

POVERTY AND ENERGY TRANSITION: A MULTINOMIAL ANALYSIS FOR HOUSEHOLDS IN BRAZIL

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Overview

In 2015, United Nations (UN) Member States included the universal access to clean fuels by 2030 in a set of measures to eradicate poverty, protect the planet and ensure prosperity for all, known as Sustainable Development Goals (SDG). Accessing clean fuels has significant impacts beyond sustainable development, since the use of solid fuels, such as firewood and charcoal, implies serious impacts on health. According to the World Health Organization (WHO, 2016), indoor air pollution increases the risk of diseases, especially in women, children, and elders.

Despite the large multi-sectoral effects of the use of solid fuels, the replacement of these energy sources to modern fuels, such as the liquefied petroleum gas (LPG), in a process known as energy transition, depends on the socioeconomic characteristics of countries and regions. Nowadays, the consumption of solid fuels for cooking is still high in many localities. According to the International Energy Agency (IEA, 2017), one-third of the world's population relies on solid fuels for cooking. In Brazil, despite cash transfer programs and policies to subsidize the price of LPG, the incidence of these solid fuels in rural areas reaches 62% of families in 2017, according to data from the Continuous Brazilian National Household Sample Survey (PNADC) of the Brazilian Institute of Geography and Statistics (IBGE).

Bacon et al. (2010) argue that the share of the household budget allocated to a particular fuel depends on the household income, price of fuel, reliability, and price of substitute fuels. Coelho et al. (2018) highlight the importance of the income level in the households fuel choice for cooking in Brazil and show that as the income level increases, the fuelwood consumption decreases by around 26%. Other recent studies such as Alkon et al. (2016) and Gould and Urpelainen (2018), also have recognized the relevance of the affordability in determining household fuel consumption decisions.

This study aims to analyze the relationship between the poverty level and the household inadequate access to clean fuels for cooking, through a multinomial logit model, controlling for several household characteristics and for the LPG price. We perform the analyses considering the different deprivation levels faced by extremely poor and poor families, besides the households facing a higher chance of future poverty (named the vulnerable households). We also take into account the location of families, through analyses for the Brazilian geographic regions and urban or rural areas. We aim to understand how the affordability and the heterogeneity of poor families are associated to different stages of the energy transition process, and which are the most disadvantaged profiles that should be the focus of public policies.

Methods

We estimate a multinomial logit model, controlling for household preferences and LPG price, to obtain the relative probabilities of choosing one fuel or a combination of fuels for cooking over another alternative. We consider three alternative choices: i) only clean fuel (LPG), ii) only solid fuel and, (iii) a combination of clean and solid fuel. This set of possible fuel choices can correspond to a probability function such as:

$$P(y = j|I, X, p) = \frac{\exp(I\alpha_j + X\beta_j + p\gamma_j)}{1 + \sum_{n=1}^j \exp(I\alpha_n + X\beta_n + p\gamma_n)}, j = 1, 2, 3$$

where j denotes the three possible fuel alternatives; y is the fuel choice that maximizes the household utility; I is the household income or binary variables reflecting the deprivation level of the family such as dummies for poor,

extremely poor or vulnerable families; X is the vector of observable household characteristics; p is the vector of LPG price.

We analyze the relative probability of using solid and clean fuels for cooking of four different groups of households according to their poverty level: i) extremely poor families; ii) poor families; iii) vulnerable families, that is, families with a higher chance of future poverty; and iv) non-poor families. We define poverty and extreme poverty according to the World Bank's thresholds for countries with a median-low income of, respectively, 3.20 and 1.90 dollars per day. We also will perform subgroup analyses according to the geographic location of the families, considering the location in rural or urban areas of the Brazilian geographic regions.

We use the microdata of PNADC (IBGE) for 2016 and 2017, which cover the entire Brazilian territory and contain 302,939 households. We also use Margin and Fuel Price Survey of the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), which contains geographically disaggregated information on the average LPG resale price.

Results

Preliminary results of multinomial logit estimations for Brazilian rural areas confirm that increases in per capita household income reduce the probability of using the combination of clean and solid fuels and reduce even more the likelihood of exclusive use of solid fuels for cooking. Among extremely poor households, the relative chance of exclusively using solid fuels is about five times greater than the risk of exclusively using LPG. For poor families, this relative probability is about four times greater.

We observe that the exclusive use of clean fuel is more frequent among extremely poor families and the combined use of fuels is more frequent among poor families. On the other hand, households with higher incomes or out of poverty are more likely to use LPG, a cleaner, healthier and more efficient fuel.

Conclusions

This study aims to analyze the relationship between the poverty level and the household inadequate access to clean fuels for cooking, through a multinomial logit model, controlling for several household characteristics and for the LPG price. The preliminary findings corroborate the hypothesis that the energy transition, in which households gradually migrate from the use of solid fuels to the use of clean fuels for cooking through an intermediate phase of concomitant use of both fuels, occurs jointly with a wider improvement on welfare household conditions.

Understanding how affordability and the heterogeneity of poor families are associated with different stages of the energy transition process makes it possible to determine which are the most disadvantaged profiles, which should be targeted by public policies. Thus, the study could contribute to the formulation and evaluation of strategies and policies to reduce the use of solid fuels and increase access to clean fuels, such as LPG, mainly in remote areas of Brazil.

References

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