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Willingness to pay for improved energy: Evidence from Kenya

Helen Hoka Osiolo

Kenya Institute of Public Policy Research and Analysis (KIPPRA), P. O. BOX 56445-00200, Nairobi, Kenya

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ABSTRACT

Using a sample respondents of 3665 households and 1669 enterprises, this paper utilizes a double bound, open-ended, contingent valuation approach where those who respond positively to the willingness to pay question, were asked to state the maximum amount they were willing to pay as quality levy. The paper identifies protest responses as those respondents who are not willing to pay for the proposed program or as outliers who may state a willingness to pay value either higher or lower than the average willingness to pay value. Bidders and genuine zeros responses are respondents that either state a zero or a positive willingness to pay respectively. Heckman's sample-selection procedure is used to test sample selection bias in and also analyze the WTP function.

The mean household willingness to pay as quality levy was estimated to be US$ 6.53, US$ 3.85 and US $ 6.34 monthly for firewood, charcoal and electricity respectively while the enterprise willingness to pay as quality levy was estimated to be US $ 355.92 monthly. Income, type of dwelling, education, gender, price, location, type of enterprise and size of employees were identified as important factors that explained the differences in the WTP variations.

1. Introduction

World Energy Outlook 2016 reports that 1.2 billion people are without access to electricity and more than 2.7 billion people rely on the traditional use of biomass (mainly firewood and charcoal) for cooking [19]. In many developing countries, the demand of energy for cooking represents a larger share estimated at 90 percent of the total household energy consumption [19]. This share is unlikely to drastically change in the near future unless deliberate actions to change the situation are implemented rapidly. According to [18], the number of households using traditional biomass is projected to rise further by 100 million in 2030. The use of biomass is associated with indoor air pollution (which adversely affects human health), land and forest degradation, and lowers productivity.

Variations in climate impact negatively on the production of firewood, charcoal and electricity. As a result the quality, reliability and efficiency of energy products and services are threatened. Until 2013, Kenya relied on hydro power for electricity generation. However this situation has changed. For instance in 2016 the proportion of power from hydro dropped by half to 35 percent from 66 percent in 1980. It is important to note that during dry seasons, the low levels of water available in dams affect the amount of electricity generated and this may lead to frequent power outages low power supply, high power systems losses, and high tariffs. Consequently, in dry seasons reliability of fuels may be questioned, as this may imply shortages/low supply of firewood and charcoal while in wet seasons the quality of such fuels may be affected.

On one hand improving the quality, reliability and efficiency for electricity as a source of energy implies that proper frameworks will be in place to allow for: increased electricity generation mix especially from renewable energy sources; and increased construction of new/improvement of existing grids and stations infrastructure. On the other hand for charcoal and firewood; quality, reliability and efficiency mean that there is need to: provide avenues that increase sustainable production of firewood and charcoal; promote slow demand growth amidst the rising population; and achieve large-scale market transformation for clean cook-stoves.

Studies done on willingness to pay for energy sources apply either: Contingent Valuation Methods or Choice Experiment Methods. Using the CVM approach, Roe et al. [33] analyzed the US consumers' willingness to pay for green electricity. The results indicate that consumers appear to be willing to pay more to achieve emission abatement targets, rather than to support an increase in renewable share. A similar study targeting to estimate the willingness to pay for electricity from renewable energy sources was

E-mail address: helen.hoka@gmail.com.

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done by Ivanova [20] among consumers in Queensland, Australia. The results show that averagely respondents are willing to pay 28 Australian Dollars per quarter on top of their quarterly electricity bill to support the increase in electricity from renewable energy sources. The significance of the heterogeneity in willingness to pay is explained by socio-demographic factors. A different study focusing on the willingness to pay for electricity among households and applying the CVM was done by Abdullah and Jeanty [1] in Kisumu, Kenya. The findings show that the willingness to pay for grid electricity is reported to be more than that of photovoltaic electricity. A close study to this is done by Mozumder et al. [27] where they investigated household willingness to pay for renewable energy sources. The results for instance, show that consumers are willing to pay an average of a 14 percent increase in their average current electricity bill (of about $10/month) for a 10 percent share increase of renewable energy.

Jensen at al. [40] uses contingent valuation method to estimate WTP for use of biomasses only for individual resident in the State of Tennessee. The response rate was 14.85percent and the results show that a WTP around 6.51 cent/kWh for wooden biomasses. A similar study was done by Arabitzis and Malesios [2] focusing on fuelwood alone in a rural area of Greece but applying a different approach – Confirmatory Factor Analysis (CFA). The study found that households generally show a positive attitude towards environmental issues and the difference in pro-environment attitude can be explained by socio-demographic characteristics such as age and education level.

There are a number of studies that summarizes studies done on willingness to pay on renewable energy and applies CVM. Using the random-effect meta-analytic approach, Soon and Ahmad [35] report the willingness to pay for use of renewable energy sources in Asia, Europe and North America among household countries to be around USD 7.76. Differences in forms of knowledge, information, awareness and exposure to renewable energy sources use explains the variation in willingness to pay among urban residents and North America households with those of Asia households. Generally Oerlemans et al. [30] identified through literature review analysis that studies carried out to measure willingness to pay for electricity generated from renewable energy sources and those that apply CVM are mainly from developed economies. The paper also identified six common errors in CVM and discusses possible remedies to address these errors in willingness to pay research. These errors are recognized as: embedding/scope; sequencing; hypothetical; strategic bias and elicitation effects. Another study that analyses literature on studies applying CVM is by Bigerna and Polinori [5] where they estimated household's willingness to pay for green electricity in Italy. The results show a general willingness to pay among household towards achieving the goal of 26.4 percent of electricity production from renewable energy sources. The differences in the willingness to pay in their study is be explained by age, sex, income, education and professional status.

Studies done on this subject and applying the choice experiment approaches are few. Murakami et al. [26] carried a comparative analysis between US and Japan and examines consumers' willingness to pay for renewable and nuclear energy as two alternatives to fossil fuels for the reduction of greenhouse gas emissions. The results indicate that US consumers' willingness to pay for a 1percent decrease in green gas emission is $0.31 per month compared to $0.26 per month for Japan. Willingness to pay for renewable energy was estimated at $0.71 per month for US and $0.31 per month for Japan for a 1 percent increase in the use of renewable energy source. Though, both countries had a negative preference for increases in nuclear power in the fuel mix.

Despite several studies undertaken on the willingness to pay for energy sources, empirical studies that focus on the energy sources for cooking among households are scanty. In addition the numerous studies undertaken have largely focused on households/residential sector with little attention on the commercial sector. This study uses the contingent valuation method (CVM) to examine the mean willingness to pay for firewood, charcoal and electricity among households and enterprises. The study also uses the Heckman sample selection model to analyses the factors explaining the variations of the estimated mean willingness to pay.

2. Energy consumption patterns in Kenya

Historically, Kenyan households have relied on biomass as the main source of cooking energy, but with advances in technology and economic growth, LPG, electricity and biogas have been adopted by about 7 percent of the households [13]. At the same time the commercial sector depends on electricity for provision of services and production of industrial goods.

A closer look at the 2005/6 Kenya Integrated Household Budget Survey (KIHBS) shows that firewood is the most common source of cooking energy accounting for 68.3 percent of the total household energy consumed. Rural households are the major consumers (87.7percent) of firewood. The second major form of fuel consumed by households is charcoal, representing 13.3 percent of the total household energy consumed. This is closely followed by paraffin/kerosene at 13.2 percent, with the urban households consuming about 44.6 percent. At the national level, LPG is the most consumed modern fuel among households estimated at 3.5 percent, compared to electricity which accounts for 0.6 percent. The urban population is the major consumer of modern energy with 11.9 and 1.8 percent for LPG and electricity, respectively.

Apart from the Kenya Integrated Household Budget Survey of 2005/6, recent statistics from the Kenya Demographic and Health Survey (KDHS) show that the highest consumed household energy in 2010 was firewood representing 63.3 percent of the total household energy at the national level; and 83.3 percent and 6.1 percent in rural and urban areas, respectively. The least consumed was electricity accounting for 0.5 percent at the national level, while 0.1 percent and 1.6 percent was consumed by rural and urban population, respectively. Comparing the Kenya Integrated Household Budget Survey of 2005/6, and the Kenya Demographic and Health Survey of 2010, we concluded that here is no evidence of significant difference in household energy consumption between 2006 and 2010 as observed in Fig. 1.

3. Methodology

3.1. Data

3.1.1. The sample, survey instrument and elicitation format

The study uses data from National Energy Survey that was carried out in 2009 and captures information in the energy sector on; energy choices and use, energy cost and expenditure, consumer satisfaction issues, energy conservation and willingness to pay.

The data had two categories of respondents: consumers (comprising of enterprises and households), and suppliers (comprising of producers). With regard to energy consumers 3665 of the respondents were households and 1663 of the respondents were from the enterprises while in the energy supply chain, 857 of the respondents were from the energy providers'.

The survey tool/questionnaire used had 6 sections. The section on willingness to pay is based on a CVM where double-bounded open-ended questions were asked to elicit household and enterprises willingness to pay for different energy sources (including firewood, charcoal and electricity). The first question is a close-ended type of question and asks respondents whether they