

# Who Adopts LPG as the Main Cooking Fuel and Why? Empirical Evidence on Ghana Based on National Survey

AMIN KARIMU<sup>a</sup>, JUSTICE TEI MENSAH<sup>b</sup> and GEORGE ADU<sup>c,d,\*</sup>

<sup>a</sup> Umea University, Sweden

<sup>b</sup> Swedish University of Agricultural Sciences, Uppsala, Sweden

<sup>c</sup> Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

<sup>d</sup> The Nordic Africa Institute, Uppsala, Sweden

**Summary.** — The aim of this paper is to identify the factors that influence the probability of adopting LPG as the main cooking fuel in Ghana using household level data gleaned from last two nationwide household surveys (GLSS 5 & GLSS 6). Using a flexible semi-parametric specification, the following were uncovered. First, we find socioeconomic and demographic factors such as income, education, access to urban infrastructure, and location of household, as key drivers of households' choice of LPG as main cooking energy source. Again the influences of these factors are stable across time, and with a strong price effect. The evidence shows that urban households with better socioeconomic and demographic factors are likely to adopt LPG as the main cooking fuel relative to households in rural areas and also urban households with poor socioeconomic and demographic factors. Finally, we observe that the imposition of fully parametric structure (functional form) prior to estimation on factors such as age of household head, income, and household size as done in the literature is inappropriate, at least in the case of Ghana and tend to bias the marginal effects. There is strong evidence of variations in the response rate of LPG adoption over the domains of income, household size, and the age of the household head. The results suggest a policy dichotomy between rural and urban dwellers for it to be effective.

© 2016 Elsevier Ltd. All rights reserved.

*Key words* — fuels, cooking, households, development, energy poverty, Ghana

## 1. INTRODUCTION

Household energy use has received considerable attention among policy makers and researchers. The keen interest in fuel use patterns particularly in developing economies stems from the heavy dependence on solid biomass or coal fuels, and their associated negative impacts on livelihoods, environment and health. Coupled with the use of inefficient cooking stoves, emissions from biomass combustion are associated with high incidence of acute respiratory infections (ARI), particularly, among women and children (Ezzati & Kammen, 2001; Mishra, 2003). Also, fuelwood collection has been shown to affect educational and labor outcomes of women and children, due to the long hours spent on collection. On the environmental impacts, emissions of black carbon among other greenhouse gases have negative impacts on the climate. Again, unsustainable harvesting of biomass for energy use is a leading driver of deforestation in tropical regions, especially, sub-Saharan Africa (SSA). Thus, continuous dependence on biomass energy, especially the use of inefficient cookstoves and methods by households poses a major threat to the survival of livelihoods and entails significant externalities on the global environment and climate.

The recognition of these impacts has led many governments and development agencies to propose various measures in the quest of addressing the issue of energy poverty by encouraging the up-take of improved cookstoves, sustainable production of biomass fuels, and the up-take of “modern” fuels such as LPG. In Ghana, for example, government has over the past three decades implemented policies such as price subsidies on LPG. Even though the policy has recorded some level of success, there is still room for improvement to ensure that LPG up-take serves as one (others include adoption of improved cookstoves for some socio-economic groups, where

modern fuel up-take is almost impossible in the near future due to cost, culture, and reliability of fuel supply) of the key solutions to the energy poverty issues in Ghana and the associated environmental, health, and development impacts. Currently, only 23.1% of Ghanaian households use LPG as the main cooking fuel (Mensah & Adu, 2015) up from under 5% in the early 1990s.

Contrary to predictions from energy theories such as the “energy ladder hypothesis”, which suggest a simplistic switch from traditional fuels to modern fuels driven largely by economic forces such as income and price; empirical evidence from many developing economies suggest that the dynamics of fuel switching is far more complex and less understood. There is a high degree of inertia in fuel switching patterns, often attributed to non-economic factors such as taste, preference, reliability in supply, inter alia. This is evident in the Ghanaian context, since despite a rise in income and price subsidies on LPG, less than a quarter of households use LPG as a main cooking fuel.

Given these complexities, it is important to fully understand and establish the motivating factors driving households' choice of a relatively “clean” cooking fuel like LPG over alternate fuels. More importantly, we address the question of “how does the response of LPG adoption rate vary over time to changes in factors driving it?” Further, even though majority of the extant studies have examined the determinants of cooking energy choices, which can be grouped broadly into two strands, a group that is more descriptive in highlighting cooking fuel transition (e.g., Barnes & Qian, 1992; Dowd, 1989;

\*We wish to acknowledge comments and suggestions from two anonymous reviewers. Their contributions are duly appreciated. Final revision accepted: May 5, 2016.

Hofstad *et al.*, 2009; Masera *et al.*, 2000) and a group that utilizes quantitative (econometric approaches) to examine the transition probabilities and/or demand for cooking fuels (see e.g., Barnes, Krutilla, & Hyde, 2005; Chambwera, 2004; Chambwera, 2007; Gebreegziabher, Mekonnen, Kassie, & Köhlin, 2012; Heltberg, 2005; Kebede, Bekele, & Kedir, 2002; Mekonnen & Köhlin, 2008; Mensah & Adu, 2015). Both strands have their respective merits in providing valuable information in understanding energy poverty dynamics, especially in developing countries. Often, the qualitative strand provides some intuition and hypothesis on cooking fuel transition dynamics, and the quantitative approaches evaluate the hypothesis to ascertain their validity and provide causal dynamics. One key question that remains is whether the functional form specification used by these studies has any impact on the results derived. Theoretically, demand for energy is assumed to be a non-linear function<sup>1</sup> of household size, the age of household head and income. However, the exact form of the non-linearity is unknown, a priori. To account for this non-linearity in the energy demand relationship, previous researchers have applied variety of techniques such as log transformation<sup>2</sup>, introduction of quadratic terms, and the use of estimators such as logit/probit models in binary outcome cases. What still remains as an empirical challenge is the extent by which these appropriately capture the inherent non-linearity in the fuel choice functions, since the exact form of the relationship is unknown to the researcher, a priori. We contribute to this discussion by adopting semi-parametric probit model which offers more flexibility in capturing the non-linearity in the relationship without imposition of any functional form prior to estimation. To illustrate the relevance of allowing the data-generating process (DGP) to select the precise form of the non-linearity rather than imposing some functional form prior to estimation, we compare our preferred semi-parametric estimates with fully parametric estimates. This comparison allows us to establish possible biases in the evidence reported in the extant literature, especially for Ghana. Further it also highlights the possibility of such biases for other developing countries studies.

The aim of this study therefore is two fold: first, to analyze the main driving forces behind a household's choice of LPG as its' main cooking fuel over alternate fuels such as biomass, and how the influences of these factors vary over time. Second, we seek to test the effect(s) of functional form bias on the results derived. In line with the aim, the following four questions are addressed: (1) Are the key determinants usually cited in the literature on cooking fuels in developing countries also important for LPG uptake in Ghana?; (2) Does the effect of the key variables vary over time?; (3) whether the usual fully parametric specification usually imposed on the empirical models is free from functional specification bias; and (4) What is the role of prices on LPG uptake and the policy ramification that emerges from it? We utilize data from two most recent nationwide household surveys to estimate a probit model using both parametric and semi-parametric econometric techniques. Results are then compared across the two datasets and models.

This study offers immense contribution to energy policy design in Ghana and many developing economies, in search of effective strategies to boost household's use of cleaner and efficient fuels such as LPG. The study also offers relevant contribution to the extant literature, as it sheds more light on the role of functional form specification in household energy demand models.

Findings from our study reveal socioeconomic and demographic factors such as income, education, access to urban

infrastructure, location of household, as key drivers of households' choice of LPG as main cooking energy source. Again the influences of these factors are stable across time. There is also evidence of a strong price effect. Finally, we observe that the imposition of parametric structure (functional form) prior to estimation on factors such as age of household head, income, and household size as done in the literature is inappropriate for the case of Ghana, and tend to bias the marginal effects. There is strong evidence of variations in the response rate of LPG adoption over the domains of income, household size, and the age of the household head.

The structure of the remaining sections of the paper is as follows: a review of relevant literature is presented in Section 2. Section 3 describes the methodology and empirical strategy for the paper, while Section 4 focuses on data description. The discussion and analysis of the results from the paper are presented in Section 5. Section 6 concludes with a summary and policy implications from the study.

## 2. LITERATURE REVIEW

Studies on the determinants of household energy choice in the literature are replete with evidence from both developed and developing countries, albeit studies from the latter are often constrained by lack of sufficient data especially on energy prices and expenditures. Notable among such studies include Couture, Garcia, and Reynaud (2012) using French data, Gebreegziabher *et al.* (2012), Kebede *et al.* (2002), Mekonnen and Köhlin (2008) for Ethiopian households, Barnes *et al.* (2005) and Heltberg (2004, 2005) for developing countries, Chambwera (2004) and Chambwera and Folmer (2007) for Zimbabwe, Akpalu, Dasmani, and Aglobitse (2011) and Mensah and Adu (2015) for Ghanaian households and Ouedraogo (2006) for households in Burkina Faso among others.

Evidence from Kebede *et al.* (2002) using Ethiopian data, reveal that non-income factors such as fuel availability and demography are key drivers of demand for modern energy other than income. This evidence offers key insight into the reasons behind the slow adoption rate of modern energy even among high-income households in developing economies, as the market for these fuels especially LPG and electricity, is often marred with frequent shortages and inefficiencies in service delivery. This inherent uncertainty in the supply of LPG and electricity creates disincentives for households' energy transition. Mekonnen and Köhlin (2008) found similar conclusions.

Nevertheless, income remains a key constraint to the transition of households from the use of traditional fuels to modern and clean fuel types like LPG and electricity. Edwards and Langpap (2005) provide an empirical test of this claim by analyzing the effects of start-up cost and restricted access to credit on the households' decision to switch from firewood to gas using Guatemalan data. Using the parametric probit model, their results reveal that access to credit via its effect on the purchasing power of households to purchase a gas stove, exerts a significant influence on the household's consumption levels of fuelwood. Their findings also reveal that high start-up cost is indeed a limiting factor for Guatemalan households in the transition from fuelwood to LPG. Hence targeted subsidies toward reducing the cost of gas stove will yield desired results. In contrast, Heltberg (2005) argues that the idea of a complete transition from fuelwood to modern fuels such as LPG does not seem plausible in the Guatemalan case, as many of the households that adopt these clean fuels still retain some preference for fuelwood. Thus any policy such as LPG subsidies that seeks to engender a complete switch to LPG will not yield the

Download English Version:

<https://daneshyari.com/en/article/990558>

Download Persian Version:

<https://daneshyari.com/article/990558>

[Daneshyari.com](https://daneshyari.com)