ENERGY CONSUMPTION BEHAVIOUR OF INDIAN HOUSEHOLDS: AN APPLICATION OF LA-AIDS

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Overview

Ensuring 'access' to affordable, reliable, sustainable and modern energy for all is the seventh Sustainable Development Goal (SDG) as given by United Nations Development Program (UNDP) in 2015. According to United Nations (UN) Report 2018 on SDGs, the percentage of global population that lacked access to clean cooking fuels was 41% and the proportion of global population without access to electricity was lower at 13% in 2016 (United Nations, 2019). The UN report also states that in India, about 264 million people are still making use of solid fuels for cooking and nearly 200 million people lack access to electricity. As per the latest figures reported in National Family Health Survey-4 (2015-16) (National Family Health Survey (NFHS-4), 2015-16: India, 2017), ~44% of households have access to clean cooking fuel and 95% have access to electricity in the country. In this context, the uptake of clean fuels for cooking and lighting assumes importance along with its effects on health and well-being of people. A state-level study reports positive correlation between the Human Development Index (HDI) and access to modern fuels: LPG for cooking and electricity for lighting (Sankhyayan and Dasgupta, 2019) however, several negative health effects of using traditional fuels are also reported (Parikh, 2011) (Smith and Sagar, 2014). The State of Global Air 2019 reports that, in India, household burning of biomass was responsible for about 24% of outdoor $PM_{2.5}$ concentration in 2015 and a mortality burden of ~5 lakh due to household air pollution alone in the year 2017 (Health Effects Institute, 2019). Against the backdrop of high economic and social cost attached to the use of traditional fuels for cooking and lighting, the process of transition assumes significance. With nearly 55% of households still making use solid fuels for cooking, we need to understand the transition from traditional to cleaner fuels as access is enhanced in terms of of two widely tested 'energy ladder' and 'energy stacking' hypotheses. In this backdrop, the objective of the paper is to estimate price and income elasticities of household demand for different fuels for cooking and lighting and to identify sign of energy transition in terms of energy ladder/energy stacking hypotheses?

Methodology

A household-level analysis is carried out to model the energy use behaviour of the households in India based on Linear Approximation of Almost Ideal Demand System (LA-AIDS). A two-stage modelling approach has been adopted to estimate parameters related to the pattern of energy demand. In model 1 expenditure shares of three commodity groups, food, energy and clothing-bedding-footwear (cbf) have been estimated. In model 2, (energy sub model) demand related parameters for three categories of fuels (kerosene, electricity, LPG) are estimated in the study. The model is estimated using LA-AIDS as:

$$w_k = \alpha_k + \sum_j \gamma_{kj} \log p_j + \beta_k \log(\frac{x}{p})$$

where, w_k is the expenditure share of category k.
α_k is constant and γ_{kj}, β_k are parameters. γ_{kj} represents changes in relative prices i.e. the effect of increase in j^{th} price on k^{th} budget share. β_k represents changes in real expenditure. $\frac{x}{p}$ is the real expenditure where x is the total expenditure and p is the price index.

The uncompensated (Marshallian) own- and cross-price elasticity for fuel (k) with respect to fuel (j) is estimated as:

$$e_{kj} = -\delta_{kj} + \frac{\gamma_{kj-\beta_k}}{w_k}$$

where, δ_{kj} is the Kronecker delta, =1 for own price, =0 for cross price elasticities.
Expenditure/Income elasticity is estimated as: $E_k = 1 + \frac{\beta_k}{w_k}$

This paper makes use of the 68th Household Consumer Expenditure Round for 2011-12 (published in 2014) (NSSO, 2014). The total number of households surveyed in the 68th round of NSSO were 101651, out of which 59,693 households belonged to rural and 41,968 households belonged to urban areas. NSSO provides data on Total Consumption Value and Total Consumption Quantity on differnt categories of food items, clothing, bedding and footwear and different fuels being used for lighting and cooking in the Indian households. The reference period taken by NSSO is 30 days.

Results

- Energy demand is sensitive to price change and more so for the people in lower income quartiles (urban and rural).
- Energy has high expenditure elasticity which means that the intervention can be made through the channel of income generation.
- The own-price elasticity values indicate that demand for LPG is more price responsiveness than demand for electricity.
- In case of expenditure elasticity, LPG demand in more sensitive to income change than the demand for electricity.
- Finding suggest kerosene being a Giffen good with positive own price elasticity and negative cross price elasticity with electricity in the low-income household.
- The over all results suggest that there is a transition towards modern fuel, however, the energy stacking behaviour is rather prominent.

Conclusions

In India, the transition to modern fuel is slow and still a large number of households are using traditional fuels for cooking and lighting. So, it is important to understand the household level behaviour towards use of different types of traditional and modern fuel, especially with respect to change in price and income. The energy transition is more in line with the energy stacking behaviour than a complete abandoning of traditional fuels and opting for modern ones. The elasticity is low for electricity i.e. it is price inelastic whereas LPG is found to be price elastic. One of the findings in paper suggest towards kerosene being a Giffen good with positive own price elasticity meaning that when the price of kerosene falls, the demand for kerosene also goes down. The households are likely to substitute kerosene for electricity given the negative cross elasticity values.

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