Policy Brief

47415 | August 2019

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How do credit and psychology affect the adoption of profitable energy efficient technologies in Kenya?

In brief:

- Energy efficient technologies are often cited for their potential to meet sustainable development goals by slowing greenhouse gas emissions and generating financial savings for households living in poverty, but adoption of energy efficient technologies remains low.
- This study conducts a randomised experiment with 1,000 low-income households in Nairobi. The authors estimate that an energy efficient charcoal cookstove reduces charcoal spending by 40 percent and saves up to USD 120 per year, or around one month of income. This is a significant sum of money for households living in poverty.
- The findings suggest credit constraints prevent most households from adopting this technology and benefiting from its savings. Providing access to affordable credit more than doubles willingness-to-pay, closing the energy efficiency gap. 90 percent of respondents pay installments in a timely fashion.
- For policymakers looking to reduce poverty and address negative environmental externalities with available tools, the presence of credit constraints may make subsidies on the energy efficient technologies a more effective tool than taxes on environmental pollutants.

This project was funded by IGC Kenya

Overview of the research

Low- and middle-income countries are expected to propel global energy demand in the next several decades. As incomes rise, households almost universally adopt energy-intensive appliances such as refrigerators. Energy efficient technologies are often cited for their potential to meet sustainable development goals by slowing greenhouse gas emissions and generating financial savings for households. With energy accounting for 80 percent of global CO2 emissions, the IEA (2018) attributes 44 percent of global targeted emissions reductions by 2040 to energy efficiency gains. Despite this, adoption of energy efficient technologies remains low.

This study examines the determinants of household adoption of a profitable energy efficient technology. Specifically, the study sought to answer the following questions:

- Are energy efficient technologies profitable?
- How do credit constraints and behavioral biases affect adoption?
- What are the policy implications of these findings for addressing environmental externalities?

More than 1,000 individuals residing in low-income informal settlement areas around Nairobi participated in the study. To understand the impact of credit and inattention on adoption, participants were randomly assigned into control and treatment arms for two interventions. Respondents in the credit treatment are allowed to pay for the stove in installments over 3 months. Respondents in the attention treatment fill in an attention sheet, writing down the amount of money they think they will save each week for the next year if they owned an energy efficient stove. They then sum the expected savings for each of the twelve months, and write down what they would do with the savings each month (for example, buy more food, or pay school fees). Finally, they write down the total amount they will have saved after one year.

Households are then randomly assigned a subsidy for the cookstove, and completed an exercise to disclose their willingness-to-pay for a stove. This allowed the researchers to understand how the two treatment arms affect people's valuation of the technology. Because the subsidy was randomly assigned, a random subset of respondents subsequently adopted the stove.

Policy motivation for research

Energy usage in low-income countries will likely continue to rise in coming decades, increasing energy expenditures and contributing to local and global environmental pollution. Almost half of all emissions reductions under the Paris agreement are targeted to come from energy efficiency improvement. An improved understanding of the barriers to household adoption of energy efficient technologies would help policymakers respond optimally to these concerns.

Many Kenyan households' primary energy-using technology is a charcoal cookstove. Traditional cookstoves contribute to growing deforestation, generate greenhouse gas emissions, and cause millions of deaths each year. The Jikokoa, an energy efficient cookstove, generates significant benefits in health and time use, but its most salient feature is a reduction in spending. Total spending on firewood and charcoal in Sub-Saharan Africa in 2012 was $12 billion. At baseline, charcoal expenditures account for 14 percent of household income.

Widespread adoption of the stove would help alleviate poverty and improve welfare by reducing household energy expenditures, curbing deforestation, and improving household respiratory health.

Findings

Key research questions	Summary of the key findings
Are energy efficient technologies profitable?	The stove reduces charcoal spending by 39 percent, saving on average $120 per year. This is around one month of income for the median respondent, and these results are stable up to 18 months after adoption. Given the stove's market price of $40, this implies an annualised internal rate of return (IRR) of 300 percent per year.
How do credit constraints affect adoption?	Households face significant credit constraints. Providing access to a loan doubles willingness-to-pay for the energy efficient stove, and closes the energy efficiency gap. More than 90 percent of respondents are reasonably on track with their instalment payments.
How do behavioural biases affect adoption?	Some respondents complete a detailed attention exercise, where they calculate their weekly and monthly savings, and think through what they would do with these savings. This activity does not move willingness-to-pay. It is likely that individuals are already very well aware of how profitable this technology is, and they are not adopting largely because of their credit constraints.
What are the policy implications of these findings for addressing environmental externalities?	Increased adoption of energy efficient technologies will save money for the poor, reduce environmental damages, and limit climate change. Widespread diffusion of these technologies can likely be achieved if policymakers are able to address frictions in the credit market and provide subsidies for energy efficient technologies.

Policy recommendations

- **Improve credit markets**
  The stove saves USD 120 per year on average, which is around one month of income for low-income households in Nairobi. However, households are unable to take advantage of this opportunity because they face significant credit constraints. Credit providers often place constraints on the size of the loan a household can take out on any one day, and taking out a loan through informal channels is often prohibitively expensive. Increased access to affordable credit would allow households to exploit cost-saving opportunities and help policymakers to curb poverty and improve environmental outcomes.

- **Subsidise profitable energy efficient technologies**
  In the absence of improved credit markets, the second-best policy solution in the short term is to subsidise energy efficient technologies. By lowering the cost of the technology today, this will act similarly to a loan. A modest USD 10-20 subsidy might save households hundreds of dollars over two years, which is a highly cost-effective poverty reduction strategy from a public policy perspective. Such a policy would furthermore help reduce the rapid deforestation, negative health effects, and carbon emissions that are frequently generated through widespread traditional charcoal usage.