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Cooking fuel preferences among Ghanaian Households: An empirical analysis

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ABSTRACT

This paper investigated the key factors influencing the choice of cooking fuels in Ghana. Results from the study indicated that education, income, urban location and access to infrastructure were the key factors influencing household's choice of the main cooking fuels (fuelwood, charcoal and liquefied petroleum gas). The study also found that, in addition to household demographics and urbanization, the supply (availability) of the fuels influenced household choice for the various fuels. Increase in household income was likely to increase the probability of choosing modern fuel (liquefied petroleum gas and electricity) relative to solid (crop residue and fuelwood) and transition fuel (kerosene and charcoal). I therefore proposed that poverty reduction policies, provision of education and modern infrastructure, as well as provision of reliable supply of modern fuels should be part of the policy framework in promoting the use of modern fuels in Ghana, especially for urban dwellers, while for rural dwellers the focus should be on how to efficiently use traditional fuels in a more environmentally friendly and sustainable way.

Introduction

In most developing countries, fuelwood is the major energy source for the household (mainly for cooking), irrespective of the health implications that this source of energy can potentially involve, especially when used indoors. It is estimated that over 2.5 billion people in the developing world depend on biomass as their primary energy source for cooking (IEA, 2006). Air pollution is increasingly becoming a major contributing factor for poor health in the world, especially respiratory diseases, of which "dirty fuel"[1] is one of the major contributing factors. For instance a study by World Health Organization (WHO, 2009) indicates that the burden of diseases attributable to indoor smoke from solid fuels for developing countries is about 1.94 million premature deaths per year. The health consequences of using dirty fuels in homes cannot be overemphasized as it contributes massively to indoor air pollution, which has both direct and indirect health consequences, which women and children are the most exposed in society.

Besides the health concerns from the high usage of "dirty fuels", especially fuelwood, there are economic consequences such as loss of productivity, either due to poor health as a result of polluted air, or time spent in gathering fuelwood at the expense of working or studying. The loss of economic opportunities via the use of fuelwood falls heavily once again on women and children, as they are responsible for gathering fuelwood for the household in most developing countries. Biomass collection is also one of the factors that contribute to deforestation in developing countries, especially near cities and major roads (Heltberg, 2001).

The proportion of households in developing countries using biomass energy (especially fuelwood) is very high compared to rich-industrialized countries. According to Bonjeur et al. (2013) solid fuel use is most prevalent in Africa and South East Asia where more than 60% of the households cook with solid fuels. For instance, in some urban cities such as Ouagadougou, 70% of the households use fuelwood as the main cooking fuel (Ouedraogo, 2006) and it is similar in the case of Ghana.

Switching to modern fuels therefore provides many potential benefits such as less time required for cooking and cleaning pots. It also increases the productivity of the poor as it allows them to redirect labor and land resources from fuelwood collection and production to activities that generate income (Heltberg, 2004). Switching into modern fuels also improves the welfare of women by providing them with the opportunity to engage in income-earning activities as a consequence of the efficiency and reduced time required for cooking.

Despite the disadvantages outlined above in the use of biomass fuels, such as fuelwood, it is still the major cooking fuel in Ghana. In 1990 approximately 69% of Ghanaian households used fuelwood as the main cooking fuel, and this figure decreased to 57.8% in 2005 (Ghana statistical service report, 2008). The reduction in 2005 indicates a remarkable

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[1] Dirty fuel in this paper refers to biomass fuels, especially cow dung, crop residue and fuelwood, Charcoal on the other hand is in this paper classified as a transition (partial) fuel in the sense that it is not as dirty as fuelwood, but not as clean as liquefied petroleum gas (LPG). Kerosene is also classified as a transition fuel in this paper. Modern fuels or "clean fuel" refers to LPG and electricity.

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progress as a result of the efforts made by the government of Ghana with the support of the United Nations Development Program (UNDP) to promote the use of modern fuels in Ghanaian households, especially liquefied petroleum gas (LPG). Various policies have been undertaken, including the national LPG promotion Program[2] and the West African Gas Pipeline (WAGP) project to aid the supply of LPG from Nigeria. Despite the efforts made by the Ghanaian government over the years, the percentage of households using fuelwood in Ghana is still very high. Within the same period (1990–2005), LPG usage increased from 0.8% in 1990 to 6.4% in 2005, and that of electricity also increased from 0.5% in 1990 to 1.1% in 2005. Irrespective of the progress made over the years to influence households to switch to modern fuels, fuelwood and charcoal are still the preferred household fuel choices for cooking in Ghana. It is therefore important to understand the main factors influencing household preferences regarding cooking fuels in order to develop appropriate policies to aid the penetration of "clean" fuels in Ghana as principal cooking fuels.

In this study, fuels are classified into three groups; modern, transition and solid fuels (traditional fuel). This classification is based on the so-called energy ladder hypothesis.[3] The energy ladder hypothesis states that at a low level of income, households tend to consume fuels that is at the bottom of the ladder and regarded as "dirty" such as biomass fuel. As income level rises, households tend to move up the ladder by replacing biomass fuels with "transition" fuels such as kerosene and further to "modern" fuels such as LPG and electricity as income rises still further. Given this classification it will be possible to investigate the energy ladder hypothesis and its relevance in the case of Ghana.

There are several studies in the literature that have studied household energy use patterns in developing countries, but most of the studies are based on descriptive statistics. Few of the studies actually based their analysis on econometric methods to try and understand causal factors influencing household energy choice, energy demand or both. Econometric studies on this topic can be grouped essentially into three based on the focus of the study, a group that focus on different energy sources (Hosier and Dowd, 1987; Reddy and Reddy, 1994; Masera et al., 2000; Barnes et al., 2002; Heltberg, 2004,2005; Ouedraogo, 2006 and Farsi and Filippini, 2007), a group that concentrate on household energy demand (Cuthbert and Dufournaud, 1998; Heltberg et al., 2000; Chambwera and Folmer, 2007) and a group that consider both choice and demand for household energy (Barnes et al., 2005 and Gupta and Köhlin, 2006)

In the literature, high cost of equipment and the high price of modern fuels, among other factors, are cited as the main constraints to the adoption of modern fuels. Furthermore, Leach (1987) states that income, cost of appliances, relative fuel prices and the availability of commercial fuels are the most important variables influencing household fuel preferences in South Asia. Soussan (1988) found that, both multiple fuels and fuel switching were common in poor households due to specific budgeting strategy. Reviewing a larger number of energy surveys, Leach and Gowan (1987) found that income, household size, climate, cultural factors and cost of appliances were the key demand-side variables influencing fuel choice. In cases of insecure energy supplies, fuel security rather than fuel switching dominates in the household energy plan (O'Keefe and Munslow, 1989). Other works that based their analysis on the energy ladder model include, Hosier and Dowd (1987), Reddy and Reddy (1994), Barnes et al. (2002), Heltberg (2004), Gupta and Köhlin (2006) and Ouedraogo, 2006. Contrary to the energy ladder model, Masera et al. (2000) found that in rural Mexico, fuel switching is actually a step toward "multiple fuel cooking" or "fuel stacking" for both fuelwood and LPG.

The aim of this paper is to determine the key factors that induce the choice between modern, solid and transition fuels, and to investigate the energy ladder hypothesis. Given the benefits of switching to modern fuels, and the challenges that high dependence on the use of biomass fuel poses on poverty alleviation Program such as the United Nations millennium development Program, it is imperative to have a clear understanding of the key variables that influence household decisions regarding the choice of cooking fuel. This will help in the designing of the appropriate policies towards efficient and sustainable cooking energy consumption. To reach the objectives I will adopt a multinomial probit regression (MNP)[4] approach to try to answer the question relating to the factors that determine the choice of a particular group of fuels (modern, solid, and transition). I will also decompose the groups into their specific fuels and investigate the factors influencing the probability of choosing each of the three main cooking fuels in Ghana (fuelwood, LPG and charcoal).

In the literature, to the best of my knowledge, the only published work on Ghana in the area of household cooking fuel is that of Heltberg (2004) and Akpalu et al. (2011). Heltberg (2004) studied eight developing countries (Ghana as one of the countries). In the paper, Heltberg used the 1998/99 survey data for each of the countries. I argue that a lot has happened since then, especially in the area of energy policy aimed at increasing LPG penetration in the domestic fuel mix from the 0.8% in 1989 to 50% by 2020. Therefore, by using new data, new light will be shed on the possible progress made, and we can also assess the impact of the availability/non-availability of the fuels on the fuel-choice process. In addition, the 2004/05 survey is more extensive in terms of coverage (increase in the number of households and additional variables such as availability of the fuels) than the 1998/99 survey, and will contribute to the literature on Ghana as the factors influencing choice of fuels are context-specific. Akpalu et al. on the other hand studied the extent to which preference matter regarding four cooking fuels (fuelwood, charcoal, kerosene and LPG), which is a different focus in comparison to that of this study. Besides, they also used the 1998/99 survey data that did not capture the second phase of the LPG promotion program (Rural LPG Challenge program) that was launched in 2004.The rest of the paper is organised as follows; section 2 contains the theoretical considerations and econometric model, section 3 presents the data. The results of the study are presented in section 4, in section 5, I present the conclusion of the study and ideas for future work.

The model

In this section, I will outline the theoretical model for household fuel demand and consequently the indirect utility function that will be used in the empirical section. The theoretical model for household demand for cooking fuels can be derived from the household utility maximisation principle. Assume that household utility depends on food consumption (C) and on the consumption of other goods and services (OG). The utility function can then be expressed as;

$$U = u(C, OG). \tag{1}$$

Further, assume that food consumption is a function of cooking fuel (F) and groceries (G), conditional on the cooking technology:

$$C = c\left(F_j, G\right), \quad j = type/alternatives\ \ of\ \ cooking\ \ fuel. \tag{2}$$

[2] This program includes expanding the capacity of the Tema oil refinery in the production of LPG to increase domestic supply, instituting the uniform petroleum price fund (UPPF) that uses sales from petrol to cross-subsidize LPG and providing financial incentives for LPG sales occurring in places more than 200km from Tema refinery.

[3] The reason for using only energy ladder model relative to the competing alternative "fuel-stack" model is due to the nature of the data at hand. In the survey, no question was asked on possible second and third fuel used by the household for cooking and as a result, the data limit the model choice for the analysis to the energy ladder model.

[4] Other econometric approaches used in the literature on this topic include Tobit model (appropriate for censored data) and the two-step selection type of model approaches (Lee, 1983; Dubin and McFadden, 1984, and Dahl, 2002). The Tobit model is more applicable in cases where there is an issue of censoring in the data, while the selection type of models deals with issues of selection in the data. Both approaches require that the dependent variable for the main model to be a non-factor variable and therefore not applicable for the data used in my study.