems are difficulty in coming up with the entire purchase price at once and fears about durability, then time payments plus the right to return the stove and cancel future

payments should suffice without the free trial. Conversely, if the main problem is that customers doubt the new stove will both cook well and save money, then a free trial should suffice without time payments.

Each of these offers raised uptake about half as much as the novel offer did. Specifically, a fourth (26%) of the households offered time payments (but without a free trial) and 33% of those offered a free trial (but without time payments) accepted the offer (N=389 and 539, respectively). Return rates were 14% at the end of the free trial, so in the end 29% of households offered the free trial ended up accepting the new stove. The 14% return rate at the end of the free trial was statistically significantly higher than the 5.5% return rates with the novel offer ( $P < 0.01$ ).

Even after returns, either time payments alone or the free trial alone raised uptake more than 20 percentage points above the 4% uptake with the traditional offer. Moving from either intermediate offer to the novel offer increased uptake by roughly another 20 percentage points to 46 percent.

The default rates for the free trials (12%) and the time payments (7%) were not statistically significantly different from the rate for novel offers (7%). As with the novel offer, those who defaulted on time payments almost always made at least partial payments. As the free trial had only a single scheduled payment, most of those who defaulted made no payments.

Among those who eventually paid in full, 8% of households taking the time-payments offer required extra collection visits, which was similar to (and not statistically distinguishable from) the 11% share for those taking the novel offer. Over a third (38%) of those taking the time-payments offer completed their payments early; again, this was not statistically distinguishable from the share for those taking the novel offer (35%).

Overall, the payment rates on stoves not returned were 97% for the novel offer, 90% for the free trial only, and 96% for time payments only.

### *Effects of Sales Offers on Uptake in Study 2*

The main results of study 2 are in Table 4, which shows rates of adoption and payment for the traditional and novel sales offers.

*Traditional Offer:* Even given the choice of buying the stove that day or in a week, only 4.6% of the households offered the traditional sales offer (N=538 offers) wanted to purchase the stove at the regular price.

*Novel offer:* We were concerned that people might not understand or trust the novel sales offer. In fact, 62% of the 866 households to whom the offer was made accepted it.

Return rates among those who accepted a free trial were 8.2%, similar to the 6.0% seen in urban areas. The most common reason to return the stove was not being able to afford it or a significant life event (*e.g.*, one woman's husband went to prison). Thus, after returns, the novel offer led to sales at 57% of homes.

As in urban areas, we were concerned consumers might steal the stove or be hard to find at home. In rural areas we were also concerned about the challenge of reaching people's houses to collect payments. In spite of these obstacles, the novel offer had even higher repayment rates in rural Mbarara (99.1%) than in urban Kampala (97.1% in study 1). Only 1% of households that accepted the free trial and kept the stove failed to complete payments.

We were concerned that consumers in rural areas may have more varying income streams, making it particularly difficult to make payments on time. However, fewer buyers completed payments late in rural areas (6.1%) than in urban areas (11% in study 1). And, as in urban areas a substantial share of buyers completed their payments early (22%), though the rate was even higher in urban Kampala (35% in Study 1).

#### *Household Characteristics of Those Who Adopt the New Stove*

In study 1, we expected the new stoves to be most valuable for households with higher charcoal expenditures and larger household size. Results are weakly in line with those expectations (see Figures 2A and 2B). For this analysis, we compress a handful of outliers reporting spending over \$30 a week for charcoal or reporting more than 40 household members. On average, adopters used about 20% more charcoal per week than decliners and tended to have about 20% larger households (mean size closer to six people than five). In results not shown, both household size and charcoal expenditure statistically significantly predict uptake of the traditional or time-payment offers, but neither is statistically significant in predicting uptake of the free trial or novel offers. When both factors are entered in a regression jointly, household size has a larger effect than charcoal expenditure.

In study 2, there is no evidence that households which purchase the new stove report gathering wood or buying wood more frequently. Novel offer participants who opted to take a free trial reported a slightly larger household size at a typical meal of 5.9 while those who declined the free trial reported 5.7. The difference in the means is not statistically significant. In traditional parishes those who purchased the improved stove reported a statistically significant larger household size at the largest meal of 6.9 while those who declined to purchase reported 5.7 ( $p < .05$ ).

We posited that liquidity constraints and risk aversion related to product quality should impede product adoption more for those receiving the cash-and-carry offer than for those with the novel offer. To test these hypotheses, we examined if owning more assets (*e.g.*, mobile phone, radio, TV, bicycle, or motorcycle), reporting having savings for emergencies, being a member of a rotating savings and credit association (ROSCA), and having adopted more new technologies (*e.g.*, genetically modified seeds) predict uptake more strongly for the cash-and-carry offer than for the novel offer. (In a companion paper [Beltramo, *et al.*, 2013] we examine the main effects of these measures, all of which except impatience are of the expected sign.) Unfortunately, because only 25 households accepted the cash-and-carry offer, statistical power on these tests is low. Perhaps due to the small sample size, none of the interactions is statistically significantly different from zero nor can they reject economically important interactions.

### *Are Sales Offers Signals of Quality?*

Signaling theories suggest that offering a free trial signals the producer's confidence that the product meets consumer needs and that a product guarantee signals durability (Moorthy and Srinivasan, 1995; Shieh, 1996). In study 1, we therefore expected to find higher confidence in fuel savings amongst those given the offer with a free trial than amongst those given the traditional offer and higher confidence in fuel savings amongst those given the novel offer, which includes a free trial, than amongst those given the offer with time payments alone. Similarly, we expected higher confidence in stove durability amongst those given the offer with time payments plus the right to return than amongst those given the traditional offer, and higher confidence in stove durability amongst those given the novel offer (including the right to return the stove) than amongst those given the free trial alone. The prediction about the sales offer

signaling durability is muted in this setting because the Ugastove producer always promises to repair manufacturing flaws (although not problems due to consumer misuse).

We find no evidence that the type of sales offer affects consumers' confidence in the product. Almost half (46%) of respondents answered "Definitely" to "Do you believe that this stove will save you half of your current charcoal expenditures?" This fraction was almost identical for all sales offers (Table 5). Similarly, 21% of respondents answered "Strongly agree" to "This stove will probably last three years or more." Again, rates of agreement were similar across sales offers (Table 5), with no consistent pattern of greater agreement if the sales offer included time payments with the right to return the stove and cancel future payments.

In results not shown, we found the same lack of the predicted relationships when we ran an ordered logit, conditioning on respondents' confidence in salespeople and in product durability more generally. These results do not support the hypotheses that these consumers used the free trial to signal fuel savings or the right to return to signal durability.

*Importance of Sales Offer Terms to Address Liquidity Constraints, Mistrust, and Consumer Skepticism about Product Quality*

In study 1, we hypothesized that a sales offer with terms that addressed a specific constraint would increase uptake more among households who reported that constraint than among other households. For example, the time payments offer should increase sales more (relative to the traditional offer) for customers who report liquidity constraints than for other customers. Because the novel offer differs from the free trial by the addition of time payments, it should similarly increase sales relative to the free trial disproportionately among those reporting liquidity constraints.

In addition, consumers with low trust in salespeople should value the free trial more than their trusting counterparts value the free trial. We would therefore expect the free trial offer to increase uptake more (relative to the traditional offer) for consumers with low trust in salespeople than for other consumers. By the same principle, we would expect the novel contract to increase uptake more (relative to the time payments contract) among consumers with low trust in salespeople.

Finally, the right to return (which was included with time payments) should matter most for those reporting concerns about product durability. So, the difference in uptake between the

time payments offer and traditional offer, and between the novel offer and free trial offer, should be greater for those with durability concerns than for others.

Of these six tests, only two produce results of the right sign and no coefficients are statistically significant. Overall these hypotheses do not receive support.

In study 2, we tested the effect of four household characteristics on the likelihood of purchase with both novel and traditional offers. Table 6 shows the mean values of our four household characteristics by offer type. As hypothesized, the asset index, a proxy of liquidity, of those who purchased under the traditional offer was higher than that of those who purchased under the novel offer. However, the difference in the asset index between those who adopted and did not adopt was about 15 points for both novel and traditional offer recipients. Thus, those with more assets seem more likely to adopt, irrespective of offer type.

Having set aside money for an emergency, another proxy of liquidity, seems to have little effect at all between offer type. About 80% of those who purchased with either offer indicated that they had money set aside.

We found little difference in our impatience measure, an approximation of present bias, across the offer or between adopters and non-adopters. Contrary to our hypothesis, traditional offer buyers had the highest percentage of impatience indicators at 100%

Adopters had higher scores on the technology adoption index in both traditional and novel groups (Web Appendix 7 outlines construction of the technology adoption index). Consistent with theory, the technology adoption index is slightly higher for traditional offer buyers than for novel offer buyers. Again, consistent with theory, the technology index differential between buyers and non-buyers was less for novel offer participants than traditional offer participants. This suggests that the free trial can mitigate informational barriers to adoption.

We tested the above characteristics in a regression framework to test formally whether the interactions of offer type and household characteristics were statistically significant. None were, so the means above can be interpreted only as weak evidence of our hypotheses

## **6. Conclusion**

Our main result is that a sales offer combining a free trial, time payments and the right to return the stove and stop payments raises uptake in urban Kampala from 4% to 46% (study 1) and in rural Mbarara from 5% to 57% (study 2). Notably, not only did the novel offer increase uptake of

the improved cookstove, but return and default rates were low. In urban Kampala we received 97% of the expected revenue and in rural Mbarara we received 99%. In study 1 consumers that received a sales offer with either just time payments or with just a free trial increase the uptake of the improved cookstoves from 5% to 25%.

The novel sales offer was designed to address liquidity constraints, present bias, concerns about savings, and concerns about durability. Its success—and our sample’s self-reporting of high rates of those four barriers—suggests that these barriers are, indeed, collectively important.

At the same time, further analysis in study 1 did not pin down what barriers were most important. For example, those reporting these constraints did not purchase improved stoves less often than those who did not. In addition, there is no evidence that a sales offer designed to address a particular barrier (such as a free trial for those with concerns about the honesty of salespeople) increased adoption more for those reporting that barrier than it did for those who did not. There is also no support for the hypotheses, suggested by signaling theory, that a free trial signals fuel savings or that the right to return signals durability.

## **7. Discussion**

From study 1, the increase in sales with a free trial indicates many consumers have concerns about how well the product works, while the increase in sales with time payments shows the challenges paying a lump sum are also important. The sales offer of a free trial followed by rent-to-own overcomes both barriers for many consumers.

We also identified important anomalies belying a simple understanding of the barriers. For example, although both samples self-reported very high impatience, there were also high rates of prepayment: 35% in study 1 and 22% in study 2. Apart from the survey results, we have some qualitative evidence that is consistent with the hypothesis that many Ugandans consider debt undesirable. Several respondents, for example, said they were prepaying so the stove salesperson would not come by for collections; they apparently perceived a stigma of owing time payments. Prepayment may also have been motivated by the irregular nature of many customers’ incomes coupled with the challenges of saving; by prepaying when they had cash on hand, they reduced the risk of losing the stove if they had no cash when the next payment was due. It is possible that one attraction of our time payments offer is this flexibility to prepay (in contrast, for example, to the typical microfinance loan).



External validity is always a concern with a field experiment. The novel offer raised acceptance to 11.5 times that of the traditional offer in urban Kampala and 11.4 times in rural Mbarara. This near exact outcome suggests that the results will plausibly generalize to different contexts.

We had two reasons to expect a lower share of households would buy a new stove in rural areas (study 2) than in urban areas (study 1). First, as noted above, in rural areas people (usually women and children) gather fuel, while in urban areas families buy charcoal. Thus, the savings of money from lower charcoal expenditures make it an easier decision to “pay what you save” in urban areas. In addition, the efficient charcoal stove costs only about half as much as the wood-burning stove, while incomes are lower in rural areas than in urban areas (Uganda Bureau of Statistics (UBOS) and ICF International Inc. 2012).

Although our studies were not designed to compare uptake across urban and rural areas, we have several hypotheses for why uptake in rural areas turned out to be slightly higher than in urban areas. First, a three-stone fire in a cooking hut is much smokier and, thus, more uncomfortable to use, than a charcoal stove used outdoors. In addition, we stressed the health benefits of an efficient stove only in study 2. A higher share of households in study 2 marketing meetings had representation by both men and women than study 1 had at the urban door-to-door sales visits (where respondents were almost entirely women). Third, the less-poor households in urban areas probably have a higher share of women who work outside the home than their poorer neighbors. If that is so, study 1 over-sampled the poorest urban residents. Finally, study 2 had community marketing meetings. It is possible that free trials became a “bandwagon,” so that social influence led to more acceptance of the free trials. (We will examine the effect of health messages and social influence in companion papers from this data collection.)

Given the success of this sales model, it is important to understand the barriers that vendors face in providing free trials and time payments to consumers. For example, the door-to-door sales model, while appropriate for research, has high transaction costs in collecting time payments. We are testing whether mobile banking or selling to organized groups of consumers (*e.g.*, members of a microfinance or church group) can substantially lower transaction costs.

In addition, many local salespeople lack liquidity to lend stoves to customers and have limited ability to bear the risk of customer returns and defaults. We are testing novel distribution

contracts that can induce vendors to extend credit and free trials to customers while still giving vendors incentives to select reliable customers and report payments truthfully.

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Table 1: Differences between Studies 1 and 2

	Study 1	Study 2
Setting	Urban Kampala	Rural communities near Mbarara in western Uganda
Fuel used by new stove	Charcoal	Wood and other biomass
Means of acquiring fuel	Purchase charcoal	In most households women and children gather wood and other biomass fuel (crop residue, etc.)
Price of stove	\$6, \$8 or \$10 for size 1, 2, and 3	\$12 for 4 meetings, then \$16 for remaining meetings
Approximate # cooks for	Size 1, cooks for 5–7 persons Size 2, cooks for 10–12 persons Size 3, cooks for 10–12 persons	4–7 persons
Sales method	Door-to-door sales by research staff acting as salespeople	Sales meetings with presentations by research staff acting as salespeople
Time payments collected by	Research staff acting as salespeople	“Focal point person” from that parish recruited by research team

Table 2A: Study 1 Baseline Household Characteristics and Randomization Checks

	By Contract				Overall	Test of Row Equality (chi2)
	Traditional and BDM	Free Trial	Time Payments	Novel		
<b>Baseline Charcoal Expenditure (USD per week)</b>						
Mean	2.5	2.5	2.7	2.7	2.6	0.23
Standard deviation	1.5	1.6	1.7	1.5	1.6	
10th percentile	1.1	1.1	1.1	1.6	1.1	
50th percentile	2.1	1.6	2.8	2.7	2.1	
90th percentile	3.7	3.7	4.5	3.8	3.7	
<b>Household Size</b>						
Mean	4.9	4.9	5.4	4.8	5.0	0.17
Standard deviation	2.6	2.5	2.8	2.7	2.7	
10th percentile	2	2	2	2	2	
50th percentile	4	5	5	4	4	
90th percentile	8	8	9	8	8	
<b>Prior Experience with Stoves</b>						
% who use more than one stove on weekly basis	70.9	64.5	68.3	71.1	68.5	0.33
% who use non-improved charcoal-burning clay stove weekly	88.8	84.6	85.9	82.5	85.8	0.13
% who use non-improved charcoal-burning metal stove weekly	33.4	34.5	34.8	36.6	34.6	0.88
% who already own improved charcoal stove (ICS)	6.7	9.0	9.5	7.7	8.2	0.36
% of non-owners who have seen an ICS before	51.3	57.0	50.7	49.7	52.5	0.50
% aware that ICSs save fuel, of those who have seen an ICS before	54.8	48.3	55.8	54.8	53.0	0.55
Number of observations	534	483	357	316	1690	

Notes: We dropped 13 households reporting \$45 or more per week in charcoal expenditures; all other responses were below \$20/week. We dropped two households reporting 500 members; all other respondents reported 20 or fewer members. The exact number of responses for a given question may be slightly lower due to missing values.



Table 2B: Study 2 Baseline Household Characteristics and Randomization Checks

	Traditional	Novel	Test of Equality (binomial)
# of offers	412	720	
Share of offers accepted, total	5.1%	60.0%	.00
% of free trials returned			
Returned after free trial		0.2%	
Returned after payments began		8.1%	
% of free trials paid in full		91.0%	
Of which: % of those who fully paid who finished paying early		23.7%	
% of those who fully paid who finished paying late		1.0%	
% free trials in default		0.7%	
Of which: % of stoves in default that paid > 0		66.7%	
% of stoves in default that paid ≥ half of price		33.3%	
Eventual uptake (after returns) as share of offers	5.1%	54.6%	.00
Share of money received (relative to retail price of stoves that were not returned)	100.0%	99.4%	

Note: This table counts offers only to those who attended the initial sales meeting.

Table 3: Study 1 Adoption and Payment Summary by Sales Offer

	Traditional/ BDM procedure	Free Trial	Time Payments	Novel	Test of Row Equality (chi2)
# of offers to randomized homes	Fixed price: 114 BDM: 456	539	389	355	
Share of offers accepted	Fixed price: 6% BDM: 3% <sup>a</sup>	33%	26%	48%	.00
Among accepted offers					
% returned		14%	1%	6%	.10
% paid in full		73%	92%	87%	
% finished paying early, of those who fully paid		9%	38%	35%	
% finished paying late, of those who fully paid		8%	12%	11%	
% of stoves in default		12%	7%	7%	.24
% of stoves in default that paid > 0		42%	83%	100%	
% of stoves in default that paid ≥ half of price		33%	50%	82%	
Eventual uptake (after returns) as share of offers	4% (combined)	29%	26%	46%	.00
Revenue as a share of what consumers owed	100%	89.9%	96.1%	97.1%	

Notes: The Test of Row Equality column reports the p-value of the chi-squared statistic of a multinomial logistic regression predicting sales. Only the share of offers accepted and eventual uptake (after returns) are identified from the experiment. Revenue as a share of what consumers owed does not count include returned stoves as either revenue or what consumers owed.

<sup>a</sup> In the BDM procedure, 3% of households stated a willingness to pay of at least the stove's retail price or higher. The difference in uptake under fixed price and BDM is not statistically significant.

Table 4: Study 2 Adoption and Payment Summary by Sales Offer

	Traditional	Novel	Test of Equality (binomial)
# of offers made to people attending sales meeting	538	866	
Purchased at sales meeting	25		
Purchased at follow-up meeting	0		
Share of offers accepted, total	4.6%	62.1%	.00
% of free trials returned			
Returned after free trial		0.6%	
Returned after payments began		7.6%	
% of free trials paid in full			
Of which:	% of those who fully paid who finished paying early		22.1%
	% of those who fully paid who finished paying late		6.1%
% free trials in default			
Of which:	% of stoves in default that paid > 0		40.0%
	% of stoves in default that paid $\geq$ half of price		20.0%
Eventual uptake (after returns) as share of offers	4.6%	56.5%	.00
Revenue as a share of what consumers owed	100%	99.1%	

Table 5: Are Sales Offers Good Signals of Quality? (Study 1)

	Traditional & BDM	Sales Offer Free Trial	Time Payments	Novel	Overall
Reply “Definitely yes” to “Do you believe that this stove will save you half of your current charcoal expenditures?”	48%	<b>44%</b>	40%	<b>51%<sup>a</sup></b>	46%
Reply “Strongly agree” to “This stove will probably last 3 years or more?”	22%	21%	<b>20%</b>	<b>22%</b>	21%
N	513	433	299	214	1,459

*Note:* Signaling theory suggests the shaded cells will be larger than the cells immediately to their left on the top row and two columns to their left on the bottom row.

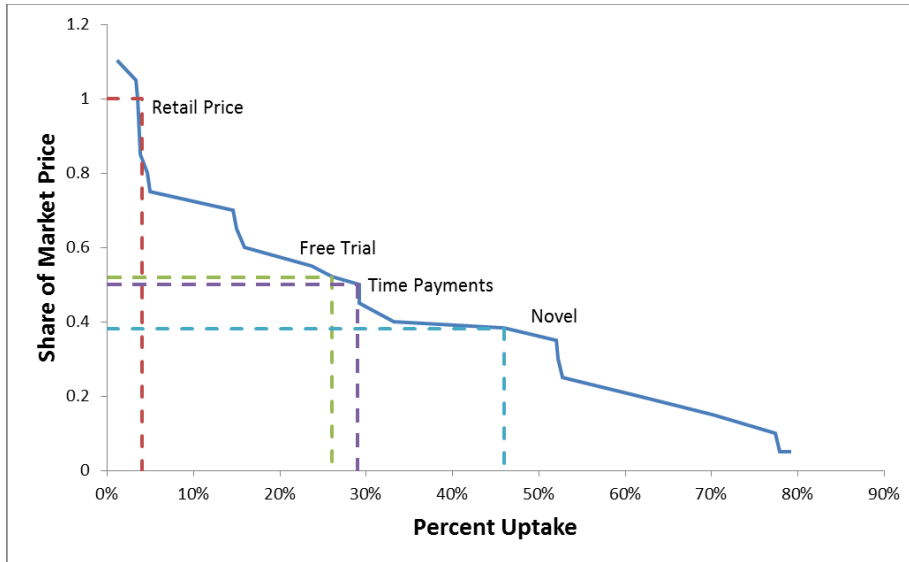
<sup>a</sup>  $P < 0.05$  for this comparison one column at a time. Neither joint test of both comparisons in a row is statistically significant at the 10% level.

Table 6: Effects of Testing Asset Index, Emergency Savings, Impatience, Early Technology Index on Stove Purchase by Offer Type, Study 2

mean (s.d.)	All participants		Traditional Purchased?		Novel	
	Y	N	Y	N	Y	Y
Asset Index (Weighted sum of ownership of 4 livestock, 3 hhld goods, and 3 transportation vehicles, ranging from 0-401)	60.33 (68.19)***	45.25 (58.24)	70.36 (53.16)*	45.54 (57.48)	59.86 (68.81)***	44.79 (59.50)
	563	841	25	513	538	328
Household reports has set money aside for emergency	80% (.40)*	75% (.43)	80% (.41)	76% (.43)	80% (.39)*	74% (.44)
	563	841	25	513	538	328
Impatience (dummy=1 if hhld selects to receive lower monetary amount today vs. tomorrow for any of the 3 inter-temporal time preference questions)	84% (.37)	86% (.34)	100% (0)*	87% (.34)	83% (.37)	86% (.35)
	563	841	25	513	538	328
Early Technology Adopter Index (Count of 5 related early technology adoption questions which respondent replied yes)	1.39 (1.01)***	1.15 (0.93)	1.52 (1.19)*	1.16 (0.93)	1.38 (1.0)***	1.14 (.92)
	563	841	25	513	538	328

Results of t-test are indicated by \* p<0.05; \*\* p<0.01; \*\*\* p<0.001

Figure 1: Demand Curve from Incentive-Compatible BDM Procedure with Traditional Offer



Notes: The vertical lines indicate uptake for the four sales offers: 3% for traditional offer (using the BDM elicitation), 29% for the free trial, 26% for time payments, and 46% for the novel sales offer. For the free trial, time payments, and novel offer, the uptake calculations are not from the BDM procedure, but from separate sales with a posted price (where we only count sales that were not followed by returns). The horizontal lines indicate the price (relative to the market price) required for the traditional offer to achieve the uptake of the other sales offers. Specifically, the price would have to fall by roughly half to have as many participants state a willingness to pay with the traditional offer as accepted the free trial or time payments and it took a reduction of 62% off the regular price to have the same uptake as the novel offer.

FIGURE 2A: MEAN BASELINE CHARCOAL EXPENDITURE

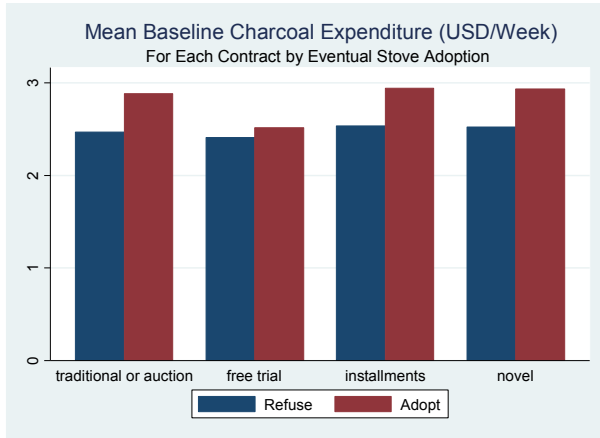


FIGURE 2B: MEAN NUMBER OF PEOPLE IN HOUSEHOLD

