Policy brief
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Liquidity constraints, LPG stoves, and charcoal consumption in Tanzania

In brief

- Over 70% of households in urban Tanzania use charcoal as their main source of energy for cooking.
- Charcoal use results in deforestation, forest degradation, emission of harmful greenhouse gases, and indoor air pollution. As a result, significant welfare can be gained from shifting to modern energy sources.
- This brief examines the impact of relaxing households' financial constraints on adoption of liquefied petroleum gas (LPG) stoves and their impact on charcoal consumption using data from a randomised controlled trial.
- It is found that the provision of LPG stoves results in a 27% reduction of charcoal use after 15 months. Also, the provision of LPG stoves on credit reduces charcoal consumption by 24%, while LPG provision through subsidy reduces charcoal consumption by about 32%.
- The authors conclude that relaxing households' financial constraints to afford the start-up cost of modern cooking appliances is crucial to promote energy transition.

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Overview of the research

Over 70% of households in urban Tanzania use charcoal as their main source of cooking energy. Tanzania currently consumes a staggering 1 million tonnes of charcoal every year, half of which is consumed by Dar es Salaam, the major commercial city. Using carefully conducted randomised controlled trials, few previous studies investigate the factors that promote adoption of improved biomass cookstoves and their impact on indoor air quality, health, and fuelwood consumption in rural areas of developing countries. These studies identify social networks, availability of continuous technical support, cultural factors, and good designs that meet households' expectations as important factors that promote the adoption and continued use of improved biomass cookstoves. The key hypothesis maintained in the current project is that, transition to modern and cleaner fuels requires the acquisition of appropriate cooking appliances, which can be very costly to households in developing countries.

This study investigates the impact of relaxing households' financial constraints on adoption of liquefied petroleum gas (LPG) stoves and the corresponding reduction in charcoal consumption.

To test the hypothesis, data was collected through a randomised controlled trial (RCT), which involves the provision of LPG stoves through subsidy and on credit. In order to study the impact of the interventions, comprehensive baseline, midline (four months after the stoves have been distributed), and endline (15 months after the stoves have been distributed) surveys were conducted.

The analysis allows conclusions to be drawn on the impact of helping households access finance on adoption of LPG stoves and the magnitude of charcoal that can be reduced due to the switch to LPG.

Policy motivation for research

Unsustainable biomass fuel use results in significant and negative environmental, climatic, and health effects. Biomass fuel production has been documented to be one of the major causes of deforestation and forest degradation. This results in destruction of irreversible biodiversity and local ecosystems in Sub-Saharan Africa, including in Tanzania. Often burned in inefficient cookstoves, biomass fuel contributes to global warming through emission of hazardous greenhouse gases, including black carbon and carbon dioxide. At the household level, biomass fuel use is the cause for indoor air pollution, which claims 3.3% of the global burden of disease, especially that of women and children, and causes about 2 million pre-mature deaths per year. Consequently, significant welfare can be gained by society if households shift from biomass fuel use to modern, environmental-friendly fuels.

The key policy question which this study attempts to answer is whether

helping urban households relax liquidity constraints can induce them switch to modern cookstoves, or whether dependence on charcoal is driven by cultural factors that cannot be altered by public policy in the short-run.

Policy impact

The study aims to provide information on the impact of switching from using charcoal to LPG and the possible mechanisms to facilitate the transition. We expect that the findings of the study would result in the formulation of appropriate policies to reduce charcoal use and protect the remaining forest resources of Tanzania.

Key research questions	Summary of the key findings
Why do households continue to use charcoal and not LPG for cooking?	Around 93% of households at the baseline indicate that the high start-up cost of LPG stoves is the key reason for not owning one.
What is the uptake rate of LPG stoves in urban Tanzania?	About 70% of the households who have been assigned to either of the interventions (LPG stoves through subsidy or on credit) agreed to uptake.
Does adopting LPG stoves reduce charcoal consumption?	Households who adopted LPG stoves reduced charcoal consumption by 27% 15 months after the intervention.
Which of the two interventions (subsidy or credit) results in larger reduction in charcoal consumption?	Households who adopted LPG stoves through credit reduced charcoal consumption by 24%, while those who adopted through subsidy reduced charcoal consumption by 32%.

Policy recommendations

- **Help households get access to micro-credit to acquire LPG stoves**
  - Given the documented adverse consequences of biomass fuel use, switching to LPG results in a significant reduction of charcoal use and, consequently, a reduction in deforestation.
  - At the time of the baseline survey (April 2015), a two-burner LPG stove including the cylinder costs TSh 200,000 (approximately $110).
  - In the subsidy treatment (75% of cost subsidy), 70% of those who were offered the LPG stoves purchased them. If the government aims to implement a subsidy initiative to encourage adoption, the per unit cost of an LPG stove would therefore be TSh 150,000 or $83.33.

- In the credit treatment, a nearly equivalent proportion of households purchased the LPG stoves. Three months after the end of the credit period (i.e., March 2016), credit households paid back 90% of the total amount of the loan. This results in a 10% default rate (TSh 20,000) per LPG stove. In addition, it costs TSh 55,000 per LPG stove to process and collect back credit from treatment households through WATT-SACCO, the micro-finance institution which we collaborated with and known as the 'Women Advancement Trust'. The total per LPG stove cost of the credit treatment to the government would therefore be TSh 75,000 or $41.67 maximum. Considering the economies of scale associated with a larger number of LPG stove adopters, the unit cost of distributing LPG stoves on credit is likely to drop significantly.
- Although we document larger impact on charcoal consumption through acquisition of LPG through subsidy (32% reduction) than on credit (24% reduction), it is often difficult to justify large-scale subsidies. Similar amount of reduction on charcoal use can be achieved through provision of LPG stoves through credit. Tanzania's forests (as well as many other Sub-Saharan African countries') are global public goods due to their carbon sequestration capacity.
- The key message that comes out of this study is that governments, international donor agencies, and other stakeholders should consider channeling resources to improve affordability of LPG stoves to the poor through provision of micro-finance loans.

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- **Improve access to LPG gas**

  - Households on average have to walk for 17 minutes to reach the nearest LPG gas dealer. However, they can reach a charcoal vendor in just about four minutes. This disparity in cost of traveling to the nearest vendor of these fuel types could potentially discourage households from refilling LPG stoves to continue using them. Making it easier for households to get easier access to LPG gas would encourage continuous use, resulting in further reduction in charcoal use. Given that our study is limited in its scope, we recommend a comprehensive assessment of the LPG market in Tanzania to identify the challenges LPG supplier firms face in distributing gas to households in urban Tanzania.