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Energy Consumption, Weather Variability, and Gender in the Philippines: A Discrete/Continuous Approach

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Energy consumption, weather variability and gender in the Philippines: A discrete/continuous approach

Connie Bayudan-Dacuycuy[1]

Using a discrete/continuous modeling approach, this paper analyzes energy use and consumption in the Philippines within the context of weather variability and gender. Consistent with energy stacking strategy where households use a combination of traditional and modern energy sources, this paper finds that households use multiple energy sources in different weather fluctuation scenarios. It also finds that weather variability has the highest effects on the electricity consumption of balanced and female-majority households that are female headed and in rural areas. Several policies are suggested.

Keywords: Discrete/continuous approach, weather variability, gender, energy choice, energy consumption
JEL Code: Q4, Q49, D12

I. Introduction

While substantial studies on energy use and consumption in developing countries have been done, there are very few researches in the Philippines that analyze such topic with a gender dimension and within the context of weather variability, the studies are even fewer. This study puts together three interrelated topics: energy use and consumption, weather, and gender. Households use different energy sources for lighting, cooking, and heating needs. It aids the pursuit of productive activities like studying and the pursuit of health and hygiene. Weather or climate is an integral part of our lives and it is certainly relevant in energy use. Electricity consumption is lower when it is raining because there is less need for cooling. Fuelwood, charcoal, and biomass consumption may be lower due to supply constraints during rainy season. LPG consumption may be affected due to damaged infrastructures resulting from landslides and heavy rains. In turn, weather shocks and climate change are known to affect men and women differently and the different effects are the likely result of the different roles gender play in the society. In the context of energy use, Charmes (2006) provides evidence refuting the claim that mostly women and girls collect firewood but provides support for the widely-held belief that majority of women and girls are involved in food preparations. In this case, the type of energy sources used for cooking affects the welfare and productivity of women and children. For example, using biomass, fuelwood, or charcoal emits particulates that can cause respiratory illnesses. The use of inefficient energy sources compromises the time allocated to productive activities like children's study time and women's effort to generate income.

Electricity is the popular energy source in rural and urban households based on the Household Energy and Consumption Survey (2011) with around 75% of rural households and 89% of urban households reporting electricity use. LPG is the next popular choice but the proportion of users is lower: around 25% and 56% of rural and urban households use LPG, respectively. Charcoal is also used and similar to LPG use, the proportion is lower for rural households (around 6%) than for urban households (around 15%). In the Philippines, Bayudan (2006) provides evidence that substantial proportion of women are in-charge of food preparation, house cleaning, and child care duties and they obtain help from children. Dacuycuy (2016) provides evidence that weather fluctuations affect different types of household consumption. To our knowledge, there are no

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studies yet that analyze energy use within the context of both weather variability and gender in the Philippines. Given this backdrop, this study analyzes how households' energy use and energy consumption with different sex composition vary in response to weather fluctuations. By doing so, this paper also analyzes the effects of income, prices, and other socioeconomic factors and predicts how total energy consumption changes in different weather fluctuation scenarios. To put the paper in perspective, we speak to the literature on energy ladder/energy switching and we discuss below some developments in the literature such as the multiple use/energy stacking model.

Energy ladder assumes that households behave as neoclassical consumers so that their demand for cleaner and safer energy sources increases with income (van der Kroon, Brouwer and Beukering, 2013; Dershorst, 2008; Hosier and Dowd, 1987). The energy ladder model envisions a three-stage fuel switching process (Heltberg, 2004). The first stage is marked by universal reliance on biomass, in the second stage households move to "transition" fuels such as kerosene, coal and charcoal, and in the third stage, households switch to LPG, natural gas, or electricity. In this model, energy sources are ranked according to households' preferences based on their technological sophistication (Hosier and Dowd, 1987) or physical characteristics (Dershorst, 2008) such that wood, biomass, and dung are in the lower rung while LPG and electricity are in the upper rung. This suggests that those found in the lower rung are energy sources for the poor and those in the upper rung are energy sources for the rich.

However, empirical evidence shows that the linkages between fuel choice and income level are rarely as strong as assumed by the energy ladder since there are studies that show income elasticities to be low, insignificant, or even positive (van der Kroon, Brouwer and Beukering, 2013). Hence, the emphasis in the literature has shifted towards multiple use or energy stacking model in recent years. In this literature, the ladder is a ladder of energy demand rather than preferences that determine fuel choices and that energy demand is driven by the services energy provides (Foley, 1995). Lower rung energy sources are used when income is low. But with increasing income, households purchase appliances that need specific energy inputs leading to a portfolio of energy sources that may span different rung of the ladder. In fuel stacking, households' energy transition is not linear but that households use one energy source without abandoning others (see for example Masera, Saatkamp and Kammen, 2008). Fuel stacking may result from supply constraints and households find it best to keep alternative sources as backups (see for example Masera, Saatkamp and Kammen (2008), from fluctuating energy prices (see for example Hosier and Kipondya, 1993), and from culture and tradition (see for example Rao and Reddy, 2007).

Recognizing the varied factors affecting energy choices, van der Kroon, Brouwer and Beukering (2013) develop a framework to explain energy choices and this framework revolves around three categories: external environment like climate and geographic location, decision context like government policies, and household opportunity set like characteristics and factor endowments. In this framework, the *household opportunity set* is the building block of households' livelihood strategy and determines the capacity of households to reduce its vulnerability and restricts or broadens their window of opportunity (van der Kroon, Brouwer and Beukering, 2013). This set, which includes culture/tradition, lifestyle choices, education, household composition, income, and labor attributes, is often given a gender dimension. However, there is still no consensus on how these variables affect energy choice. For example, there are studies that find a positive effect on fuel switching (Mekonnen and Kohlin, 2008) while others find no significant effect (Heltberg, 2005). Similar issue occurs on household size where others find that it has no significant effect (Heltberg, 2004) while others argue that it has (Mekonnen and Kohlin, 2008). *Decision context* is related to the functioning of consumer markets. This set includes the reliability of supply, number of distributors, and transaction costs related to distance to markets. While prices are also included in this set, researchers still have to fully understand its effect on fuel choice. Households can move back and forth on the ladder in response to energy prices or supply failure if they have the necessary equipments (Leach, 1992). In this case, prices per se are not the main drivers of transition but the 'stove barrier' or the issue of affordability of appropriate equipments.

Closely related to the decision context is the *external environment*, which includes geographical location that largely determines access to consumer markets. Energy switching is found to be prominent in urban areas (Hosier and Dowd, 1987) while Heltberg (2004) finds energy switching in both rural and urban areas, although differing in magnitudes.

This paper follows van der Kroon, Brouwer and Beukering (2013) framework and it focuses on the role of external environment on multiple use or energy stacking. Studies that deal with external environment focus on rural-urban energy use and this paper aims to contribute to the literature by focusing on a less researched factor that is weather variability. While this is the case, several factors related to decision context such as prices and household opportunity sets such as household compositions are also analyzed. Hence, this paper also speaks to possible policies on energy use within the context of weather variability and gender.

This paper employs a discrete-continuous modeling strategy. In this approach, the first decision is the choice whether to use a specific energy source. Conditional on this choice, households will then decide how much of the energy source will be consumed. Variables related to weather and climate are included to analyze their effects on energy choice and consumption and this strategy is applied on a cross-sectional dataset. The use of cross-section data to analyze the effect of climate/weather on various outcomes is widely criticized. Auffhammer and Mansur (2014), for example, argue that the estimates exploiting the cross-sectional variation in climate are subject to omitted variables bias. This is the bias resulting from the correlation of the unobservable characteristics of households and climate and is corroborated by Albouy, Graf, Kellogg and Wol (2013) who find that northern households are less tolerant of heat than southern households in the US. This issue is mitigated in the Philippine case since the country is located in the tropics and has two seasons only: wet and dry. Households' unobserved characteristics are less likely to be systematically correlated with their geographical location. Dell, Jones and Olken (2014) support the use of panel data to understand the dynamics of consumer choices in the face of climate/weather change. Unfortunately, longitudinal household data on energy in the Philippines are not available. This is a limitation of the paper that we acknowledge at the outset.

The discrete-continuous approach is used in Vaage (2000) on a cross-section dataset to describe the structure of the energy consumption of Norwegian households. Their study involves the following households' energy choice: electricity only, combination of electricity and wood, combination of electricity and oil, or all fuels. Conditional on this choice, fuel expenditures are estimated. Their results indicate that households in the warmer regions are less likely to choose all fuels and they spend 30% less. The discrete-continuous choice model is also used in Mansur, Mendelsohn and Morrison (2008) to analyze fuel choice and expenditures in the US. They find that global warming will result in more electricity and oil consumption during warmer summers and in less natural gas consumption in warmer winters. A similar approach is used in Couture, Garcia and Reynaud (2012) to analyze the fuel choice and fuelwood consumption of French households. However, they did not analyze the role of climate/weather. These studies use multinomial logit to model energy choice and expenditures to model energy consumption. Since our paper uses quantities to model energy consumption, which differ in units and the quantity (e.g. electricity in kilowatt-hours and LPG in kilograms), probit is used to model energy choice.

This paper uses the Household Energy Consumption Survey conducted by the Philippine Statistics Authority and the Department of Energy and the weather data collected by the Philippine Atmospheric and Geophysical Astronomical Services Administration (PAGASA) in 59 weather stations all over the country. It uses the temperature and relative humidity data and their 30-year average values to come up with a measure of heat index deviation, which serves as a proxy for weather fluctuation. Based on the discrete-continuous estimations, the marginal effects of key variables are computed at representative values and this is done for three household types (balanced, male-majority and female-majority) and for four head sex-location configurations (female headed in rural areas, male headed in rural areas, female headed in urban areas, and male headed in the areas). Using scenarios on electricity and LPG price increases, the total consumption for representative profiles is also predicted and the consumption with heat index deviation relative to the consumption without is also analyzed. Based on these results, some patterns on household's energy consumption are established. Several policy suggestions are also mentioned.

This paper is organized as follows: section 2 discusses the energy use and income profiles in the Philippines, section 3 discusses the theoretical framework and empirical strategy, section 4 discusses the data sources while section 5 discusses the definition and construction of key variables and some profiles on weather and energy consumption, section 6 discusses the results, and section 7 provides the summary and conclusion.

II. Energy use and income profiles in the Philippines

To document energy use in the Philippine households, the 2011 Household Energy Consumption Survey (HECS) is used. Three income classes are defined: low-income, middle-income, and high-income. Low-income is defined as average monthly income less than PhP29999, middle-income between PhP 30000-59999, and high-income above PhP60000.

Looking at figure 1, average monthly electricity consumption is the lowest for low-income households and is the highest for high income households. In particular, it is around 60 kilowatt-hours for low-income households while middle-income households' average consumption is around 210 kilowatt-hours. The consumption of high-income households is almost twice of the middle-income households' consumption. A similar pattern can be observed in the households' average LPG consumption. However, middle-income and high-income households' consumption is closer at around 40 and 45 kilograms, respectively. In addition, low-income households consume more biomass (around 2 kilograms) than charcoal and fuelwood (around 1 kilogram). On the other hand, middle-income households consume more charcoal and fuelwood than biomass. High-income households have almost no biomass consumption and they consume more charcoal than fuelwood.

The number of energy sources used is also documented. To facilitate this exercise, four energy sources are identified: electricity, LPG, charcoal, and organic sources. Organic sources represent the use of either biomass or fuelwood. Figure 2 shows that out of the 15889 low-income households, around 16% do not use any of the four energy sources. Around 43%, 33%, and 7% use one energy source, two energy sources, and three energy sources, respectively. Out of the 1272 middle-income households, around 1% does not use any of the four energy sources while around 2% use four energy sources. Around 68% use two energy sources while around 10% and 19% use one energy source and two energy sources, respectively. Out of the 326 high-income households, around 6%, 71%, 22%, and 1% uses one, two, three, and four energy sources, respectively.

Figure 3 documents the percentage of energy usage of households using a single energy source. It can be seen that electricity is the main energy source of households in all income classes. Around 94% of the 6820 low-income households and 129 mid-income households while 100% of the 19 high-income households use electricity. For households that use two energy sources, figure 6 shows that around 85% of the 5191 low-income households use electricity and LPG, 6% use electricity and charcoal and 7% use electricity and organic sources. Around 98% of the 864 middle-income households use electricity and LPG and with the remaining 2% split evenly into other combinations of energy sources. All 230 high-income households use electricity and LPG. For households that use three energy sources, figure 3 shows that around 75% of the 1173 low-income households use electricity, LPG, and charcoal and 20% use electricity, LPG, and organic sources. Out of the 242 middle-income households, around 80% use electricity and LPG, and charcoal and 18% use electricity and LPG, and organic sources. Roughly similar numbers are associated with the 71 high-income households. There are 132 households that use all four energy sources.

It can be seen that electricity consumption is the lowest(highest) in low-income(high-income) households. In addition, majority of households use electricity, either alone or together with other energy sources. Complementary to the results above, the proportion of households with zero energy consumption is also documented in figure 4. It can be seen that at least 80% of all households by income class reported zero consumption of charcoal, firewood, and biomass. More than 60% reported zero LPG consumption in low-income households while around 15% and 10% reported zero consumption in middle-income and high-income households. Around 20% reported zero electricity consumption in low-income households. Roughly 2% of the middle-income households reported zero electricity consumption while no high-income households reported zero electricity consumption.

Based on the preceding discussion, electricity is a popular energy choice even among low-income households. Middle- and high-income households consume charcoal fuelwood as well. These simple summary statistics are consistent with energy stacking. Results in figure 4 motivates the empirical strategy adopted in the paper and is discussed below.

III. Theoretical framework and empirical strategy

Given that the majority of households have zero consumption on energy sources other than electricity, a plausible empirical strategy is to use the discrete-continuous approach to model energy choice and energy consumption. In this model, a binary choice model is fitted for the probability of observing a positive outcome. Conditional on a positive outcome, a linear regression is then used to model energy consumption.

To motivate the use of the discrete-continuous approach, households are assumed to have the following utility function: $u = u(Q,b,z,s,e)$. Q is a vector of energy type, z is a numeraire, b is a vector of characteristics of Q, s is a vector of household characteristics and e is an unobservable component. In the context of discrete-continuous choice modeling, the discrete choice is to decide if Q is zero or not while the continuous choice is to decide how much Q to consume (Vaage, 2000).

If household chooses energy f, Hanemann (1984) states that the conditional utility function associated with energy type f is $\bar{u}_f = \bar{u}_f(Q_f, b_f, z, s, \varepsilon)$ subject to $p_f Q_f + z \leq y$ where p_f is the price of energy f, y is income, and the rest is as defined above. Anticipating the available data at hand, f includes electricity, LPG, charcoal, biomass, and fuelwood. Mansur, Mendelsohn and Morrison (2008) define the conditional indirect utility function as $\bar{v}_f(p_f, b_f, y, s, e) = \bar{u}_f[\overline{Q}_f(p_f, b_f, y, s, e), b_f, z(p_f, b_f, y, s, e), s, e]$. Applying Roy's identity, the conditional demand for energy f is $\overline{Q}_f(p_f, b_f, y, s, e) = -\dfrac{\partial \bar{v}(p_f, b_f, y, s, e)/\partial p_f}{\partial \bar{v}(p_f, b_f, y, s, e)/\partial y}$.

For the empirical implementation, we assume that the conditional indirect utility function for energy type f is $\bar{v}_f^* = x_f \delta_f + e_f$, where x is a vector of observable factors and e is an unobservable shock. $\bar{v}_f^*$ is not observed but v_f is and it is 1 if energy type f is chosen. To model energy choice, we use $\phi(Q_f > 0) = \Pr(Q_f > 0 \mid x) = F(x\delta)$ where δ is a vector of parameters associated with x while F is the cumulative distribution of an independent and identically distributed error term.

The conditional demand for energy type f is then modeled as $\phi(Q_f \mid Q_f > 0, x) = g(x\gamma) + u_f$ where γ is a vector of parameters associated with the vector of explanatory variables x, u is an unobservable shock, g is the density function for $Q_f \mid Q_f > 0$. These models[2] are jointly estimated and the overall conditional mean is just $E(Q_f \mid x) = \Pr(Q_f > 0 \mid x) * E(Q_f \mid Q_f > 0, x)$.[3]

[2] Technical details of the estimator can be found in Belotti, Deb, Manning and Norton (2015).

Further, x is assumed to be a vector of demand shifters, $x = x(S, p_f, d)$, where S is weather shocks, p_f is a vector of energy prices, and d is a vector of sociodemographic attributes. Following Mansur, Mendelsohn and Morrison (2008), the welfare[4] impacts of variability in weather on households' energy use can be interpreted as the change in income necessary to keep the utility constant given weather variability. In the present context this is $\Delta w = E(Q_f \mid x)_{S_1} - E(Q_f \mid x)_{S_0}$ where s_1 is the scenario with weather fluctuations and s_0 is the no shock scenario.

Following the literature on double hurdle models, the choice equation for energy source *f* is:

$$\begin{aligned}\Pr(Q_f > 0) &= \beta_1 headsex + \beta_2 headage + \beta_3 headcoll + \beta_4 headjob + \beta_5 tothhmem + \beta_6 q\_bedroom \\ &+ \beta_7 q\_batthroom + \beta_8 q\_storey + \beta_9 urban + \beta_{10} heat\_elec + \beta_{11} heat\_lpg + \beta_{12} heat\_charcoal \\ &+ \beta_{13} heat\_others + \beta_{14} f1 + \beta_{15} f2 + \beta_{16} diff\_HI_1 + \beta_{17} diff\_HIsq + e\end{aligned} \quad (1)$$

and the conditional demand equation for energy source *f* is:

$$\begin{aligned}E(Q_f \mid Q_f > 0) &= \beta_1 headsex + \beta_2 headage + \beta_3 headcoll + \beta_4 headjob + \beta_5 tothhmem + \beta_6 q\_bedroom \\ &+ \beta_7 q\_batthroom + \beta_8 q\_storey + \beta_9 urban + \beta_{10} heat\_elec + \beta_{11} heat\_lpg + \beta_{12} heat\_charcoal \\ &+ \beta_{13} heat\_others + \beta_{14} f1 + \beta_{15} f2 + \beta_{16} diff\_HI_1 + \beta_{17} diff\_HIsq + \beta_{18} income \\ &+ \beta_{18} p\_elec + \beta_{19} p\_lpg + \beta_{20} p\_charocal + \beta_{21} p\_others + u\end{aligned} \quad (2)$$

where *headsex*, *headage*, *headcoll*, and *headjob* refer to the household head's sex age, college education or greater, and whether the head has a job, respectively. The variables *tothhmem*, *q_bedroom*, *q_bathroom*, *q_storey*, and *urban* refer to the total household members, number of bedrooms, bathrooms and floors/storey, and urban dummy, respectively. The variables *heat_elec*, *heat_lpg*, *heat_charcoal*, *and heat_organic sources* are dummy variables to represent the use of electricity, LPG, charcoal, and organic sources for heating water. The variables *f1* and *f2* are scores from the principal component analysis applied on the detailed data on the household's electricity use. The variable *diff_HI* is the difference between the current heat index (HI) from its normal values. Normal values are defined as the 30-year (1981-2010) average.

Detailed discussion on the construction of *f1*, *f2*, *and diff_HI* is provided below. The variables *p_elec*, *p_lpg*, *p_charcoal*, *and p_organic sources* denote the price of electricity, LPG, charcoal, and organic sources, respectively.

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[3] An alternative strategy is to use the Heckman selection model. Belotti, Deb, Manning and Norton (2015), however, argue that the zeros in the Heckman selection model are censored values of the positive outcome (e.g. wages that are not reported or top-coded) while the zeros in the two-part model are true zeros. In this paper, consumption is computed using three sets of information. If these three sets of information are consistently missing, then it is plausible that households have really nothing to report and we take this to mean as zero consumption

[4] Consumption-based measure of welfare is based on the Samuelson's (1974) *money metric utility*, which measures levels of living by the money required to sustain them. The starting point is the standard utility maximization problem where households choose goods to maximize utility subject to a budget constraint. Deaton and Zaidi (2002) discuss that the "Consumer preferences over goods are thought of as a system of indifference curves that can be labeled by taking a set of reference prices and calculating the amount of money needed to reach a utility level. The exact calculation of money metric utility requires information on preferences, which can be approximated from the cost function. By the known Shepard's Lemma, the derivative of this cost function with respect to prices is the quantity consumed." Building up on this, the literature has used household consumption as an indicator of household welfare (see for example, Deaton 1997; Skoufias and Coady 2007, Skoufias, Katayama and Essama-Nssah 2012, and Thomas, Christiansen, Do and Trung 2002).

Equations 1 and 2 are simultaneously estimated following the empirical strategy outlined above using three subsamples based on the gender composition of household members: male-majority, female-majority, and balanced. Male-majority households refer to households whose male members are at least 60% of the total household size. Female-majority households are analogous to male-majority definition. Balanced households are households with male and female members consisting 41-59% of the total household size. The sample is limited to households with heads aged 20-85.

IV. Data sources

2011 Household Energy Consumption Survey (HECS)

The main dataset to be used for this paper is the 2011 HECS. This is a nationwide survey conducted by the Philippine Statistics Authority and the Department of Energy to collect data on household's usage of fuel and supply systems to assess the energy scenario in the Philippines. HECS collects information on household head's information such as age, sex, educational attainment, job status, type/class of work, and occupation. HECS also collects information on the average family income and information on the number of floors, bedrooms, and bathrooms in the house. In addition to the use of different energy sources, household practices on energy conservation, and energy prices are also collected. The 2011 HECS has 20591 observations and 114 provinces.

Philippine Atmospheric and Geophysical Astronomical Services Administration (PAGASA)

Weather data are collected by the Philippine Atmospheric and Geophysical Astronomical Services Administration (PAGASA) weather stations spread across the Philippines. We initially focus on three weather variables, namely, temperature represented by drybulb readings (in degrees Celsius), relative humidity (in percent), and average rainfall (in millimeters). All parameters have been measured, compiled, and disseminated through a public use file containing 59 PAGASA weather stations. To map the weather information with the HECS dataset, we use the province of residence as the merging variable.

The PAGASA datasets have the following features: First, there are several provinces that host multiple weather stations. Second, there are several provinces that has no weather station but that are possible to be assigned weather stations on the basis of the relative distance between the province and the location of the weather station (in kilometers). In merging the PAGASA dataset with the HECS, we address the first feature by selecting the weather station that is located in or in close proximity to the provincial capital. As an illustration, Palawan province, located in Luzon's Region 4A, has three stations, namely, Coron, Cuyo and Puerto Princesa. In this case, Puerto Princesa is chosen because it is the capital city.

Second, in view of the importance of accounting for similar weather patterns and enhancing data variability, we do not automatically remove households in provinces without weather stations. For example, Mountain Province and the provinces of La Union and Ifugao are assigned the weather station in Baguio City, Benguet while Tarlac is assigned the weather station in Cabanatuan, Nueva Ecija. Assigning adjacent weather stations to provinces without one maximizes the number of households included in the estimation sample. Without this assignment, 75 provinces will be dropped out of the sample. This translates to a reduction of 11196 households. Table 1A provides the mapping of the respective weather stations to provinces and cities. The first column lists the provinces in HECS while the second column lists the PAGASA weather station assigned to it. For provinces without weather stations, the air/straight distance between their capital and the nearby weather stations is computed using the following website: http://distancecalculator.globefeed.com/Philippines_Distance_Calculator.asp. The fourth column shows the distance corresponding to the third column. Out of the 114 provinces, there are 37 that have weather stations, 75 that are assigned nearby weather stations, and 3 that could not be reasonably mapped. The 3 provinces where a match could not be found in the PAGASA weather data include Guimaras, Batanes and Tawi-Tawi. Out of the 73 provinces mapped to nearby weather stations, provinces whose distance is greater than 80 kilometers from the assigned weather station are excluded. This resulted in 3035 observations dropped from the sample.

Based on the consultation with the PAGASA personnel, rainfall is highly localized and matching the rainfall data with the provinces can introduce substantial measurement error. However, the PAGASA personnel has affirmed that weather measurements such as temperature and relative humidity are relatively stable across provinces. This means that the temperature and relative humidity data measured in another province can be used for adjacent provinces that do not have weather stations.

Griffiths et al (2005) show that changes in the mean temperature have effects on changes in extreme temperature in Asia–Pacific. Specifically, for the Philippines, it is found that significant correlation exists between the mean temperature and the frequency of extreme temperature. However, relative humidity can interact with temperature to form the heat index. Heat index is a human discomfort index that measures the temperature that the human body perceives or feels. Since climate in the Philippines is characterized by high temperature, high humidity, and abundant rainfall,[5] heat index appears to be an ideal weather variable that can be linked to consumption patterns of energy. Prolonged activity under the hot sun when heat index is high can have severe consequences such as fatigue, heat cramps, heat exhaustion, and heat stroke. Hence, people may be cautious to go out when heat index is high an this can have significant implications on households' energy choice and energy consumption.

Heat index (HI) is computed using the average of relative humidity and temperature collected by PAGASA in 2011. The temperature data are converted into Fahrenheit using $T_{(^0F)} = T_{(^0C)} * 9/5 + 32$. Heat index is then generated using the following formula:[6]

$$\begin{aligned} HI &= 42.379 + 2.04901523 * T + 10.14333127 * R - 0.22475541 * TR - 6.83783 * (10^{\wedge}(-3)) * Tsq \\ &- 5.481717 * (10^{\wedge}(-2)) * Rsq + 1.22874 * (10^{\wedge}(-3)) * TsqR \\ &+ 8.5282 * (10^{\wedge}(-4)) * TRsq - 1.99 * (10^{\wedge}(-6)) * TsqRsq \end{aligned}$$

where *T* is temperature in Fahrenheit, *Tsq* is squared temperature, *R* is relative humidity in percentage, and *Rsq* is squared relative humidity.

Data on normal values, or the 30-year average, are also collected by PAGASA between 1981 and 2010 and are used to proxy for long-run values. The difference between the 2011 HI and the normal HI is then generated. This deviation represents weather fluctuation/variability. To recognize the nonlinear effects of the HI deviation, a squared HI deviation is also used as an additional weather-related variable. Squaring the deviation puts more weight on observations that are very far from the long-run average. This asymmetric treatment may prove useful in providing a more complete characterization of the empirical effects of weather variables on energy choice and energy consumption.

V. Variables and definition of terms

Dependent variables

The dependent variables are the quantity consumed and are computed using the following formula[7]:

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[5] http://www.pagasa.dost.gov.ph/

[6] Taken from the National Weather Service-National Oceanic and Atmospheric Administration website.

[7] If the information used to compute the consumption is consistently missing, then it is plausible that the households have really nothing to report and we take this to mean as zero consumption.

$$LPG = \frac{\text{frequency of purchase on the average* cylinder size (in kg)}}{\text{number of months}}$$

$$Charcoal = \frac{\text{frequency of consumption * quantity consumed (in equivalent kg)}}{\text{number of months}}$$

$$Biomass = \frac{\text{frequency of consumption * quantity consumed (in equivalent kg)}}{\text{number of months}}$$

$$Firewood = \frac{\text{frequency of consumption * quantity consumed (in equivalent kg)}}{\text{number of months}}$$

Average electricity consumption (in kwh) is directly taken from the HECS.

Explanatory variables

Explanatory variables include the household head's age and sex, a dummy for college education or higher, and a dummy if the head has a job. Attributes at the household level are also included such as average family income, total number of household members, number of bedrooms, number of bathrooms, number of floors, and a dummy for urban area.

Dummy variables to represent the use of electricity, LPG, charcoal, and organic sources (consist of biomass and firewood[8]) for heating water are also included as regressors. HECS has detailed data on household electricity usage including whether or not the household use electricity for lighting, cooking, ironing, laundry and to power the radio, television, refrigerator, air conditioner, fan, pump, and other appliances. To include this information, an index is constructed using the score generated by the principal component analysis (PCA). The PCA is a technique to reduce the dimension of the data by creating uncorrelated indices or components, where each component is a linear weighted combination of the initial variables. The variance of each of the component is generated such that the first component contains the largest variation in the original data; the second explains additional but less variation and so on[9]. Positive scores generated by the PCA are associated with higher electricity usage. Based on the Kaiser criterion, two factors are retained since these factors have eigenvalues greater than 1. The overall Kaiser-Meyer-Olkin measure of sampling adequacy is 0.89, which indicates that these assets contain enough similar information to warrant the principal component analysis.[10]

While HECS also collected data on energy prices, there are many missing values in the dataset. For example, LPG prices are available for 7890 observations, charcoal prices are available for 6508 observations and electricity prices are available for 16642 observations. Using these together in the estimation will greatly reduce the sample. To work around this issue, energy prices are predicted using the tropical cyclone data that

8 These two energy sources are combined since a very small portion of household uses these sources and dummies representing each are dropped out of the regressors when included in the regressions.

9 For technical details, see Filmer and Pritchett (2001). An application of PCA is on household assets to create an indicator for socioeconomic status in the absence of income and expenditure data such as those found in Filmer and Pritchett (2001).

10 The KMO statistic is a test if the data are suited for factor analysis by measuring the sampling adequacy for 1) each variable and 2) for the complete model (Kaiser, 1970). This statistic is a summary of how small the partial correlations are relative to the original correlations. If the variables share common factor/s, then the partial correlations should be small and the KMO should be close to 1.0 (http://www-01.ibm.com/support/docview.wss?uid=swg21479963).

crossed the provinces in 2011, which are also obtained from PAGASA. Extreme weather events, such as tropical cyclones, affect energy prices by affecting the supply side. Typhoons can destroy trees to provide more sources for firewood and can bring about heavy rains to wash out possible sources of biomass. It also disrupts the processes to produce these energy sources. Firewood takes longer time to dry up and charcoal-making halts. Heavy rains brought by typhoons can cause landslides or damages to roads, which can affect the transport of LPG. To constitute the variables associated with the tropical cyclone data, provinces crossed by the tropical cyclones are identified. The number of tropical storms (a tropical cyclone with maximum wind speed of 62 to 88 kph) and the number of typhoons (a tropical cyclone with maximum wind speed of 118 to 220 kph) for each province are then counted.

The number of tropical storms and typhoons, together with the dummies for each region, make up the explanatory variables to predict the price of electricity, LPG, charcoal, and organic sources. The price of organic sources is the average of biomass and firewood prices. These two prices are combined since their average prices are very close to each other: the average price of firewood is PhP 7.9 while the average price of biomass is PhP 8.9. Results to predict the energy prices using OLS are presented in table 1. It can be noted that the tropical cyclone data are significant predictors of energy prices. The price of LPG is positively affected by the frequency of tropical cyclones. The price of electricity is positively affected by the frequency of tropical storm but is negatively affected by the frequency of typhoons. While typhoons in 2011 have caused substantial devastation in private properties, infrastructure, and in the agriculture sector[11], these typhoons also brought heavy rains which possibly boost other alternative sources of electricity such as hydroelectric power. This could possibly explain the negative effect of the frequency of typhoon on the price of electricity. The price of charcoal is affected by the frequency of tropical storm and typhoon in similar magnitude but opposite in direction. This possibly reflects that tropical cyclones disrupt the processes of charcoal making on one hand but these increase the supply of materials needed to produce charcoal on the other hand. The price of organic sources is negatively affected by the frequency of tropical storm. Comparison shows that the averages of both the original and the predicted prices are close to each other. For example, the average HECS electricity price is around PhP 8.9 while the average predicted electricity price is around PhP 8.8. The average HECS price is around PhP 67.6, PhP15.7, and PhP 6.9 for LPG, charcoal, and organic sources, respectively. The predicted price is around PhP 71, PhP 16, and PhP 6.9 for LPG, charcoal, and other energy sources, respectively.

The descriptive statistics of key variables are presented in table 2. It can be seen that female-majority households have the highest electricity and LPG monthly consumption at 92 kilowatt-hours and 17 kilograms, respectively. The consumption of charcoal, firewood, and biomass is minimal at less than 2 kilograms each month. Weather variables and prices are similar in each household type. More male-majority households have incomes lower than PhP 10000. However, these three households have relatively similar average in other income brackets. Slightly more male-majority households are headed by males and who are in the labor market while slightly more female-majority households are headed by persons with at least a college degree. Balanced households have higher total household members while more female-majority households are in urban areas. The usage of various energy sources for heating water is similar across households. However, female-majority households have higher scores on the use of electricity for purposes other than heating water.

To understand the patterns of energy consumption given weather fluctuations, some graphs are presented in figures 5-9. Female-majority households have the highest monthly electricity consumption. In particular, these households consume 85-88 kilowatt-hours each month. Balanced households consume 80 kilowatt-hours while male-majority households consume 63-67 kilowatt-hours. It can be noted that the average electricity consumption of balanced households is similar regardless of the fluctuations in the heat index. Female- and male-majority households have higher consumption when heat index is higher than its normal

[11] The estimated damages of typhoon Mina, for example, was at PhP 2.089 Billion while that of Pedring was at PhP 15.553 Billion.

value. The average LPG consumption of the three household types is higher when heat index is lower than its normal value, with the consumption of balanced and female-majority households being relatively similar at around 18 kilograms each month. When heat index is higher than its normal value, the LPG consumption of female-majority households is the highest at around 15 kilograms while the consumption of balanced and male-majority households is between 11-12 kilograms. The average charcoal consumption across household types is relatively similar at around 1.1 kilograms each month when heat index is higher than its normal value. When heat index is lower than its normal value, the charcoal consumption of households is not far apart: male-majority households consume 1.4 kilograms, balanced households consume 1.3 kilograms, and female-majority households consume 1.2 kilograms. The average biomass consumption is higher when heat index is lower than its normal value and the consumption of male-majority households the highest at around 2.5 kilograms. The consumption of balanced households is at 2.3 kilograms while the consumption of female-majority households is at 1.6 kilograms. When heat index is lower than its normal value, the firewood consumption of balanced households is around 1.3 kilograms while the consumption of male and female-majority households is around 1.1 kilograms. Similar patterns can be observed for firewood consumption.

VI. Discussion of results

Probit-GLM coefficients: Energy choice and energy consumption

The coefficients using the discrete/continuous approach outlined above are presented in tables 2A-4A in the appendix. From table 2A, it can be seen that weather variables are significant determinants of the electricity consumption of the three household types. In particular, heat index fluctuation from its normal value negatively affects electricity choice. However, conditional on a positive consumption, heat index fluctuation positively affects electricity consumption. Among the household head's characteristics, male and female-majority households with male heads are less likely to choose electricity. Heads who have at least college education in balanced and male-majority households positively affect both choice and consumption decision. The number of bedrooms positively affects both electricity choice and consumption and the effect is similar in magnitude across the three household types. The number of bathrooms significantly affects the consumption equation only. Total household members and the number of floors negatively affect choice but positively affect consumption. Households in urban areas are less likely to spend on electricity but conditional on spending a positive amount, these households spend more on electricity than their rural counterparts. The use of electricity for various purposes other than heating water positively affects both electricity choice and consumption. The price of electricity negatively affects while the price of organic sources positively affects electricity consumption and the magnitude is similar across the three household types. Income positively affects electricity consumption as well.

Turning to the estimates of LPG choice and consumption, heat index fluctuation significantly affects the consumption of male-majority households only. The characteristics of the household head do not have significant effects on LPG choice and consumption of LPG. The number of total household members negatively affects LPG choice but it positively affects LPG consumption. The use of firewood for heating positively affects the LPG consumption of male-majority and female-majority households while the use of organic sources for heating positively affects the LPG consumption of all household types. The use of electricity for various purposes other than heating water positively affects the LPG consumption of female-majority households. The LPG consumption of male-majority households is not affected by energy prices. However, the consumption of balanced and female-majority households is positively affected by the electricity price. The LPG consumption of female-majority households is negatively affected by the LPG price and is positively affected by the price of organic sources. Income interval up to PhP 59999 affects the consumption of all three household types.

Based on table 3A, heat index fluctuation from its normal value positively affects the charcoal choice of the three household types. Most of the household characteristics do not affect the charcoal choice and consumption except for the education attainment of the household head. In particular, balanced households are less likely to choose charcoal if their heads finished at least college while conditional on consuming positive amount, male-majority household consume less charcoal. In addition, the use of firewood for heating water positively affects while the use of organic sources negatively affects the charcoal choice of the three households. Using electricity for other purposes positively affects charcoal choice as well. The effects of energy prices on consumption differ across households. In particular, the price of electricity positively affects the charcoal consumption of balanced households. The price of LPG positively affects the charcoal consumption of the three households while the price of charcoal negatively affects the charcoal consumption of balanced and male-majority households. The price of organic sources positively affects the charcoal consumption of both male and female-majority households. Different income levels are not significant determinants of charcoal consumption except for the PhP 60000- PhP 99999 interval, which appears to positively affect the consumption of male- and female-majority households.

Heat index fluctuation from its normal value affects both biomass choice and consumption. In particular, heat index deviation negatively affects biomass choice. Conditional on a positive consumption, however, heat index deviation positively affects biomass consumption. Male heads negatively affect the biomass consumption in balanced and male-majority households. Conditional on a positive consumption, households with heads who have jobs consume more biomass in both balanced and male-majority households. The characteristics of household heads do not have significant effects on female-majority households, except for the head's gender which appears to negatively affect the households' biomass consumption. The total number of household members positively affects biomass consumption. The number of bedrooms positively affects the biomass consumption in both male and female-majority households while the number of bathrooms negatively affects the biomass choice in the three household types. Urban households are less likely to choose biomass. The use of firewood for heating water negatively affects the biomass choice of balanced and male-majority households. Conditional on a positive consumption, balanced and female-majority households that use electricity to heat water consume less biomass. Households that use electricity for purposes other than heating water have lower biomass consumption and this is the case for male-majority households. The price of electricity does not affect biomass consumption while the prices of charcoal and organic sources negatively affect charcoal consumption. Income has no significant effect on biomass consumption.

Probit-GLM results: Marginal effects

Based on the coefficients of the Probit-GLM estimations, the marginal effects of each variable are also computed. The marginal effects are evaluated at two profiles[12]. *Profile 1* consists of the means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1), use of LPG to cook foods (=1), and $\mathrm{HID}=-1$ (1 degree Celsius lower than normal). *Profile 2* is similar to profile 1 except that $\mathrm{HID}=1$ (1 degree Celsius higher than normal). Further, the marginal effects are computed for the three household types and for the following head sex-location configurations: female headed in rural areas, male headed in rural areas, female headed in urban areas, and male headed in urban areas.[13]

From table 3, it can be noted that the electricity consumption of balanced households increases with HI deviation and this effect is higher when $\mathrm{HID}=1$. The marginal effect of HI deviation is the highest in female

[12] The marginal effects will likely vary over different values of HID. To investigate this, we evaluated the marginal effects at different points in the domain of HID. Only $\mathrm{HID}=1$ and $\mathrm{HID}=-1$ are presented in the interest of space. But the marginal effects using profiles with other HI values below or above the normal are also computed and are available from the author upon request.

[13] Marginal effects calculated at representative values are different from the marginal effects at the means (MEM) and the average marginal effects (AME) in that the latter two produce a single estimate of the marginal effect of a variable. MEM and AME rely on averages.

headed households in rural areas. Electricity consumption decreases with its own price and the decline is higher when $HID = 1$. The decline in electricity consumption due to the price of electricity is the highest in female headed households in rural areas and in male headed households in urban areas. Except for male headed households in rural areas, the price of charcoal decreases the electricity consumption of all households. While the price of LPG does not have a significant effect, the price of organic sources increases electricity consumption. This effect is higher when $HID = 1$ and is the highest in male headed households in rural areas. Consistent with the results in the literature, electricity consumption increases with income and the consumption is bigger for higher income intervals. While this can be noted across sex-location configurations, the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas and in male headed households in urban areas. The age of the household head increases LPG consumption and its effect is higher when $HID = 1$ and is the highest in male headed households in rural areas. The job status of the household head significantly affects the electricity consumption of male headed households only. Attributes at the household level (such as the total household members and the number of bedrooms, bathrooms, and floors) increase consumption. This effect is higher when $HID = 1$. The use of charcoal for heating water increases the electricity consumption of all households except for male-rural combination. The use of organic sources for heating water decreases the electricity consumption of all households and the effect is higher when $HID = 1$ and is the highest for male headed households in rural areas. As expected, the use of electricity for various purposes other than heating water increases electricity consumption. Except for male headed households in rural areas, the use of LPG for cooking increases electricity consumption. The use of LPG for cooking also increases electricity consumption and the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas.

Unlike in balanced households, the impact of HI deviation on electricity consumption is significant only when $HID = -1$. As in balanced households, the increase is the highest in female headed households in rural areas. Electricity consumption decreases with its own price and the decline is higher when $HID = 1$. As in balanced households, the decline in the electricity consumption of male-majority households due to the price of electricity is the highest in female headed households in rural areas. The marginal effect of the price of electricity on the electricity consumption of male-majority households is lower than the consumption of balanced households. While LPG and charcoal prices do not have significant effects, the price of organic sources increases electricity consumption. Similar to balanced households, this effect is higher when $HID = 1$ and among the sex-location configurations, is the highest in female headed households in rural areas. However, this effect is lower than the ones observed in balanced households. Income increases electricity consumption and the consumption is bigger when household income falls under higher income intervals. While this can be noted across sex-location configurations, the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas. The age of the household head increases consumption. Its effect is higher when $HID = 1$ and among the sex-location configurations, is the highest in female headed households in rural areas and in male headed households in urban areas. While similar observations can be noted on the effects of the household head that has finished at least college, the job status of the household head has no significant effect on electricity consumption. Similar to balanced household, attributes at the household level (such as the total household members and the number of bedrooms, bathrooms, and floors) increase consumption. Households that use organic sources for heating water consume less electricity. This effect is higher when $HID = 1$ and in female headed households in urban areas. Consistent with expectations, households that use electricity for various purposes other than for heating water consume more electricity and this effect is higher when $HID = 1$ and is the highest in female rural households. The use of LPG for cooking also increases electricity consumption and the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas.

Similar to balanced households, the positive significant marginal effect of HI deviation on the electricity consumption of female-majority households can be observed for all sex-location configurations and the effect is the highest in female headed households in rural areas. Electricity consumption decreases with its own price and the decline is higher when $HID = 1$ and across sex-location configurations, is the highest in female headed households in rural areas. While LPG and charcoal prices have no significant impact, the price of organic sources increases electricity consumption. Its effect is higher in urban areas and the magnitude is similar for both male and female headed households. Electricity consumption increases with income and the consumption is bigger for higher income intervals. This effect is higher when $HID = 1$ and the magnitude is similar for both female headed households in rural areas and male headed households in urban areas. Among the household head's characteristics, age and college education have significant effects. Households headed by persons who have at least college education have higher electricity consumption. This effect is bigger when $HID = 1$ and in female headed households in rural areas. The head's age increases electricity consumption and its effect is higher when $HID = 1$. Attributes at the household level, such as the household members, number of bedrooms, bathrooms, and floors, increase electricity consumption as well. The effect is higher when $HID = 1$ in female headed households in rural areas and in male headed households in urban areas. The use of electricity and LPG for heating water does not have significant effects on the electricity consumption of female-majority households. The use of charcoal (organic source) for heating water increases (decreases) electricity consumption and these effects are higher when $HID = 1$ in female headed households in rural areas and in male headed households in urban areas. As expected, the use of electricity for various purposes other than for heating water increases electricity consumption and this effect is higher when $HI = 1$. The use of LPG for cooking also increases electricity consumption and the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas.

From table 4, heat index deviation has no significant effect on the LPG consumption of balanced households. LPG consumption is not affected by its own price. However, it increases with the price of electricity and the effect is higher when $HID = -1$. LPG consumption increases with income. This is observed across household types and sex-location configurations but only up to the PhP 30000 – PhP 59999 interval. The effect of income is higher when $HID = -1$ and is the highest in female headed households in rural areas. While the characteristics of household heads have no significant effects, some characteristics at the household level, such as the total number of household members and number of bedrooms, are significant determinants. These variables increase LPG consumption and the increase is higher when $HID = -1$ and is the highest in female headed households in rural areas. The use of LPG or charcoal for heating water increases LPG consumption and this effect is higher when $HID = -1$ and is the highest in male headed households in rural areas. On the other hand, the use of organic sources for heating water decreases LPG consumption while the use of electricity for purposes other than for heating water increases LPG consumption.

Unlike balanced households, the LPG consumption of male-majority households is significantly affected by HI deviation. In particular, LPG consumption decreases with HI deviation. This effect can be observed for all sex-location configurations and the effect is the highest in female headed households in rural areas. The price of electricity (charcoal) increases (decreases) LPG consumption and this effect is higher when $HID = -1$ and is the highest in female headed households in rural areas. Income increases LPG consumption and this effect is higher when $HID = -1$. Similar to balanced households, the characteristics of household heads have no significant effect but some households' characteristics, such as the total number of household members and the number of bedrooms, are significant determinants of LPG consumption. These variables increase consumption and the effect is higher when $HI = -1$ and is the highest in female headed households in urban areas. The use of LPG or charcoal for heating water increases LPG consumption and this effect is higher when $HI = -1$ and is the highest in male headed households in rural areas. The use of electricity for various purposes other than for heating water also increases LPG consumption while the use of organic sources for heating water decreases LPG.

Similar to balanced households, heat index deviation has no significant effect on the LPG consumption of female-majority households. LPG consumption decreases with its price and its effect is similar across sex-location configurations. In addition, LPG consumption increases with the prices of electricity and organic sources. The increase is higher when $HID = -1$. Only the PhP10000-29999 income interval significantly affects LPG consumption. While the characteristics of household heads do not have significant effects, some household's attributes, such as the total number of household members and the number of bedrooms, increase LPG consumption. This effect is higher when $HID = -1$. The use of charcoal for heating water increases LPG consumption when $HID = -1$. Similar observations is also be noted on households that use electricity for various purposes other than for heating water.

From table 5, HI deviation increases the charcoal consumption of balanced households and this effect is higher when $HID = 1$. The price of electricity increases charcoal consumption and this effect is higher when $HID = 1$ and in female headed households. The price of LPG also increases charcoal consumption. Income and the characteristics of household head do not have significant effects on the charcoal consumption of all sex-location configurations. The attributes of households do not have significant effects as well, except for the total number of household members, which increases charcoal consumption. This effect can be observed across the sex-location configurations and is higher when $HID = 1$ and for female headed households in both urban and rural areas. Charcoal consumption decreases with its own price while it increases with electricity and LPG prices. The use of electricity for purposes other than for heating water increases charcoal consumption and this effect is higher when $HID = 1$. Similar observation is noted in the use of LPG for cooking.

HI deviation increases the charcoal consumption of male-majority households when $HID = 1$. The price of LPG increases charcoal consumption and this effect is similar across sex-location configurations and between the two HI deviation values. The price of organic sources also increases consumption and the effect is higher when $HID = -1$. Income has no significant effect on the charcoal consumption of male-majority households. The characteristics of the household head do not have significant effects as well, except for the head's education level. Households headed by persons with at least college units use lower charcoal. The use of electricity for heating water decreases while the use of organic sources for similar purpose increases charcoal consumption. These effects are higher when $HID = 1$. Similar observations can be noted on the use of electricity for various purposes other than for heating water and in the use of LPG for cooking.

Unlike balanced and male-majority households, the charcoal consumption of female-majority households is not significantly affected by HI deviation, income, and household head characteristics. The price of electricity increases the charcoal consumption of balanced households while the price of LPG increases the charcoal consumption of all households. The positive effect is higher when $HID = 1$ and among the sex-location configurations, is the highest in male headed households in rural areas. Most attributes at the household level also do not significantly affect consumption, except for the total number of household members, which increases the charcoal consumption of rural households. While this is noted across sex-location configurations, the marginal effects are highest when $HID = 1$ and in male-headed households. The use of electricity and LPG does not have significant effects on charcoal consumption while the use of organic sources for heating decreases charcoal consumption. The use of electricity for purposes other than for heating water increases charcoal consumption and the effect is higher when $HID = -1$. Similar observations are noted in the use of LPG for cooking.

Predicted total consumption

We also predict the total consumption of the four sex-location configurations (female headed in rural areas, male headed in rural areas, female headed in urban areas, and male headed in urban areas) of the three household types (balanced, male-majority and female-majority) and assuming different values of HI below and above its normal value. Finally, three scenarios are assumed to predict total consumption. Scenario 1 assumes the same attributes as in profiles 1 and 2 above. This is the base scenario and the estimates are presented in the topmost panel of tables 5A-8A. Scenario 2 assumes similar attributes as scenario 1 except that the price of electricity has increased by 25% (from the mean PhP 8 to PhP 10). Estimates are presented in the middle section of tables 5A-8A. Scenario 3 assumes similar attributes as scenario 1 except that the price of LPG has increased by 25% (from the mean PhP 71 to PhP 80). Estimates are presented in the lowest panel of tables 5A-8A.

To analyze the welfare change resulting from HI fluctuations, the difference between the total consumption at different HI deviation values and $\text{HI deviation} = 0$ is computed. The consumption differences (henceforth referred to as *relative consumption*) between deviations $HI = i \quad (i \neq 0)$ and $HI = 0$ for electricity, LPG, and charcoal are presented in figures 10-15. The exercise is not done for firewood and biomass consumption since the predicted total consumption for these energy sources is not statistically significant.

From the base scenario, comparison shows that the total consumption of electricity changes more when $\text{HI deviation} > 0$ than when $\text{HI deviation} < 0$. In particular, the total consumption for positive (negative) HI deviation is higher (lower) relative to the no HI shock consumption. Comparison across the three household types shows that balanced and female-majority households have higher relative consumption than male-majority households. Results indicate that in the event of a 1 degree Celsius HI fluctuation above the normal value, the electricity consumption of balanced and female households is higher (than the no shock total consumption) by around 3 kilowatt-hours and by around 5-6.5 kilowatt-hours in the event of a 2 degrees Celsius HI fluctuation above the normal value. The electricity consumption of male-majority households is higher by around 1.5 kilowatt-hours and around 2-3 kilowatt-hours, respectively. In the event of a 1 degree Celsius HI fluctuation below the normal value, the electricity consumption of balanced and female-majority households is lower (than the no shock total consumption) by around 2 kilowatt-hours and by around 3.5-4.5 kilowatt-hours in the event of a 2 degrees Celsius HI fluctuation below the normal value. The electricity consumption of male-majority households is lower by around 1.5-2 kilowatt-hours and around 2-3.5 kilowatt-hours, respectively. Comparison within balanced and female-majority households shows that the relative consumption of those in urban areas (both male and female headed) is higher than those in the rural households. However, for male-majority households, the relative consumption of those headed by female (both in urban and rural) is higher than their male counterparts. These observations are noted in both scenarios 2 and 3. However, the relative consumption is lower than the base case when the price of electricity increases by 25% and are higher than the base case when the price of LPG increases by 25%.

In contrast to the results on electricity, the total consumption of LPG changes more when $\text{HI deviation} < 0$ than when $\text{HI deviation} > 0$. Comparison across the three household types shows that male-majority households have a relative consumption that is substantially higher than the consumption of balanced and female-majority households. Results indicate that in the event of a 1 degree Celsius HI fluctuation above the normal value, the LPG consumption of male-majority households is lower (than the no shock total consumption) by around 2-3 kilograms and by around 5-6 kilograms in the event of a 2 degrees Celsius HI fluctuation above the normal value. The LPG consumption of balanced and female-majority households is lower and is within the 1.5-2.5 kilograms interval for both HI fluctuation scenarios. In the event of a 1 degree Celsius HI fluctuation below the normal value, the LPG consumption of male-majority households is higher (than the no shock total consumption) by around 2 kilograms and by around 4-5 kilograms in the event of a 2 degrees Celsius HI fluctuation below the normal value. The LPG consumption of balanced and female-majority households is within the 0.5-2 kilograms interval for both HI fluctuation scenarios. Comparison within male-majority households shows that those headed by female in urban areas have relative consumption that is higher than the other sex-location configurations. However, the relative consumption in balanced households is relatively similar across sex-location configurations. The preceding observations are also observed in both scenarios 2 and 3. The relative consumption is similar with the base case when the price of electricity increases by 25% and are lower than the base case when the price of LPG increases by 25%.

Similar to the results on electricity, total consumption of charcoal changes more when $\text{HI deviation} > 0$ than when $\text{HI deviation} < 0$. Comparison across the three household types shows that balanced households have relative consumption that is substantially higher than the consumption of male and female-majority households'. Results indicate that in the event of a 1 degree Celsius HI fluctuation above the normal value, the consumption of balanced households is higher (than the no shock total consumption) by around 0.5 kilogram and by around 1.5-2 kilograms in the event of a 2 degrees Celsius HI fluctuation above the normal value. The charcoal consumption of male and female-majority households is higher by around 0.25-0.75 kilogram in both HI fluctuations scenarios. In the event of a 1 degree Celsius HI fluctuation below the normal value, the charcoal consumption of balanced households is lower (than the no shock total consumption) by around 0.5 kilogram and by around 0.75 kilogram in the event of a 2 degrees Celsius HI fluctuation below the normal value. The charcoal consumption of male and female-majority households is lower and is within the 0.25-0.5 kilogram interval for both HI fluctuation scenarios. Comparison within balanced households shows that those headed by female, both in urban and rural areas, have relative consumption that is higher than their male counterparts. Similar observation is noted within male-majority households, except that the magnitude is substantially lower. Within female-majority households, male headed households in urban and rural areas, have relative consumption that is higher than their female counterparts. The preceding observations are also noted in both scenarios 2 and 3. The relative consumption is higher than the base case when the price of electricity increases by 25% and are lower than the base case when the price of LPG increases by 25%. However, this is only observed for balanced households. The relative consumption of male and female-majority households is similar to the consumption of similar households in the base scenario.

Based on these results, predicted changes in the monthly energy consumption are presented in table 6. The consumption of electricity increases by around 33000-43000 kilowatt-hours when heat index is 1 degree Celsius above the normal value and by around 68000-88000 kilowatt-hours when heat index is 2 degrees above normal. The decline in the electricity consumption is lower for heat indices below the normal value than for heat indices above the normal value. The consumption of charcoal increases by around 6000-8000 kilograms and around 15000-20000 kilograms for heat indices 1 and 2 degrees Celsius above the normal, respectively. The decline in the charcoal consumption is lower for heat indices below its normal value than for heat indices above the normal value. On the other hand, the consumption of LPG decreases by around 22000-28000 kilograms and by around 48000-59000 kilograms for heat index 1 and 2 degrees Celsius above the normal, respectively. The consumption of LPG increases by around 35000 kilograms and by 47000-53000 kilograms for heat indices 1 and 2 degree Celsius above normal, respectively.

VII. Summary and conclusions

This paper uses the discrete-continuous modeling approach using the Household Energy Consumption Survey conducted by the Philippine Statistics Authority and the Department of Energy in 2011 and the weather data collected by the Philippine Atmospheric and Geophysical Astronomical Services Administration in 59 weather stations all over the country. It uses the temperature and relative humidity data and their 30-year average values to come up with a measure of heat index (HI) deviation, which serves as a proxy for weather fluctuation. Based on the discrete-continuous estimations, the marginal effects of key variables are computed at representative values and this is done for three household types (balanced, male-majority and female-majority) and for four head sex-location configurations (female headed in rural areas, male headed in rural areas, female headed in urban areas, and male headed in the areas). Using scenarios on electricity and LPG price increases, the total consumption for representative profiles is also predicted and the consumption with heat index deviation relative to the consumption without is also analyzed. Based on these results, some patterns on household's energy consumption are established.

Based on the Probit/GLM results, a variable can have different effects on households' energy choice and energy consumption. This is illustrated by the negative effect of HI deviation on electricity choice and its positive effect on electricity consumption. This is also illustrated by the opposite effects of variables such as the total number of household members and the number of floors on electricity choice/consumption. Clearly, separate investigation of energy choice and energy consumption would lead to different inferences. These lend support to the use of discrete-continuous modeling strategy. In addition, the effects of variables on energy choice and energy consumption differ across the three household types. For example, HI deviation affects the electricity and biomass choice/consumption of the three households while it affects the LPG choice and consumption of male-majority households only. The different effects of the price of electricity on energy choice/consumption are also observed. The price of electricity affects the electricity consumption of all three household types while it affects only the LPG consumption of balanced and female-majority households and the charcoal consumption of balanced households. Income also has varying effects on the consumption of the different energy sources. These lend support to the approach of dividing the samples into three different household types.

In terms of the marginal effects, several salient results are noted on the households' electricity consumption. *One*, HI deviation positively affects the electricity consumption of the three household types. Comparison across the three household types shows that the consumption of male-majority households is affected only by HI deviation when HI is above its normal value (between 1.3-1.9 kilowatt-hours increase). Balanced and female-majority households are affected by deviations above and below normal HI in similar magnitudes (between 2.0-2.6 kilowatt-hours increase). Within the same household type, the increase in consumption due to HI deviation is the highest in female headed households in rural areas. *Two*, the electricity consumption of the three household types is negatively affected by the price of electricity. Comparison across the three household types shows that female-majority households' electricity consumption has the highest decline (between 4.4-6.0 kilowatt-hours) and that of male-majority households has the lowest decline (between 2.8-4.0 kilowatt-hours). Within the same household type, the decline is higher when HI is above its normal value and is the highest in female headed households in rural areas and in male headed households in urban areas. The price of organic sources (biomass and firewood) has a positive effect on electricity consumption. Comparison across the three household types shows that the consumption of female-majority households has the highest increase (between 3.3-4.5 kilowatt-hours) and that of male-majority households have the lowest increase (between 1.5-2.3 kilowatt-hours). Within the same household type, the decline is higher when HI is above its normal value and is the highest in female headed households in rural areas and in male headed households in urban areas. *Three*, income has a positive effect on electricity consumption and the consumption is bigger for households with income falling under higher income intervals. Comparison across the three household types shows that balanced households have the highest consumption and within the same household type, the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas and in male headed households in urban areas. *Four*, among the household head characteristics, age and educational attainment have significant and positive effects. Comparison across the three household types shows that the consumption of female-majority households has the highest increase (between 0.3-0.4 kilowatt-hour) and that of male-majority households has the lowest increase with head's age (between 0.1-0.2 kilowatt-hour). The consumption of balanced households has the highest increase with head's education (between 5.7-9.1 kilowatt-hours). Comparison across the three household types shows that balanced households have the highest consumption and within the same household type, the effect is higher when $HID = 1$ and is the highest in female headed households in rural areas and in male headed households in urban areas. *Five*, electricity consumption is affected by the households' use of other energy sources. Balanced households that use charcoal (organic sources) for heating water have higher (lower) electricity consumption. Male and female-majority households that use organic sources for heating water have lower electricity consumption. The effect of using organic sources for heating water is higher in balanced households. Within the same household type, the effect is higher when HI is above its normal value. Comparison across the three household types shows that balanced and female-majority households have higher consumption. Within the same household type, the effect is higher when HI is above its normal value.

Some notable results are observed on the households' LPG consumption as well. *One*, while HI deviation does not have a significant effect on the consumption of balanced and female-majority households, it has a significant and negative effect on the consumption of male-majority households. This effect is noted for all sex-location configurations and the effect is the highest in female headed households in rural areas. *Two*, the effect of energy prices on LPG consumption varies across household types. The consumption of balanced households is not affected by the price of LPG but is positively affected by the price of electricity. The consumption of male-majority households is not affected by any of the energy prices. The consumption of female-majority households is negatively affected by the price of LPG and is positively affected by the prices of electricity and organic sources. This observed effect is higher when HI is below its normal value and is similar across sex-location configurations. *Three*, while income positively affects LPG consumption, only the lower income intervals have significant impacts. Comparison across the three household types shows that male-majority households have the highest increase in LPG consumption and within the same household type, the effect is higher when HI is below its normal value and is the highest in female headed rural households. *Four*, the characteristics of the household head do not have significant effects on LPG consumption while characteristics at the household level (such as the total household members and the number of bedrooms and bathrooms) positively affect LPG consumption. Within the same household type, the increase is higher when HI is above its normal value and across sex-location configurations, is the highest in female headed households in the areas. *Five*, LPG consumption is affected by alternative sources. Households that use LPG or charcoal for heating water have higher LPG consumption. Comparison across the three household types shows that male-majority households have the highest increase in consumption and within the same household type, the effect is higher when HI is below its normal value and is the highest in female headed urban households. The use of electricity for purposes other than for heating water also increases LPG consumption. Comparison across the three household types shows that female-majority households have the highest increase in consumption and within the same household type, the effect is higher when HI is below its normal value.

Some notable results are observed on the households' charcoal consumption as well. *One*, the effect of HI deviation is observed only for selected household types and sex-location configurations. While it positively affects the consumption of balanced and male-majority households, it does not significantly affect the consumption of female-majority households. *Two*, the effect of energy prices is observed only for selected household types and sex-location configurations as well. The price of LPG positively affects charcoal consumption. Comparison across the three household types shows that balanced and female-majority households have similar increase in consumption (between 0.8-0.17 kilogram) while the consumption of male-majority household is lower (between 0.03-0.06 kilogram). Within the same household type, the effect is higher when HI is above its normal value. While the price of electricity positively affects the charcoal consumption of balanced households when HI is above normal, the price of organic sources positively affects the charcoal consumption of male-majority households. The price of charcoal affects the consumption of balanced households only and this effect is higher in female headed households in both urban and rural areas. *Three*, income has no significant effect on consumption across household types and sex-location configurations. *Four*, most of the characteristics of the household head do not have significant effect on consumption except for the total number of household members in balanced and female-majority households and for the head's education level in male-majority households. *Five*, the use of charcoal is also affected by the use of other energy sources. The consumption of balanced households is negatively affected by the use of organic sources for heating water. The consumption of male-majority households is negatively affected by the use of electricity for heating water. The consumption of female-majority households is positively affected by the use of LPG.

Based on the preceding discussion, the following salient results are highlighted:

1. The *effect of weather variability is most evident on electricity consumption*. HI deviation affects the LPG consumption of male-majority households only and the charcoal consumption of balanced and female-majority households. HI deviation affects the electricity consumption of all three household types. This likely reflects the convenience of electricity in the face of increased need to address bodily discomfort arising from weather fluctuations. When there is an immediate need to mitigate the effect of a higher than normal heat index, households turn to the most convenient energy source to power cooling appliances. In addition, *the impact of weather variability on energy consumption differs across household types*. Heat index fluctuation affects the

electricity consumption of all three household types while it has no effect on the LPG consumption of balanced and female-majority households and it has no effect on the charcoal consumption of female-majority households. *The impact of weather variability on energy consumption differs in direction as well*. While electricity and charcoal consumption is positively affected, LPG consumption is negatively affected by heat index fluctuations. *The impact of weather variability is the highest in female headed households in rural areas*.

2. *Own-price effect also differs across energy sources and household types*. The electricity consumption of all household types is negatively affected by the price of electricity and the consumption of balanced and female-majority households is the most affected. The price of LPG affects the consumption of female-majority households only while the price of charcoal affects the consumption of balanced households only. *Own-price effect on energy consumption differs depending on weather fluctuations*. The decline in electricity and charcoal consumption is higher when HI deviation is above normal while the decline in LPG consumption is higher when HI deviation is below normal. *Own-price effect is higher in female headed households in rural areas and in male headed households in urban areas.*

3. *The cross-price effects differ across energy sources and household types as well.* When charcoal price increases, results indicate that balanced households will decrease their electricity/LPG consumption, which are relatively more expensive energy sources. Households may deem it reasonable to reallocate their budget from the relatively more expensive energy sources to charcoal to mitigate the impact of the price increase. This is likely in the case of households that consider charcoal as a staple in their energy portfolio (i.e. more intensively used) whose most probable response to a charcoal price increase is to lower the consumption of other relatively more expensive energy sources to maintain the continued use of the relatively cheaper charcoal. On the other hand, a decrease in charcoal price increases electricity consumption. This likely reflects the budget reallocation to electricity-based activities resulting from the income freed up by the price decrease in charcoal. In both price change scenarios, income is likely reallocated among the energy sources in the households' portfolio to sustain the households' activities at the least.

However, the price change of the more expensive energy sources does not have a parallel effect on charcoal consumption. For example, an increase in the price of LPG increases the charcoal consumption of all household types and the price of electricity increases the charcoal consumption of balanced households. These suggest that households likely increase their consumption of the cheaper alternative energy source to perform household chores that the more expensive alternative (electricity or LPG) would otherwise accomplish (i.e. cooking foods, heating water). This is still consistent with the budget reallocation discussed above and is likely to be observed for households which consider electricity/LPG as a staple in their energy portfolio. While the organic sources are relatively cheaper than charcoal, these are not readily usable and require some machineries to convert the energy for fuel use. *The cross-price effects differ depending on weather fluctuations as well.* The consumption of electricity and charcoal (LPG) is higher when HI is above (below) normal. *Cross-price effect is relatively higher in female headed households in rural areas.*

4. *Income effects differ across energy sources*. While this is consistent with the findings of other studies that higher income leads to cleaner energy choices, several points are noted. Income effect is most evident on electricity consumption and the effect is higher when income falls under higher intervals. Other than the fact that well-off households can afford appliances like air conditioning units, fan, and water heater, these households are most likely to have bigger energy needs due to bigger floor areas and higher number of rooms and bathrooms. It does not affect any of the households' charcoal consumption while only the lower income intervals affect LPG consumption. This likely reflects that well-off households have an array of alternatives to choose from to service their energy needs that charcoal and LPG will otherwise provide. *Income effects differ across household types as well*. The electricity consumption of balanced households increases with income the most and the effect is higher when HI is above normal. The LPG consumption of male-majority households

increases with income the most and the effect is higher when HI is below the norm. *The impact of income is higher in female headed households in rural areas and in male headed households in urban areas*.

5. Among the head's characteristics, age and educational attainment significantly affect energy consumption. These characteristics affect the electricity consumption of all household types. These do not affect the households' LPG consumption. Educational attainment affects the charcoal consumption of male-majority households. Attributes at the household level affect electricity and LPG consumption as well. The effects of these attributes on electricity (LPG) consumption are higher when HI is above (below) the norm. *The impact of these attributes is higher in female headed households in rural areas and in male headed households in urban areas*.

6. *The consumption of specific energy source is affected by the use of other energy sources for various purposes. Different household types are affected differently as well.* Results indicate that the electricity consumption of balanced and female-majority households increases with the use of charcoal to heat water. This effect is higher when $HID = 1$.The electricity consumption of all household types decreases with the use of organic sources to heat water, however, and the effect is higher when $HID = 1$. The LPG consumption of balanced and male-majority households increases with the use of charcoal to heat water while the LPG consumption of all household types decreases with the use of organic sources to heat water. These effects are higher when $HID = -1$. Charcoal consumption decreases with the use of electricity to heat water in male-majority households and with the use of organic sources in balanced households. Charcoal consumption increases with the use of LPG to heat water. These effects are higher when $HID = 1$. The use of LPG for cooking positively affects the electricity and charcoal consumption of all household types. These effects are higher when $HID = 1$.The use of electricity for purposes other than heating positively affects the LPG (higher when $HID = -1$) and charcoal consumption (higher when $HID = 1$) of all household types.

Results from the exercise to ascertain the welfare change associated with heat index fluctuations suggest the importance of weather deviations in energy consumption. Fluctuations above the normal value affect the frequency of the usage of appliances, which is mostly powered by electricity. While charcoal consumption is also predicted to increase, its increase is not as much. These suggest that increases in electricity consumption are likely results of an effort to mitigate the bodily impact of above normal fluctuations. Households use electricity on the basis of routines established overtime. When faced by shocks, these routines will adjust and the associated energy use as well. Hence, in the face of persistent above normal heat index, households will opt to use air conditioning units all day instead of electric fan on certain hours. Charcoal can be viewed as a supplementary to electricity consumption since its usage is limited to cooking foods and heating water and may not adequately address the immediate physical needs like the attenuation of perceived heat. The increase in electricity consumption and the complementarity of electricity and charcoal likely explain the decrease in the LPG consumption when HI is above normal.

Since different household types are affected differently by socioeconomic factors, household composition also plays a role in the prediction exercise. For example, the maximum value of the predicted change in electricity consumption for a 2 degrees Celsius fluctuation is mainly driven by the high relative consumption of female-majority households with female heads in urban areas. The maximum value of the predicted change in LPG consumption is mainly driven by the high relative consumption of male-majority households with female heads in urban areas. The maximum value of the predicted change in charcoal consumption is mainly driven by the high relative consumption of balanced households with female heads. Consistent with the literature on gender differences on energy/caloric needs, results above indicate that men and women have different needs. Women/girls are more likely to stay at home while men/boys are more likely to go out to work or play. In the event of an immediate need for bodily comfort arising from above normal weather fluctuations, the response of balanced and female-majority households to increase electric consumption more than male-majority households is not surprising. Male-majority households have higher changes in LPG consumption and possibly suggest that men/boys' energy use in the household is concentrated on food/drinks preparation or heating water.

Results show the importance of weather deviations in energy consumption and several potential policies related to energy are worth mentioning. Households turn to the most convenient energy source to power cooling appliances during weather fluctuations. Persistent and increasingly above normal heat index can have severe health implications. The patterns of weather variables are changing due to climate change and energy sources that address the needs arising from these changes should be made accessible to the rest of the population. Along these lines, government programs on rural electrification should be continued but at the same time should be carefully evaluated. Barriers to electricity subscription should be identified. Households located in geographically isolated and disadvantaged areas are highly unlikely to have the appropriate infrastructures to attract investors or service providers. In this case, alternative projects to generate electricity should be supported. One such project is the saline solution that can power lamps. It should be improved and upscaled so that its technology can have wider scope and application. If price is the barrier to subscription and subsidy is feasible, then subsidy recipients should be carefully identified to minimize leakages. In this regard, the paper finds that female-majority households with female heads are the most affected by weather variability in terms of electricity consumption. This provides not only support for the widely-held belief that women are more affected by weather fluctuations and climate change but identifies possible additional requirement for eligibility to subsidies.

In the literature, women are argued to be disproportionately vulnerable to climate change than men due to the social roles they played (Chikulo, 2014; UNDP, 2007). This paper finds that among the sex-location configurations, heat index variability has the highest effects on the electricity consumption of balanced and female-majority households that are female headed and in rural areas. Heat index variability also has the highest effect on the charcoal consumption of female headed households in balanced households. While this paper cannot provide concrete evidence on the channels why this is the case, we allude to the combined effects of traditional gender roles and headship as a source of strong bargaining power in the household as plausible reasons why female headed households seem to be most affected by weather variability. Women are possibly more attuned to the needs of their household members and being the head gives them traction to address these needs. In addition, women in female-headed households are likely to have more decision-making power relative to women in male-headed households. While not related to energy use, there are studies that provide evidence on the positive effects of female heads on various children's outcomes (see for example Chudgar, 2011) and the positive effects can plausibly spillover to energy use, which has welfare effects as well. Rural households can be more affected by weather fluctuations than households in urban areas where malls and recreation centers provide alternative ways to reduce energy consumption. Taken together, these can plausibly explain why female headed households seem to be most affected by weather variability. Consistent with the literature, the demand for cleaner and safer energy sources moves positively with income and this relationship is again the highest for rural female headed households.

Some information on gender equality in the country become relevant to a conversation that attempts to speak to policies on gender in the context of energy use and weather shocks. While substantial progress has been achieved towards gender equality in education, labor market returns are still lower for female. Asian Development Bank (2013) finds that the gender wage gap that takes into account human capital gender differences is between 23% and 30%, an indication of high gender inequality. Female labor force participation rate is consistently lower than the male labor force participation as well. Based on the 2016 CIA World Factbook, the country has the highest fertility rate in the region at 3 children born per woman and evidence shows that low labor force participation rate is correlated with high fertility rate (Orbeta, 2005). Child-bearing and child-nurturing responsibilities that typically fall under the women's sphere of responsibility likely result in the gap on women's labor market participation and in women choosing informal labor market arrangements that are likely to have lower returns. The paper finds that income affects households' electricity consumption and among these households, the impact is higher in female headed households in rural areas and in male headed households in urban areas and when the weather shock is higher than normal. Therefore, policies related to employment are worth mentioning here. Despite the passage of the Magna Carta for Small, Micro and Medium Enterprises, there are still gaps in access to credit and technical skills to support entrepreneurs, who are mostly composed of women, and programs that can address these gaps can be alternatives to intervention on energy prices. Since these policies and programs can speak to empowerment of men and women alike, these have far-reaching implications in mitigation and adaptation related to weather shocks.

While evidence on the negative effects of poverty in female headed households is thin and results of the paper do not speak directly to this issue, in broader strokes, poverty is a binding constraint to the adoption of cleaner, safer, and more efficient energy sources. In this respect, the internal and external convergence strategy of the Department of Social Welfare and Development is worth mentioning. This strategy intends to harmonize existing social protection programs such as the KALAHI-CIDSS–National Community-Driven Development Program (KC-NCDDP), the Pantawid Pamilyang Pilipino Program, and the Sustainable Livelihood Program, which has the Microenterprise Developments track and the Employment Facilitation track. This program should be carefully evaluated in terms of process (planning, implementation, and monitoring) and impact.

Results provide limited support for the energy ladder model. While all income intervals significantly affect electricity consumption, LPG consumption is affected only by lower income intervals and charcoal consumption is not significantly affected at all. Based on the effects of alternative use of energy sources for cooking and heating water, energy stacking is observed in different weather fluctuations scenario. Similar to Hosier and Kipondya (1993), results indicate that households consume a portfolio of energy sources spanning different stages of the energy ladder model. For example, LPG consumption increases with the use of charcoal for heating water when heat index is below its normal value, presumably these two energy sources are used more to address the households' energy needs when there is less need to mitigate bodily discomfort from heat and humidity. On the other hand, electricity consumption increases with charcoal use when heat index is above its normal value, presumably when electricity is more expensive (i.e. during summer time) and there is a bigger need to mitigate bodily discomfort. Most appliances are powered by electricity and the use of other energy sources for heating water or cooking food allows the households to reallocate resources towards electricity consumption to address bodily needs arising from higher than the average heat index. Similar explanation is offered why electricity consumption increases with the use of LPG for cooking when HI is above its normal value**.** These results can help explain the puzzle in the literature: why do non-poor households continue to use traditional fuels despite having the means to afford modern energy sources. Heltberg (2004) explains that this puzzle can sometimes be attributed to preferences for cooking using a specific energy source to achieve certain taste or texture. It can sometimes be attributed to the shortages in supply. Our results illustrate that households use combinations of energy sources in different weather fluctuation scenarios.

van der Kroon, Brouwer and Beukering (2013) argue that energy stacking is an inherent strategy of poor households especially in the rural areas where irregular income flows deter the regular consumption of modern energy sources and households' consumption of modern energy sources adjusts with income variability. In this regard, inadequate income appears to be a constraint for rural households' full transition to sophisticated modern energy sources. Weather deviations, however, are external challenges that can be addressed by the energy stacking strategy and the paper finds some links between electricity and charcoal consumption. One possible policy concerning charcoal is to make it accessible by ensuring steady supply of charcoal. This can be done by supporting small enterprises related to charcoal-making in rural areas. Since health concerns can be an issue in charcoal use, another policy that can be explored is to address the constraints on supply and demand side of LPG use. 'Stove barriers' or the issue of affordability of appropriate equipments can be addressed by ensuring that there is a market for durable and affordable equipments related to LPG use.

It is clear that weather variability shapes households' energy use and energy consumption and the government has to continue to find cheaper alternative sources to boost the generation of electricity, the energy type used by the majority of Philippines' households. Energy use and consumption appear to be shaped by household composition and by the gender of the household head as well. While substantial studies on energy use and energy consumption in developing countries have been done, there are very few researches that analyze such topic with a gender dimension in the Philippines and within the context of weather fluctuations, even fewer. This paper has provided systematic evidence how energy use and energy consumption changes with gender and weather variability. This paper based the gender dimension on household composition and headship. Future research can use other factors, such as household activities assigned at the individual level, to fine tune the gender dimension on energy use and energy consumption. Efforts to collect longitudinal data will greatly improve the research in this field. Using extreme weather events should be explored as well.

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Table 1: OLS estimates of fuel prices

	Electricity	LPG	Charcoal	Organic sources
Number of tropical storm	0.19***	0.60***	0.81***	-0.76**
	[0.03]	[0.12]	[0.21]	[0.35]
Number of typhoon	-0.09**	0.49***	-0.82***	-0.28
	[0.04]	[0.13]	[0.24]	[0.38]
Region 2	-0.37***	4.60***	-0.81	-0.6
	[0.08]	[0.32]	[0.64]	[0.78]
Region 3	-0.26***	-1.80***	0.05	1.36**
	[0.06]	[0.22]	[0.43]	[0.57]
Region 5	-0.27***	4.88***	-0.72	1.99***
	[0.08]	[0.36]	[0.51]	[0.72]
Region 6	-0.50***	10.42***	-3.57***	-0.23
	[0.11]	[0.47]	[0.72]	[1.09]
Region 7	-0.78***	13.08***	-1.38*	-2.23**
	[0.11]	[0.45]	[0.77]	[1.05]
Region 8	-1.18***	12.58***	0.74	0.21
	[0.10]	[0.40]	[0.65]	[0.82]
Region 9	-3.12***	11.03***	-3.88***	-2.55**
	[0.13]	[0.58]	[0.82]	[1.11]
Region 10	-2.09***	12.60***	0.81	-2.68**
	[0.12]	[0.49]	[0.89]	[1.05]
Region 11	-3.16***	13.11***	-2.33***	0.88
	[0.12]	[0.48]	[0.83]	[1.07]
Region 12	-3.33***	11.75***	-5.22***	-2.23*
	[0.12]	[0.59]	[0.76]	[1.14]
Region 3	0.73***	-0.90***	2.91***	4.56***
	[0.07]	[0.26]	[0.50]	[0.83]
Region 14	0.02	3.04***	3.24***	0.78
	[0.11]	[0.36]	[1.17]	[1.50]
Region 15	-2.15***	15.08***	-0.61	-0.91
	[0.14]	[0.65]	[0.88]	[1.12]
Region 16	-2.89***	13.81***	7.90***	-3.92***
	[0.13]	[0.57]	[0.88]	[1.11]
Region 4A	-0.71***	-1.14***	1.86***	1.32
	[0.08]	[0.28]	[0.52]	[0.87]
Region 4B	-0.15	11.36***	-6.51***	-1.81
	[0.10]	[0.49]	[0.60]	[1.24]
Constant	9.77***	63.66***	16.59***	8.16***
	[0.10]	[0.38]	[0.68]	[1.01]
R^2	0.34	0.59	0.17	0.10
N	16373	7777	6334	2501

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted OLS. Region 1 is the base category.

Table 2: Descriptive statistics, by household type

	Balanced		Male-majority		Female-majority	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Fuel usage						
Electricity, kwh	80.76	124.30	68.43	100.04	91.95	138.42
LPG, kg	14.57	25.87	12.69	24.70	16.73	27.20
Gas, kg	0.41	9.91	0.49	10.10	0.18	4.63
Charcoal, kg	1.18	7.35	1.22	10.14	1.15	6.37
Firewood, kg	1.21	14.66	1.30	16.06	1.07	12.90
Biomass, kg	1.78	19.78	1.80	18.20	1.34	13.70
Weather variables						
HI deviation	-0.27	1.73	-0.32	1.83	-0.29	1.71
HI deviation^2	3.07	12.91	3.44	14.05	3.01	12.98
Prices						
Price of electricity	8.81	1.28	8.76	1.28	8.87	1.27
Price of LPG	70.78	5.95	70.83	5.89	70.27	6.02
Price of charcoal	16.19	3.23	16.10	3.23	16.33	3.13
Price of others	7.68	2.19	7.59	2.09	7.82	2.23
Family income						
Less than 10,000	0.63	0.48	0.66	0.47	0.59	0.49
10,000 to 29,999	0.28	0.45	0.27	0.44	0.30	0.46
30,000 to 59,999	0.07	0.26	0.06	0.24	0.08	0.28
60,000 to 99,999	0.01	0.11	0.01	0.10	0.02	0.14
100,000 and over	0.00	0.07	0.00	0.07	0.01	0.07
Household head characteristics						
Male	0.83	0.37	0.90	0.31	0.67	0.47
Age	50.73	13.42	49.20	12.89	50.60	13.98
At least college	0.23	0.42	0.23	0.42	0.28	0.45
Has a job	0.80	0.40	0.84	0.37	0.76	0.43
House attributes						
Total household members	5.10	2.51	4.69	2.11	4.68	2.10
Number of bedrooms	1.87	1.05	1.77	1.03	1.87	1.06
Number of bathrooms	1.05	0.52	1.01	0.49	1.07	0.56
Number of floors	1.18	0.41	1.17	0.40	1.20	0.43
Urban	0.41	0.49	0.41	0.49	0.46	0.50
Energy use						
Use of electricity: heating	0.04	0.20	0.03	0.17	0.05	0.22
Use of LPG: heating	0.10	0.30	0.09	0.28	0.11	0.31
Use of charcoal: heating	0.09	0.29	0.10	0.30	0.10	0.30
Use of organic: heating	0.27	0.44	0.27	0.44	0.26	0.44
Use of electricity: others (score 1)	0.04	0.85	0.00	0.87	0.11	0.81
Use of electricity: others (score 2)	0.01	0.83	0.05	0.78	0.13	0.92

Table 3: Marginal effects of key variables on electricity consumption

	Female rural		Female urban		Male rural		Male urban	
	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2
Balanced								
HI deviation	2.51**	2.57**	2.04***	2.15**	2.04***	2.15**	2.48**	2.53**
	[1.03]	[1.20]	[0.74]	[0.86]	[0.75]	[0.86]	[1.04]	[1.21]
HI deviation^2	0.13	0.11	0.14	0.14	0.14	0.14	0.12	0.1
	[0.14]	[0.16]	[0.09]	[0.10]	[0.09]	[0.11]	[0.14]	[0.16]
Price of electricity	-4.45***	-4.74***	-3.32***	-3.57***	-0.24	-0.26	-4.47***	-4.75***
	[1.37]	[1.45]	[1.04]	[1.10]	[0.24]	[0.25]	[1.36]	[1.43]
Price of LPG	-0.32	-0.34	-0.24	-0.26	-0.45*	-0.48*	-0.32	-0.34
	[0.32]	[0.34]	[0.24]	[0.25]	[0.23]	[0.25]	[0.32]	[0.34]
Price of charcoal	-0.60*	-0.64*	-0.45*	-0.48*	2.64***	2.83***	-0.60*	-0.64*
	[0.31]	[0.33]	[0.23]	[0.25]	[0.60]	[0.64]	[0.31]	[0.33]
Price of others	3.52***	3.75***	2.63***	2.82***	6.99***	7.50***	3.53***	3.76***
	[0.77]	[0.81]	[0.60]	[0.63]	[2.01]	[2.16]	[0.77]	[0.81]
10,000 to 29,999	9.31***	9.92***	6.95***	7.46***	8.66***	9.28***	9.34***	9.94***
	[2.68]	[2.86]	[2.01]	[2.16]	[2.86]	[3.06]	[2.67]	[2.85]
30,000 to 59,999	11.53***	12.28***	8.61***	9.23***	13.45**	14.41**	11.56***	12.31***
	[3.77]	[4.01]	[2.84]	[3.04]	[6.01]	[6.44]	[3.78]	[4.02]
60,000 to 99,999	17.91**	19.08**	13.37**	14.34**	51.04***	54.71***	17.96**	19.12**
	[7.90]	[8.43]	[5.95]	[6.38]	[13.31]	[14.26]	[7.96]	[8.48]
100,000 and over	67.96***	72.42***	50.75***	54.42***	0.32	0.32	68.18***	72.57***
	[17.66]	[18.84]	[13.31]	[14.27]	[1.79]	[1.92]	[17.57]	[18.72]
Male	0.26	0.19	0.33	0.33	0.19***	0.21***	0.23	0.15
	[2.42]	[2.62]	[1.76]	[1.89]	[0.07]	[0.07]	[2.47]	[2.69]
Age	0.29***	0.33***	0.19***	0.21***	5.20***	5.73***	0.30***	0.34***
	[0.10]	[0.11]	[0.07]	[0.07]	[1.93]	[2.09]	[0.10]	[0.11]
At least college	7.89***	8.88***	5.11***	5.63***	-2.08	-2.16	8.09***	9.13***
	[2.78]	[3.05]	[1.93]	[2.09]	[1.64]	[1.77]	[2.79]	[3.06]
Has a job	-2.35	-2.31	-2.09	-2.18	1.95***	2.07***	-2.29	-2.21
	[2.27]	[2.50]	[1.61]	[1.73]	[0.36]	[0.39]	[2.33]	[2.59]
Total household members	2.48***	2.58***	1.94***	2.07***	4.41***	4.84***	2.46***	2.56***
	[0.52]	[0.58]	[0.36]	[0.39]	[0.90]	[0.98]	[0.51]	[0.58]
Number of bedrooms	6.54***	7.29***	4.35***	4.76***	4.18**	4.43**	6.68***	7.46***
	[1.40]	[1.56]	[0.90]	[0.98]	[1.63]	[1.75]	[1.40]	[1.57]
Number of bathrooms	5.29**	5.51**	4.17**	4.43**	2.46	2.5	5.26**	5.46**
	[2.27]	[2.46]	[1.63]	[1.75]	[1.78]	[1.93]	[2.27]	[2.46]
Number of storeys	2.49	2.27	2.49	2.55	17.46***	18.45***	2.36	2.09
	[2.53]	[2.82]	[1.76]	[1.91]	[2.14]	[2.33]	[2.59]	[2.89]
Urban	21.70***	22.35***	17.45***	18.47***	-0.62	-0.89	21.48***	22.03***
	[4.19]	[4.72]	[2.25]	[2.44]	[2.77]	[3.04]	[4.18]	[4.77]
Use of electricity: heating	-2.15	-2.95	-0.54	-0.78	1.69	2.15	-2.4	-3.27
	[4.26]	[4.91]	[2.74]	[3.00]	[2.35]	[2.57]	[4.37]	[5.06]
Use of LPG: heating	4.28	5.56	1.56	1.99	10.65***	11.30***	4.67	6.06
	[3.56]	[4.01]	[2.33]	[2.56]	[2.86]	[3.07]	[3.57]	[4.00]
Use of charcoal: heating	13.47***	14.01***	10.63***	11.29***	-9.42***	-10.16***	13.39***	13.87***
	[3.85]	[4.20]	[2.81]	[3.03]	[2.25]	[2.42]	[3.91]	[4.27]
Use of organic: heating	-12.97***	-14.03***	-9.34***	-10.08***	37.34***	40.83***	-13.09***	-14.16***
	[2.94]	[3.18]	[2.22]	[2.40]	[3.29]	[3.72]	[2.96]	[3.20]
Use of electricity: others (score 1)	54.46***	60.37***	36.87***	40.25***	27.55***	29.65***	55.51***	61.63***
	[5.86]	[6.82]	[3.25]	[3.68]	[2.05]	[2.16]	[5.93]	[6.90]
Use of electricity: others (score 2)	37.42***	40.23***	27.35***	29.44***	15.70***	16.77***	37.67***	40.49***
	[2.94]	[3.11]	[2.13]	[2.26]	[2.85]	[3.02]	[2.71]	[2.84]
Use of LPG: cooking	20.54***	21.70***	15.63***	16.71***	-3.34***	-3.58***	20.53***	21.66***
	[3.65]	[3.91]	[2.80]	[2.97]	[1.04]	[1.10]	[3.70]	[3.97]
Male-majority								
HI deviation	1.87*	1.68	1.55**	1.49*	1.26*	1.14	1.4	1.14
	[1.11]	[1.34]	[0.74]	[0.90]	[0.73]	[0.88]	[1.08]	[1.30]
HI deviation^2	0.04	-0.02	0.07	0.04	0.03	-0.01	-0.03	-0.1
	[0.16]	[0.19]	[0.10]	[0.13]	[0.10]	[0.12]	[0.15]	[0.18]
Price of electricity	-3.98***	-4.19***	-2.88***	-3.07***	-2.67***	-2.81***	-3.64***	-3.79***
	[1.25]	[1.32]	[0.90]	[0.96]	[0.84]	[0.89]	[1.14]	[1.21]
Price of LPG	0.12	0.12	0.08	0.09	0.08	0.08	0.11	0.11

	[0.25]	[0.27]	[0.18]	[0.20]	[0.17]	[0.18]	[0.23]	[0.24]
Price of charcoal	-0.23	-0.25	-0.17	-0.18	-0.16	-0.16	-0.21	-0.22
	[0.32]	[0.33]	[0.23]	[0.24]	[0.21]	[0.22]	[0.29]	[0.30]
Price of others	2.26***	2.38***	1.64***	1.74***	1.51***	1.60***	2.07***	2.15***
	[0.65]	[0.69]	[0.49]	[0.52]	[0.45]	[0.47]	[0.60]	[0.63]
10,000 to 29,999	11.56***	12.18***	8.38***	8.91***	7.76***	8.18***	10.58***	11.03***
	[2.38]	[2.51]	[1.71]	[1.81]	[1.59]	[1.68]	[2.20]	[2.33]
30,000 to 59,999	12.62***	13.30***	9.15***	9.73***	8.47***	8.93***	11.55***	12.04***
	[3.66]	[3.88]	[2.63]	[2.80]	[2.46]	[2.61]	[3.41]	[3.58]
60,000 to 99,999	26.49**	27.92**	19.20**	20.42**	17.77**	18.74**	24.24**	25.26**
	[10.55]	[11.17]	[7.61]	[8.11]	[7.02]	[7.43]	[9.65]	[10.13]
100,000 and over	48.60***	51.22***	35.22***	37.46***	32.61***	34.38***	44.48***	46.35***
	[15.90]	[16.91]	[11.49]	[12.30]	[10.65]	[11.33]	[14.62]	[15.44]
Male	-5.45*	-6.45**	-3.46*	-4.08*	-3.64*	-4.30**	-5.75**	-6.77**
	[2.87]	[3.21]	[1.98]	[2.20]	[1.90]	[2.15]	[2.83]	[3.23]
Age	0.24***	0.28***	0.16***	0.18***	0.16***	0.19***	0.25***	0.28***
	[0.08]	[0.09]	[0.06]	[0.06]	[0.06]	[0.06]	[0.08]	[0.09]
At least college	6.38***	7.38***	4.16**	4.80***	4.26***	4.93***	6.55***	7.56***
	[2.44]	[2.75]	[1.66]	[1.85]	[1.62]	[1.82]	[2.41]	[2.74]
Has a job	-1.98	-2.04	-1.47	-1.54	-1.33	-1.37	-1.76	-1.78
	[2.45]	[2.75]	[1.69]	[1.87]	[1.66]	[1.87]	[2.46]	[2.80]
Total household members	2.63***	2.66***	1.99***	2.05***	1.77***	1.79***	2.29***	2.26***
	[0.60]	[0.70]	[0.39]	[0.45]	[0.39]	[0.45]	[0.60]	[0.70]
Number of bedrooms	4.53***	5.35***	2.88***	3.39***	3.02***	3.57***	4.77***	5.62***
	[1.38]	[1.56]	[0.92]	[1.05]	[0.89]	[1.00]	[1.31]	[1.46]
Number of bathrooms	5.50***	6.22***	3.68***	4.16***	3.67***	4.16***	5.49***	6.20***
	[2.05]	[2.30]	[1.40]	[1.55]	[1.36]	[1.53]	[2.03]	[2.29]
Number of storeys	5.03**	4.82*	3.98***	3.96**	3.39**	3.26*	4.09*	3.73
	[2.24]	[2.65]	[1.44]	[1.67]	[1.45]	[1.70]	[2.29]	[2.73]
Urban	20.91***	21.30***	15.67***	16.25***	14.05***	14.33***	18.34***	18.30***
	[4.13]	[4.82]	[2.27]	[2.64]	[2.25]	[2.62]	[4.13]	[4.82]
Use of electricity: heating	-1.61	-2.16	-0.84	-1.16	-1.07	-1.44	-1.98	-2.58
	[4.80]	[5.85]	[2.97]	[3.56]	[3.18]	[3.87]	[5.23]	[6.38]
Use of LPG: heating	-2.05	-2.13	-1.5	-1.58	-1.38	-1.43	-1.85	-1.9
	[2.80]	[3.32]	[1.82]	[2.09]	[1.86]	[2.20]	[2.97]	[3.56]
Use of charcoal: heating	4.1	3.98	3.21	3.22	2.76	2.69	3.39	3.15
	[3.29]	[3.77]	[2.25]	[2.55]	[2.23]	[2.55]	[3.30]	[3.82]
Use of organic: heating	-5.66**	-6.01**	-4.06**	-4.35**	-3.79**	-4.03**	-5.23**	-5.51*
	[2.65]	[2.94]	[1.88]	[2.06]	[1.80]	[2.00]	[2.57]	[2.89]
Use of electricity: others (score 1)	52.48***	60.06***	34.70***	39.61***	35.08***	40.14***	53.18***	60.70***
	[7.12]	[8.25]	[4.58]	[5.53]	[4.45]	[5.18]	[6.61]	[7.29]
Use of electricity: others (score 2)	34.83***	37.36***	24.78***	26.74***	23.36***	25.06***	32.59***	34.69***
	[2.82]	[3.15]	[1.95]	[2.17]	[1.71]	[1.96]	[2.56]	[2.94]
Use of LPG: cooking	12.64***	12.30**	9.89***	9.93***	8.51***	8.29***	10.45**	9.75**
	[4.05]	[4.85]	[2.60]	[3.07]	[2.60]	[3.10]	[4.10]	[4.88]
Female-majority								
HI deviation	2.51**	2.63*	2.02**	2.13*	2.00**	2.10*	2.44*	2.53*
	[1.24]	[1.41]	[0.96]	[1.09]	[0.98]	[1.12]	[1.27]	[1.45]
HI deviation^2	0.31*	0.32*	0.26**	0.27*	0.25*	0.25*	0.28	0.28
	[0.17]	[0.19]	[0.13]	[0.14]	[0.13]	[0.15]	[0.17]	[0.20]
Price of electricity	-5.58***	-5.94***	-4.37***	-4.66***	-4.45***	-4.73***	-5.65***	-6.00***
	[1.46]	[1.51]	[1.18]	[1.22]	[1.20]	[1.24]	[1.47]	[1.51]
Price of LPG	0.05	0.06	0.04	0.04	0.04	0.05	0.05	0.06
	[0.31]	[0.33]	[0.24]	[0.26]	[0.25]	[0.26]	[0.32]	[0.34]
Price of charcoal	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	[0.39]	[0.41]	[0.30]	[0.32]	[0.31]	[0.33]	[0.39]	[0.42]
Price of others	4.22***	4.49***	3.30***	3.52***	3.36***	3.58***	4.27***	4.53***
	[0.74]	[0.77]	[0.63]	[0.66]	[0.64]	[0.66]	[0.75]	[0.78]
10,000 to 29,999	12.02***	12.79***	9.41***	10.04***	9.58***	10.19***	12.17***	12.91***
	[2.10]	[2.27]	[1.64]	[1.77]	[1.67]	[1.80]	[2.13]	[2.30]
30,000 to 59,999	20.83***	22.17***	16.32***	17.40***	16.60***	17.66***	21.09***	22.38***
	[3.85]	[4.10]	[3.01]	[3.20]	[3.06]	[3.25]	[3.89]	[4.14]
60,000 to 99,999	40.13***	42.71***	31.43***	33.51***	31.97***	34.03***	40.62***	43.11***
	[9.43]	[9.87]	[7.62]	[7.99]	[7.79]	[8.15]	[9.60]	[10.03]
100,000 and over	49.64**	52.83**	38.87**	41.45**	39.54**	42.09**	50.24**	53.33**

	[22.88]	[24.33]	[17.92]	[19.09]	[18.19]	[19.33]	[23.11]	[24.51]
Male	1.19	1.07	1.19	1.16	0.96	0.87	0.74	0.51
	[2.10]	[2.27]	[1.60]	[1.72]	[1.70]	[1.83]	[2.25]	[2.44]
Age	0.37***	0.40***	0.28***	0.30***	0.30***	0.32***	0.39***	0.43***
	[0.08]	[0.09]	[0.06]	[0.07]	[0.06]	[0.07]	[0.09]	[0.09]
At least college	3.64*	3.84*	2.89*	3.07*	2.90*	3.07*	3.61	3.79
	[2.12]	[2.29]	[1.64]	[1.76]	[1.70]	[1.83]	[2.22]	[2.42]
Has a job	0.9	1.09	0.52	0.63	0.7	0.86	1.23	1.5
	[2.39]	[2.57]	[1.84]	[1.98]	[1.90]	[2.04]	[2.48]	[2.68]
Total household members	4.45***	4.73***	3.49***	3.72***	3.54***	3.77***	4.48***	4.75***
	[0.52]	[0.57]	[0.41]	[0.44]	[0.40]	[0.44]	[0.52]	[0.57]
Number of bedrooms	5.00***	5.51***	3.67***	4.01***	3.97***	4.37***	5.50***	6.10***
	[1.24]	[1.35]	[0.91]	[0.97]	[0.97]	[1.05]	[1.35]	[1.48]
Number of bathrooms	7.73***	8.31***	5.95***	6.39***	6.15***	6.61***	8.01***	8.61***
	[1.80]	[1.95]	[1.37]	[1.48]	[1.40]	[1.51]	[1.85]	[2.01]
Number of storeys	5.39**	5.53**	4.50**	4.69**	4.31**	4.43**	4.97*	4.98*
	[2.44]	[2.65]	[1.84]	[1.98]	[1.92]	[2.08]	[2.59]	[2.83]
Urban	19.38***	20.42***	15.44***	16.36***	15.45***	16.29***	19.13***	20.01***
	[3.21]	[3.52]	[1.96]	[2.14]	[2.03]	[2.23]	[3.40]	[3.75]
Use of electricity: heating	5.07	5.44	3.91	4.19	4.04	4.33	5.24	5.62
	[3.38]	[3.67]	[2.56]	[2.75]	[2.68]	[2.91]	[3.64]	[4.03]
Use of LPG: heating	-1.2	-1	-1.29	-1.24	-0.97	-0.83	-0.57	-0.23
	[2.58]	[2.83]	[1.93]	[2.09]	[2.01]	[2.20]	[2.76]	[3.04]
Use of charcoal: heating	9.56**	10.01**	7.70**	8.13**	7.63**	7.99**	9.28**	9.62**
	[4.12]	[4.39]	[3.21]	[3.40]	[3.33]	[3.54]	[4.30]	[4.59]
Use of organic: heating	-8.68***	-9.24***	-6.79***	-7.25***	-6.91***	-7.36***	-8.79***	-9.34***
	[3.25]	[3.48]	[2.56]	[2.74]	[2.63]	[2.82]	[3.34]	[3.58]
Use of electricity: others (score 1)	55.01***	59.77***	41.46***	44.85***	43.74***	47.51***	58.62***	63.95***
	[4.83]	[5.42]	[3.26]	[3.59]	[3.56]	[3.94]	[5.35]	[5.98]
Use of electricity: others (score 2)	37.94***	40.59***	29.43***	31.49***	30.21***	32.32***	38.91***	41.60***
	[2.17]	[2.31]	[1.78]	[1.87]	[1.79]	[1.88]	[2.15]	[2.28]
Use of LPG: cooking	20.16***	21.39***	15.86***	16.88***	16.06***	17.05***	20.26***	21.42***
	[3.03]	[3.29]	[2.38]	[2.57]	[2.42]	[2.62]	[3.13]	[3.42]

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted. The marginal effects are evaluated at two profiles. *Profile 1* consists of the means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1), use of LPG to cook foods (=1), and $HID = -1$ (1 degree Celsius lower than normal). Profile 2 is similar to profile 1 except that $HID = 1$ (1 degree Celsius higher than normal). Only these HID values are presented in the interest of space. But the marginal effects using other HID values are also computed and are available from the author upon request.

Table 4: Marginal effects of key variables on LPG consumption

	Female rural		Female urban		Male rural		Male urban	
	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2
Balanced								
HI deviation	-0.6	-0.58	-0.56	-0.54	-0.53	-0.51	-0.56	-0.55
	[0.91]	[0.85]	[0.85]	[0.80]	[0.81]	[0.76]	[0.86]	[0.80]
HI deviation^2	-0.09	-0.08	-0.08	-0.08	-0.08	-0.07	-0.08	-0.08
	[0.11]	[0.10]	[0.10]	[0.09]	[0.10]	[0.09]	[0.10]	[0.10]
Price of electricity	5.15***	4.97***	4.86***	4.70***	-0.24	-0.23	4.90***	4.73***
	[1.49]	[1.50]	[1.40]	[1.41]	[0.21]	[0.20]	[1.42]	[1.42]
Price of LPG	-0.27	-0.26	-0.25	-0.24	-0.68**	-0.66**	-0.25	-0.24
	[0.24]	[0.23]	[0.22]	[0.21]	[0.31]	[0.30]	[0.22]	[0.21]
Price of charcoal	-0.76**	-0.73**	-0.72**	-0.69**	0.19	0.18	-0.72**	-0.70**
	[0.35]	[0.34]	[0.32]	[0.32]	[0.49]	[0.48]	[0.33]	[0.32]
Price of others	0.21	0.2	0.2	0.19	2.96**	2.86**	0.2	0.19
	[0.55]	[0.53]	[0.52]	[0.50]	[1.51]	[1.46]	[0.52]	[0.50]
10,000 to 29,999	3.30*	3.19*	3.12*	3.01*	8.14***	7.87***	3.14*	3.03*
	[1.73]	[1.67]	[1.62]	[1.56]	[2.38]	[2.29]	[1.62]	[1.56]
30,000 to 59,999	9.08***	8.77***	8.57***	8.28***	1.89	1.83	8.63***	8.34***
	[2.72]	[2.61]	[2.57]	[2.47]	[3.20]	[3.10]	[2.52]	[2.42]
60,000 to 99,999	2.11	2.04	1.99	1.92	6.44	6.23	2.01	1.94
	[3.58]	[3.45]	[3.38]	[3.26]	[6.02]	[5.81]	[3.40]	[3.28]
100,000 and over	7.19	6.94	6.79	6.56	-1.59	-1.53	6.83	6.6
	[6.75]	[6.51]	[6.37]	[6.15]	[1.52]	[1.47]	[6.38]	[6.16]
Male	-1.73	-1.66	-1.67	-1.61	0.01	0.01	-1.67	-1.6
	[1.79]	[1.73]	[1.69]	[1.63]	[0.05]	[0.05]	[1.62]	[1.56]
Age	0.01	0.01	0.01	0.01	0.86	0.83	0.01	0.01
	[0.06]	[0.06]	[0.06]	[0.05]	[1.27]	[1.22]	[0.06]	[0.05]
At least college	0.94	0.9	0.9	0.87	2.05	1.97	0.9	0.87
	[1.42]	[1.37]	[1.34]	[1.29]	[1.43]	[1.39]	[1.35]	[1.30]
Has a job	2.2	2.09	2.14	2.05	2.74***	2.65***	2.13	2.03
	[1.65]	[1.60]	[1.54]	[1.49]	[0.41]	[0.39]	[1.54]	[1.49]
Total household members	3.03***	2.92***	2.88***	2.78***	1.28*	1.24*	2.89***	2.79***
	[0.48]	[0.45]	[0.46]	[0.43]	[0.70]	[0.68]	[0.43]	[0.41]
Number of bedrooms	1.47*	1.43*	1.36*	1.32*	1.75	1.68	1.38*	1.34*
	[0.80]	[0.77]	[0.75]	[0.72]	[1.13]	[1.09]	[0.75]	[0.73]
Number of bathrooms	1.83	1.73	1.82	1.74	1.79	1.72	1.79	1.7
	[1.29]	[1.25]	[1.20]	[1.16]	[1.16]	[1.12]	[1.21]	[1.17]
Number of storeys	1.87	1.76	1.86	1.78	1.82	1.75	1.83	1.74
	[1.32]	[1.28]	[1.23]	[1.18]	[1.69]	[1.63]	[1.23]	[1.19]
Urban	1.93	1.84	1.89	1.82	0.21	0.2	1.88	1.79
	[2.01]	[1.94]	[1.78]	[1.72]	[2.45]	[2.37]	[1.90]	[1.83]
Use of electricity: heating	0.18	0.15	0.21	0.19	3.36**	3.26**	0.19	0.17
	[2.74]	[2.64]	[2.58]	[2.49]	[1.63]	[1.55]	[2.60]	[2.51]
Use of LPG: heating	3.92**	3.84**	3.57**	3.47**	5.75*	5.55*	3.65**	3.56**
	[1.88]	[1.79]	[1.75]	[1.66]	[3.13]	[3.02]	[1.74]	[1.66]
Use of charcoal: heating	6.41*	6.19*	6.05*	5.85*	-10.09***	-9.74***	6.09*	5.88*
	[3.52]	[3.39]	[3.33]	[3.21]	[2.74]	[2.66]	[3.32]	[3.19]
Use of organic: heating	-11.08***	-10.64***	-10.60***	-10.21***	1.84	1.78	-10.61***	-10.21***
	[3.13]	[3.04]	[2.96]	[2.88]	[2.00]	[1.94]	[2.89]	[2.80]
Use of electricity: others (score 1)	2.04	1.96	1.94	1.87	1.96***	1.89***	1.94	1.87
	[2.25]	[2.18]	[2.12]	[2.05]	[0.74]	[0.71]	[2.13]	[2.06]
Use of electricity: others (score 2)	2.21***	2.14***	2.06***	2.00***	75.80***	73.41***	2.09***	2.02***
	[0.82]	[0.79]	[0.78]	[0.76]	[9.69]	[9.08]	[0.77]	[0.74]
Use of LPG: cooking	86.48***	84.11***	80.20***	77.76***	4.62***	4.46***	81.35***	78.99***
	[12.11]	[11.48]	[10.85]	[10.24]	[1.32]	[1.34]	[10.61]	[9.90]
Male-majority								
HI deviation	-3.06***	-2.58***	-2.71***	-2.28***	-2.39***	-2.01***	-2.70***	-2.27***
	[1.18]	[0.85]	[1.04]	[0.75]	[0.92]	[0.66]	[1.04]	[0.75]
HI deviation^2	-0.33**	-0.27***	-0.29**	-0.24***	-0.26**	-0.22***	-0.30**	-0.25***
	[0.14]	[0.10]	[0.12]	[0.09]	[0.11]	[0.08]	[0.12]	[0.09]
Price of electricity	1.47	1.22	1.3	1.08	1.17	0.98	1.32	1.1
	[1.31]	[1.11]	[1.15]	[0.98]	[1.03]	[0.87]	[1.17]	[0.99]

Price of LPG	-0.35	-0.29	-0.31	-0.26	-0.28	-0.23	-0.31	-0.26
	[0.24]	[0.20]	[0.21]	[0.17]	[0.19]	[0.16]	[0.22]	[0.18]
Price of charcoal	0.4	0.33	0.36	0.3	0.32	0.27	0.36	0.3
	[0.43]	[0.35]	[0.39]	[0.31]	[0.35]	[0.29]	[0.39]	[0.32]
Price of others	0.12	0.1	0.11	0.09	0.1	0.08	0.11	0.09
	[0.55]	[0.46]	[0.50]	[0.41]	[0.45]	[0.37]	[0.50]	[0.42]
10,000 to 29,999	8.23***	6.82***	7.32***	6.08***	6.58***	5.49***	7.41***	6.17***
	[2.27]	[1.88]	[2.03]	[1.69]	[1.76]	[1.46]	[1.97]	[1.63]
30,000 to 59,999	9.28***	7.70***	8.26***	6.86***	7.42***	6.19***	8.36***	6.96***
	[3.03]	[2.50]	[2.75]	[2.28]	[2.45]	[2.03]	[2.69]	[2.23]
60,000 to 99,999	10.24**	8.50**	9.11**	7.57**	8.20**	6.83**	9.23**	7.68**
	[4.60]	[3.82]	[4.08]	[3.40]	[3.64]	[3.03]	[4.10]	[3.42]
100,000 and over	5.29	4.39	4.71	3.91	4.24	3.53	4.77	3.97
	[5.50]	[4.55]	[4.94]	[4.09]	[4.43]	[3.68]	[4.94]	[4.10]
Male	-3.32	-2.61	-3.01	-2.38	-2.88*	-2.33*	-3.20*	-2.58*
	[2.29]	[2.00]	[2.00]	[1.73]	[1.55]	[1.32]	[1.76]	[1.50]
Age	0.06	0.06	0.05	0.05	0.04	0.03	0.04	0.04
	[0.08]	[0.07]	[0.07]	[0.06]	[0.05]	[0.05]	[0.06]	[0.05]
At least college	-1.23	-1.12	-1.05	-0.96	-0.83	-0.74	-0.96	-0.86
	[1.70]	[1.46]	[1.50]	[1.29]	[1.29]	[1.09]	[1.46]	[1.23]
Has a job	0.07	0.03	0.08	0.04	0.11	0.08	0.12	0.08
	[1.86]	[1.58]	[1.65]	[1.39]	[1.46]	[1.22]	[1.64]	[1.38]
Total household members	3.15***	2.63***	2.80***	2.34***	2.50***	2.09***	2.82***	2.35***
	[0.54]	[0.45]	[0.49]	[0.41]	[0.42]	[0.35]	[0.47]	[0.38]
Number of bedrooms	0.99	0.84	0.88	0.74	0.78	0.65	0.88	0.74
	[0.82]	[0.70]	[0.72]	[0.62]	[0.64]	[0.54]	[0.72]	[0.61]
Number of bathrooms	3.88***	3.27***	3.43***	2.89***	3.02***	2.54***	3.41***	2.87***
	[1.42]	[1.23]	[1.24]	[1.07]	[1.04]	[0.88]	[1.18]	[0.99]
Number of storeys	0.59	0.51	0.52	0.45	0.45	0.38	0.51	0.43
	[1.26]	[1.07]	[1.11]	[0.94]	[0.98]	[0.83]	[1.11]	[0.94]
Urban	3.84*	3.15*	3.43**	2.82**	3.12**	2.59**	3.51**	2.90**
	[1.97]	[1.65]	[1.56]	[1.30]	[1.36]	[1.13]	[1.72]	[1.43]
Use of electricity: heating	-0.97	-0.83	-0.85	-0.73	-0.73	-0.62	-0.83	-0.71
	[2.86]	[2.43]	[2.52]	[2.14]	[2.23]	[1.87]	[2.52]	[2.12]
Use of LPG: heating	2.45	1.98	2.2	1.78	2.04	1.67	2.28	1.87
	[2.09]	[1.76]	[1.85]	[1.55]	[1.63]	[1.36]	[1.84]	[1.53]
Use of charcoal: heating	11.19***	9.55***	9.86***	8.40***	8.56***	7.26***	9.70***	8.23***
	[4.09]	[3.50]	[3.65]	[3.11]	[3.14]	[2.65]	[3.50]	[2.95]
Use of organic: heating	-16.16***	-13.54***	-14.33***	-12.01***	-12.74***	-10.68***	-14.37***	-12.04***
	[4.22]	[3.51]	[3.80]	[3.17]	[3.32]	[2.77]	[3.68]	[3.05]
Use of electricity: others (score 1)	3.21	2.58	2.89	2.33	2.69	2.21	3.01	2.46
	[2.17]	[1.85]	[1.94]	[1.64]	[1.71]	[1.44]	[1.91]	[1.61]
Use of electricity: others (score 2)	1.56*	1.30*	1.38*	1.16*	1.23*	1.03*	1.38*	1.16*
	[0.84]	[0.71]	[0.75]	[0.63]	[0.66]	[0.55]	[0.74]	[0.62]
Use of LPG: cooking	-4.51	-0.47	-5.3	-1.77	-8.48	-5.58	-8.74	-5.4
	[13.74]	[13.72]	[11.02]	[11.29]	[6.09]	[6.33]	[7.58]	[7.73]
Female-majority								
HI deviation	-0.76	-0.88	-0.96	-0.97	-0.98	-1.02	-0.72	-0.89
	[1.19]	[1.02]	[1.15]	[0.98]	[1.24]	[1.05]	[1.28]	[1.09]
HI deviation^2	-0.02	-0.06	-0.07	-0.09	-0.07	-0.09	0	-0.06
	[0.16]	[0.13]	[0.14]	[0.12]	[0.16]	[0.13]	[0.17]	[0.14]
Price of electricity	1.83*	1.72*	1.83*	1.70*	1.95*	1.81*	1.94*	1.83*
	[1.02]	[1.01]	[0.99]	[0.98]	[1.06]	[1.05]	[1.08]	[1.08]
Price of LPG	-0.34*	-0.32*	-0.34*	-0.31*	-0.36*	-0.33*	-0.36*	-0.34*
	[0.20]	[0.18]	[0.20]	[0.18]	[0.21]	[0.19]	[0.21]	[0.19]
Price of charcoal	0.14	0.13	0.14	0.13	0.15	0.14	0.15	0.14
	[0.26]	[0.24]	[0.26]	[0.24]	[0.27]	[0.25]	[0.27]	[0.26]
Price of others	0.72*	0.68*	0.72*	0.67*	0.76*	0.71*	0.76*	0.72*
	[0.39]	[0.36]	[0.41]	[0.38]	[0.43]	[0.40]	[0.41]	[0.39]
10,000 to 29,999	2.87**	2.70**	2.86**	2.67**	3.05**	2.84**	3.03**	2.87**
	[1.34]	[1.27]	[1.34]	[1.26]	[1.41]	[1.32]	[1.41]	[1.33]
30,000 to 59,999	2.72	2.56	2.72	2.53	2.89	2.69	2.88	2.72
	[1.81]	[1.72]	[1.82]	[1.71]	[1.92]	[1.81]	[1.90]	[1.81]
60,000 to 99,999	1.7	1.59	1.69	1.58	1.8	1.68	1.79	1.69

	[2.45]	[2.30]	[2.44]	[2.27]	[2.59]	[2.42]	[2.58]	[2.44]
100,000 and over	2.29	2.16	2.29	2.13	2.44	2.27	2.43	2.29
	[4.39]	[4.14]	[4.39]	[4.10]	[4.67]	[4.36]	[4.64]	[4.39]
Male	1.6	1.61	1.72	1.65*	1.8	1.75	1.63	1.68
	[1.13]	[0.99]	[1.06]	[0.96]	[1.22]	[1.09]	[1.35]	[1.15]
Age	0.07	0.05	0.06	0.05	0.06	0.05	0.07	0.06
	[0.05]	[0.04]	[0.05]	[0.04]	[0.05]	[0.04]	[0.05]	[0.05]
At least college	-0.16	0.04	0.07	0.16	0.02	0.15	-0.27	-0.01
	[1.24]	[1.08]	[1.15]	[1.04]	[1.26]	[1.12]	[1.39]	[1.18]
Has a job	-1.82	-1.42	-1.47	-1.23	-1.64	-1.35	-2.07	-1.59
	[1.31]	[1.13]	[1.18]	[1.08]	[1.28]	[1.16]	[1.41]	[1.22]
Total household members	2.90***	2.85***	3.05***	2.90***	3.21***	3.07***	3.00***	2.99***
	[0.51]	[0.41]	[0.47]	[0.42]	[0.51]	[0.43]	[0.57]	[0.44]
Number of bedrooms	2.11***	1.88***	1.98***	1.79***	2.13***	1.92***	2.29***	2.03***
	[0.65]	[0.58]	[0.61]	[0.56]	[0.66]	[0.60]	[0.71]	[0.62]
Number of bathrooms	-0.15	-0.08	-0.07	-0.04	-0.09	-0.05	-0.18	-0.1
	[0.95]	[0.86]	[0.91]	[0.84]	[0.97]	[0.89]	[1.04]	[0.92]
Number of storeys	-1.62	-1.33	-1.38	-1.19	-1.52	-1.29	-1.82	-1.47
	[1.08]	[0.99]	[1.04]	[0.97]	[1.11]	[1.03]	[1.17]	[1.06]
Urban	-0.24	0.17	0.25	0.42	0.16	0.4	-0.45	0.07
	[1.77]	[1.57]	[1.63]	[1.48]	[1.76]	[1.58]	[1.91]	[1.69]
Use of electricity: heating	1.6	1.62	1.74	1.68	1.82	1.77	1.63	1.69
	[2.02]	[1.75]	[1.85]	[1.69]	[2.00]	[1.80]	[2.23]	[1.89]
Use of LPG: heating	1.39	1.54	1.67	1.67	1.72	1.75	1.35	1.57
	[1.56]	[1.30]	[1.38]	[1.23]	[1.50]	[1.31]	[1.74]	[1.41]
Use of charcoal: heating	3.71	4.27	4.65	4.7	4.74	4.91	3.54	4.32
	[3.53]	[2.97]	[3.24]	[2.88]	[3.54]	[3.09]	[3.91]	[3.22]
Use of organic: heating	-6.94**	-7.10***	-7.62***	-7.37***	-7.95**	-7.77***	-7.06**	-7.38***
	[3.10]	[2.57]	[2.85]	[2.55]	[3.11]	[2.72]	[3.46]	[2.78]
Use of electricity: others (score 1)	7.65***	7.04***	7.46***	6.86***	7.97***	7.33***	8.17***	7.53***
	[1.73]	[1.62]	[1.74]	[1.65]	[1.81]	[1.71]	[1.81]	[1.68]
Use of electricity: others (score 2)	3.45***	3.11***	3.29***	3.00***	3.53***	3.21***	3.71***	3.34***
	[0.75]	[0.64]	[0.71]	[0.64]	[0.75]	[0.67]	[0.81]	[0.68]
Use of LPG: cooking	103.20***	90.42***	94.98***	85.15***	102.73***	91.57***	112.47***	97.92***
	[16.98]	[14.46]	[16.14]	[14.70]	[17.63]	[15.65]	[18.67]	[15.63]

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted. The marginal effects are evaluated at two profiles. Profile 1 consists of the means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1), use of LPG to cook foods (=1), and $HID = -1$ (1 degree Celsius lower than normal). Profile 2 is similar to profile 1 except that $HID = 1$ (1 degree Celsius higher than normal). Only these HID values are presented in the interest of space. But the marginal effects using other HID values are also computed and are available from the author upon request.

Table 5: Marginal effects of key variables on charcoal consumption

	Female rural		Female urban		Male rural		Male urban	
	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2	Profile 1	Profile 2
Balanced								
HI deviation	0.49**	0.74*	0.53**	0.80*	0.46**	0.70*	0.43**	0.65*
	[0.23]	[0.42]	[0.27]	[0.49]	[0.23]	[0.42]	[0.20]	[0.36]
HI deviation^2	0.05**	0.07*	0.05*	0.08	0.05*	0.07	0.04**	0.07*
	[0.02]	[0.04]	[0.03]	[0.05]	[0.02]	[0.04]	[0.02]	[0.04]
Price of electricity	1.00**	1.52**	1.09**	1.65**	0.10*	0.14*	0.88**	1.33**
	[0.48]	[0.71]	[0.50]	[0.77]	[0.05]	[0.08]	[0.41]	[0.61]
Price of LPG	0.10*	0.15*	0.11*	0.17*	-0.11*	-0.17*	0.09*	0.13*
	[0.06]	[0.09]	[0.06]	[0.10]	[0.06]	[0.09]	[0.05]	[0.07]
Price of charcoal	-0.12*	-0.18*	-0.13*	-0.19*	-0.05	-0.07	-0.10*	-0.16*
	[0.07]	[0.10]	[0.07]	[0.11]	[0.09]	[0.14]	[0.06]	[0.09]
Price of others	-0.05	-0.08	-0.05	-0.08	-0.23	-0.35	-0.04	-0.07
	[0.10]	[0.15]	[0.11]	[0.16]	[0.30]	[0.45]	[0.09]	[0.13]
10,000 to 29,999	-0.25	-0.38	-0.27	-0.41	-0.31	-0.48	-0.22	-0.33
	[0.32]	[0.47]	[0.35]	[0.51]	[0.44]	[0.66]	[0.28]	[0.42]
30,000 to 59,999	-0.33	-0.51	-0.36	-0.55	0.04	0.06	-0.29	-0.44
	[0.46]	[0.69]	[0.50]	[0.75]	[0.82]	[1.25]	[0.41]	[0.61]
60,000 to 99,999	0.05	0.07	0.05	0.07	-0.63	-0.96	0.04	0.06
	[0.87]	[1.32]	[0.95]	[1.44]	[0.95]	[1.44]	[0.76]	[1.16]
100,000 and over	-0.67	-1.02	-0.73	-1.1	-0.31	-0.48	-0.59	-0.89
	[1.02]	[1.54]	[1.09]	[1.66]	[0.37]	[0.56]	[0.89]	[1.35]
Male	-0.3	-0.46	-0.34	-0.53	-0.01	-0.01	-0.28	-0.43
	[0.41]	[0.63]	[0.46]	[0.70]	[0.01]	[0.02]	[0.33]	[0.51]
Age	-0.01	-0.01	-0.01	-0.01	-0.04	-0.07	-0.01	-0.01
	[0.01]	[0.02]	[0.01]	[0.02]	[0.37]	[0.57]	[0.01]	[0.02]
At least college	0	0	-0.02	-0.03	0.02	0.03	-0.02	-0.03
	[0.39]	[0.59]	[0.42]	[0.65]	[0.39]	[0.60]	[0.34]	[0.52]
Has a job	0.01	0.02	0.02	0.02	0.26**	0.39**	0.01	0.02
	[0.40]	[0.61]	[0.44]	[0.67]	[0.12]	[0.18]	[0.36]	[0.55]
Total household members	0.26**	0.39**	0.29**	0.44**	-0.33	-0.51	0.23**	0.35**
	[0.13]	[0.18]	[0.14]	[0.21]	[0.24]	[0.37]	[0.11]	[0.16]
Number of bedrooms	-0.33	-0.51	-0.37	-0.57	0.54	0.82	-0.3	-0.46
	[0.24]	[0.36]	[0.27]	[0.42]	[0.43]	[0.64]	[0.21]	[0.32]
Number of bathrooms	0.58	0.88	0.63	0.95	0.02	0.03	0.51	0.77
	[0.45]	[0.67]	[0.49]	[0.74]	[0.38]	[0.58]	[0.40]	[0.59]
Number of storeys	0.01	0.01	0.01	0.02	-0.16	-0.24	0.01	0.02
	[0.40]	[0.60]	[0.43]	[0.66]	[0.42]	[0.64]	[0.35]	[0.53]
Urban	-0.2	-0.29	-0.2	-0.3	1.72	2.62	-0.16	-0.24
	[0.40]	[0.61]	[0.47]	[0.73]	[1.18]	[1.79]	[0.35]	[0.54]
Use of electricity: heating	1.75	2.66	1.93	2.94	0.05	0.07	1.57	2.39
	[1.23]	[1.85]	[1.35]	[2.05]	[0.45]	[0.69]	[1.09]	[1.63]
Use of LPG: heating	0.01	0.02	0.03	0.05	4.19**	6.37**	0.03	0.05
	[0.46]	[0.70]	[0.51]	[0.77]	[1.77]	[2.65]	[0.41]	[0.63]
Use of charcoal: heating	4.22**	6.43**	4.68**	7.12**	-1.50*	-2.29*	3.80**	5.78**
	[1.86]	[2.71]	[2.03]	[3.06]	[0.87]	[1.32]	[1.65]	[2.38]
Use of organic: heating	-1.48*	-2.27*	-1.66*	-2.54*	0.72**	1.10**	-1.35*	-2.06*
	[0.89]	[1.33]	[0.98]	[1.48]	[0.36]	[0.53]	[0.80]	[1.19]
Use of electricity: others (score 1)	0.70**	1.08**	0.79*	1.21**	0.37*	0.56*	0.64**	0.98**
	[0.36]	[0.52]	[0.40]	[0.61]	[0.20]	[0.32]	[0.32]	[0.46]
Use of electricity: others (score 2)	0.34*	0.53*	0.40*	0.61	1.27*	1.95*	0.32*	0.50*
	[0.20]	[0.31]	[0.24]	[0.37]	[0.70]	[1.05]	[0.17]	[0.27]
Use of LPG: cooking	1.19*	1.83*	1.37*	2.09*	0.95**	1.43**	1.12*	1.71*
	[0.70]	[1.03]	[0.77]	[1.17]	[0.43]	[0.65]	[0.64]	[0.94]
Male-majority								
HI deviation	0.13*	0.18	0.17*	0.24	0.17**	0.24*	0.13**	0.18*
	[0.07]	[0.11]	[0.10]	[0.16]	[0.09]	[0.14]	[0.06]	[0.10]
HI deviation^2	0.01*	0.02	0.02	0.02	0.02*	0.02	0.01*	0.02
	[0.01]	[0.01]	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.01]
Price of electricity	0.03	0.04	0.04	0.05	0.04	0.05	0.03	0.04
	[0.07]	[0.10]	[0.10]	[0.14]	[0.10]	[0.14]	[0.07]	[0.10]
Price of LPG	0.03*	0.05*	0.04*	0.06*	0.04*	0.06*	0.03*	0.05*

	[0.02]	[0.03]	[0.03]	[0.04]	[0.02]	[0.04]	[0.02]	[0.03]
Price of charcoal	-0.03	-0.04	-0.04	-0.05	-0.04	-0.05	-0.03	-0.04
	[0.02]	[0.03]	[0.03]	[0.04]	[0.02]	[0.03]	[0.02]	[0.03]
Price of others	0.12*	0.17**	0.16*	0.23*	0.16**	0.23**	0.12**	0.17**
	[0.06]	[0.09]	[0.09]	[0.12]	[0.08]	[0.10]	[0.06]	[0.07]
10,000 to 29,999	-0.02	-0.03	-0.02	-0.03	-0.02	-0.03	-0.02	-0.03
	[0.11]	[0.15]	[0.14]	[0.19]	[0.14]	[0.19]	[0.11]	[0.15]
30,000 to 59,999	0.05	0.07	0.07	0.1	0.07	0.1	0.05	0.07
	[0.15]	[0.21]	[0.20]	[0.28]	[0.20]	[0.27]	[0.15]	[0.21]
60,000 to 99,999	5.57	7.78	7.3	10.17	7.25	10.12	5.49	7.67
	[3.82]	[5.30]	[5.18]	[7.20]	[4.63]	[6.43]	[3.39]	[4.71]
100,000 and over	0.43	0.6	0.56	0.79	0.56	0.78	0.42	0.59
	[0.49]	[0.69]	[0.64]	[0.89]	[0.62]	[0.86]	[0.47]	[0.65]
Male	-0.01	-0.01	0	-0.01	-0.01	-0.01	-0.01	-0.02
	[0.19]	[0.26]	[0.25]	[0.35]	[0.25]	[0.34]	[0.18]	[0.25]
Age	0	0	0	0	0	0	0	0
	[0.00]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]	[0.01]
At least college	-0.33*	-0.46**	-0.44*	-0.61*	-0.43**	-0.61**	-0.32**	-0.45**
	[0.17]	[0.23]	[0.23]	[0.31]	[0.21]	[0.29]	[0.16]	[0.21]
Has a job	0.2	0.28	0.26	0.36	0.26	0.36	0.2	0.28
	[0.20]	[0.27]	[0.27]	[0.37]	[0.24]	[0.33]	[0.18]	[0.24]
Total household members	0.07*	0.09*	0.09*	0.13*	0.09**	0.13**	0.06**	0.09**
	[0.04]	[0.05]	[0.05]	[0.07]	[0.04]	[0.06]	[0.03]	[0.04]
Number of bedrooms	0.08	0.1	0.09	0.13	0.1	0.13	0.07	0.1
	[0.07]	[0.10]	[0.10]	[0.14]	[0.09]	[0.13]	[0.07]	[0.10]
Number of bathrooms	0	0	-0.01	-0.01	0	-0.01	0.01	0.01
	[0.16]	[0.22]	[0.21]	[0.29]	[0.21]	[0.29]	[0.15]	[0.21]
Number of storeys	0.17	0.24	0.24	0.34	0.23	0.33	0.17	0.23
	[0.16]	[0.23]	[0.22]	[0.30]	[0.21]	[0.29]	[0.16]	[0.22]
Urban	-0.23	-0.31	-0.26	-0.37	-0.27	-0.38	-0.23*	-0.32*
	[0.15]	[0.21]	[0.24]	[0.34]	[0.23]	[0.32]	[0.14]	[0.19]
Use of electricity: heating	-0.34*	-0.47*	-0.43*	-0.60*	-0.43*	-0.60*	-0.33**	-0.47**
	[0.18]	[0.24]	[0.25]	[0.34]	[0.23]	[0.31]	[0.16]	[0.22]
Use of LPG: heating	0.32	0.45	0.45	0.63	0.44	0.62	0.31	0.44
	[0.22]	[0.30]	[0.31]	[0.42]	[0.28]	[0.39]	[0.20]	[0.28]
Use of charcoal: heating	1.05*	1.47*	1.48*	2.07*	1.44**	2.02**	1.01**	1.42**
	[0.56]	[0.77]	[0.78]	[1.06]	[0.69]	[0.93]	[0.50]	[0.68]
Use of organic: heating	-0.11	-0.16	-0.18	-0.25	-0.17	-0.24	-0.1	-0.14
	[0.28]	[0.39]	[0.37]	[0.52]	[0.36]	[0.50]	[0.27]	[0.37]
Use of electricity: others (score 1)	0.27*	0.37*	0.38*	0.53*	0.37**	0.51**	0.26**	0.36**
	[0.14]	[0.19]	[0.20]	[0.27]	[0.17]	[0.23]	[0.12]	[0.16]
Use of electricity: others (score 2)	-0.03	-0.04	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
	[0.09]	[0.12]	[0.11]	[0.16]	[0.11]	[0.16]	[0.09]	[0.12]
Use of LPG: cooking	0.44*	0.62*	0.65*	0.92*	0.63*	0.88*	0.42*	0.59*
	[0.26]	[0.35]	[0.38]	[0.50]	[0.35]	[0.47]	[0.25]	[0.33]
Female-majority								
HI deviation	0.2	0.24	0.24	0.28	0.33	0.39	0.28	0.33
	[0.16]	[0.24]	[0.20]	[0.29]	[0.27]	[0.38]	[0.21]	[0.31]
HI deviation^2	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]	[0.03]	[0.04]
Price of electricity	0.3	0.37	0.36	0.44	0.49	0.59	0.4	0.49
	[0.24]	[0.30]	[0.28]	[0.35]	[0.39]	[0.49]	[0.33]	[0.42]
Price of LPG	0.09**	0.11*	0.11*	0.13*	0.14*	0.17*	0.12**	0.14*
	[0.05]	[0.06]	[0.06]	[0.07]	[0.07]	[0.09]	[0.06]	[0.08]
Price of charcoal	-0.07	-0.08	-0.08	-0.1	-0.11	-0.14	-0.09	-0.11
	[0.06]	[0.08]	[0.07]	[0.09]	[0.10]	[0.12]	[0.08]	[0.10]
Price of others	0.15	0.19	0.18	0.22	0.25	0.3	0.21	0.25
	[0.11]	[0.13]	[0.14]	[0.17]	[0.19]	[0.22]	[0.14]	[0.17]
10,000 to 29,999	0.05	0.06	0.06	0.07	0.08	0.1	0.07	0.08
	[0.29]	[0.35]	[0.34]	[0.41]	[0.46]	[0.55]	[0.38]	[0.46]
30,000 to 59,999	0.05	0.06	0.06	0.07	0.08	0.09	0.06	0.08
	[0.42]	[0.51]	[0.51]	[0.61]	[0.68]	[0.82]	[0.56]	[0.68]
60,000 to 99,999	3.1	3.75	3.73	4.48	5.01	6.05	4.14	5.03
	[2.10]	[2.55]	[2.47]	[3.00]	[3.27]	[3.98]	[2.78]	[3.39]

100,000 and over	2.19	2.65	2.63	3.17	3.54	4.27	2.92	3.55
	[2.19]	[2.63]	[2.61]	[3.12]	[3.43]	[4.12]	[2.88]	[3.46]
Male	0.62*	0.76*	0.76*	0.93*	1.01	1.23	0.82	1.01
	[0.35]	[0.43]	[0.43]	[0.53]	[0.70]	[0.87]	[0.58]	[0.71]
Age	0.02	0.03	0.03	0.03	0.03	0.04	0.03	0.03
	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.02]	[0.02]
At least college	0.11	0.12	0.12	0.13	0.17	0.19	0.15	0.18
	[0.35]	[0.43]	[0.43]	[0.52]	[0.57]	[0.70]	[0.46]	[0.57]
Has a job	-0.16	-0.2	-0.2	-0.24	-0.27	-0.32	-0.22	-0.26
	[0.32]	[0.39]	[0.39]	[0.48]	[0.53]	[0.65]	[0.43]	[0.53]
Total household members	0.26**	0.32**	0.32**	0.39**	0.42**	0.51**	0.34**	0.42**
	[0.12]	[0.14]	[0.15]	[0.18]	[0.19]	[0.23]	[0.15]	[0.18]
Number of bedrooms	-0.02	-0.04	-0.04	-0.06	-0.04	-0.06	-0.01	-0.03
	[0.16]	[0.19]	[0.19]	[0.23]	[0.25]	[0.31]	[0.21]	[0.26]
Number of bathrooms	-0.35	-0.42	-0.42	-0.49	-0.57	-0.68	-0.48	-0.57
	[0.31]	[0.39]	[0.39]	[0.48]	[0.52]	[0.64]	[0.41]	[0.52]
Number of storeys	0.06	0.07	0.06	0.08	0.09	0.1	0.08	0.09
	[0.28]	[0.35]	[0.35]	[0.42]	[0.46]	[0.56]	[0.37]	[0.46]
Urban	-0.4	-0.47	-0.46	-0.54	-0.64	-0.76	-0.55	-0.65
	[0.36]	[0.45]	[0.52]	[0.64]	[0.68]	[0.84]	[0.47]	[0.58]
Use of electricity: heating	0.72	0.89	0.89	1.08	1.18	1.44	0.95	1.17
	[0.77]	[0.94]	[0.95]	[1.16]	[1.24]	[1.53]	[1.00]	[1.23]
Use of LPG: heating	1.02*	1.26*	1.26*	1.55*	1.66*	2.04*	1.33*	1.64*
	[0.60]	[0.73]	[0.75]	[0.93]	[0.96]	[1.18]	[0.76]	[0.94]
Use of charcoal: heating	2.88**	3.56**	3.58**	4.41**	4.68**	5.78**	3.73**	4.64***
	[1.18]	[1.41]	[1.51]	[1.82]	[1.86]	[2.25]	[1.46]	[1.75]
Use of organic: heating	-0.67	-0.85	-0.86	-1.07	-1.1	-1.38	-0.86	-1.08
	[0.60]	[0.73]	[0.75]	[0.91]	[0.96]	[1.17]	[0.77]	[0.93]
Use of electricity: others (score 1)	0.12	0.17	0.18	0.24	0.21	0.28	0.14	0.2
	[0.32]	[0.40]	[0.39]	[0.48]	[0.52]	[0.65]	[0.43]	[0.52]
Use of electricity: others (score 2)	-0.15	-0.16	-0.15	-0.16	-0.23	-0.25	-0.22	-0.24
	[0.22]	[0.26]	[0.25]	[0.30]	[0.34]	[0.41]	[0.29]	[0.35]
Use of LPG: cooking	1.39**	1.76**	1.78**	2.24**	2.28**	2.87**	1.76**	2.23**
	[0.64]	[0.80]	[0.81]	[1.01]	[1.03]	[1.29]	[0.82]	[1.02]

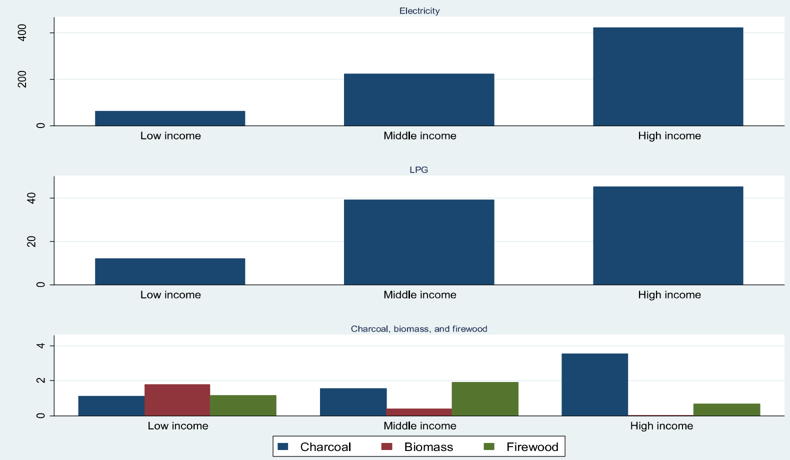
***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted. The marginal effects are evaluated at two profiles. *Profile 1* consists of the means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1), use of LPG to cook foods (=1), and $HID = -1$ (1 degree Celsius lower than normal). Profile 2 is similar to profile 1 except that $HID = 1$ (1 degree Celsius higher than normal). Only these HID values are presented in the interest of space. But the marginal effects using other HID values are also computed and are available from the author upon request.

Table 6: Predicted change in monthly fuel consumption, by HI fluctuations from the normal value

	Above normal		Below normal	
	1 degree	2 degrees	1 degree	2 degrees
Electricity (kilowatt-hour)	33402 to 42678	68392 to 88360	-28561 to -37549	-51798 to -68908
LPG (kilogram)	-22421 to -27890	-48043 to -59164	18968 to 23849	34580 to 42942
Charcoal (kilogram)	6217 to 8308	15168 to 20104	-4357 to -5923	-7376 to -10045

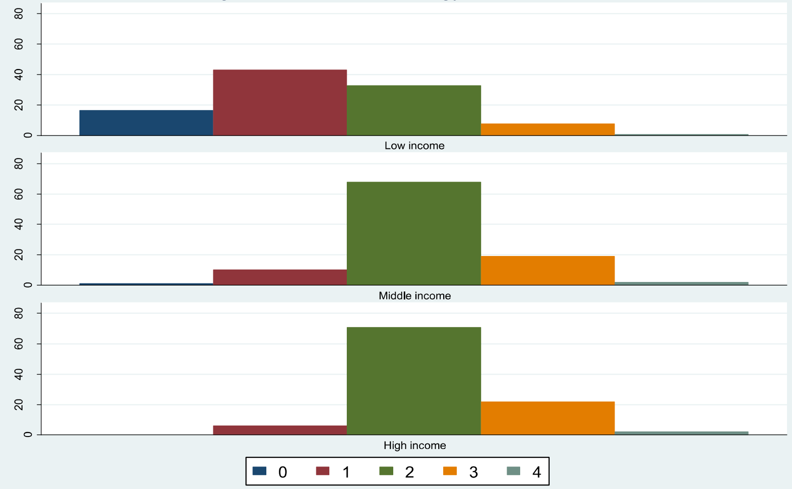
Note: Figures are computed using the relative consumption figures for balanced, male-majority and female-majority households and using the base scenario. From HECS 2011, there are 5795 balanced households, 5928 male-majority households, and 5764 female-majority households.
Sample computation for electricity: for different HID values, compute
Balanced :N1= 5795* femrurbaseelec, N2=5795*femurbbaseelec, N3= 5795 *malerurbaseelec, N4= 5795 *maleurbbaseelec
Male-majority :N1=5928 * femrurbaseelec, N2=5928 *femurbbaseelec, N3= 5928 *malerurbaseelec, N4= 5928 *maleurbbaseelec
Female-majority : N1=5764 *femrurbaseelec, N2=5764 *femurbbaseelec, N3= 5764 *malerurbaseelec , N4=5764 *maleurbbaseelec
where femrurbaseelec, femurbbaseelec, malerurbaseelec, and maleurbbaseelec are the relative consumption differences associated with the sex-location configurations. Get x=minimum(N1, N2, N3, N4) for each of the HID values and sex-location configurations and then get the sum of x for different household types and HID values, ai=sum(x) for HID=i, i=-2, -1, 1, 2.

Figure 1: Average monthly consumption



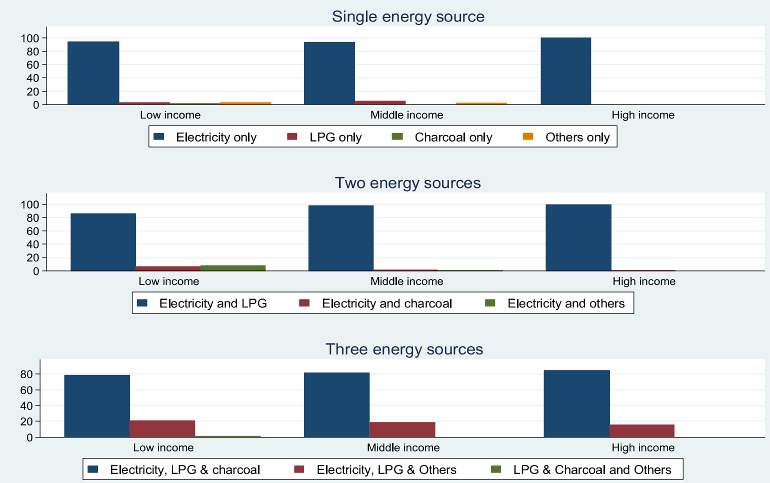
Source: Author's computation based on HECS 2011

Figure 2: Number of energy sources used



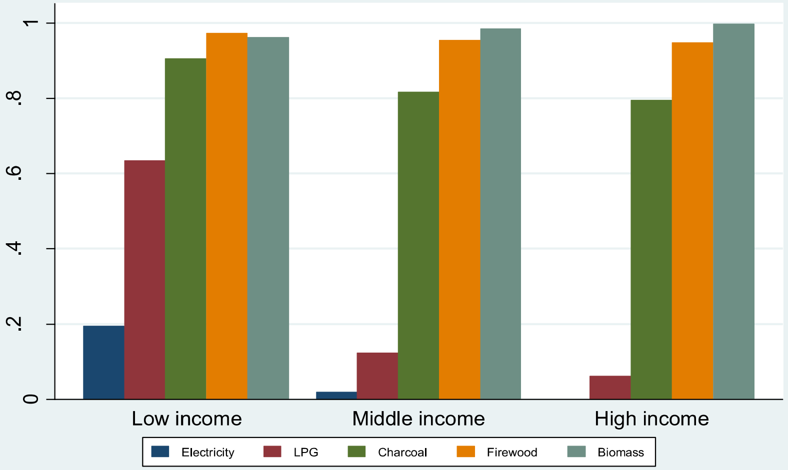
Source: Author's computation based on HECS 2011

Figure 3: Household's energy use



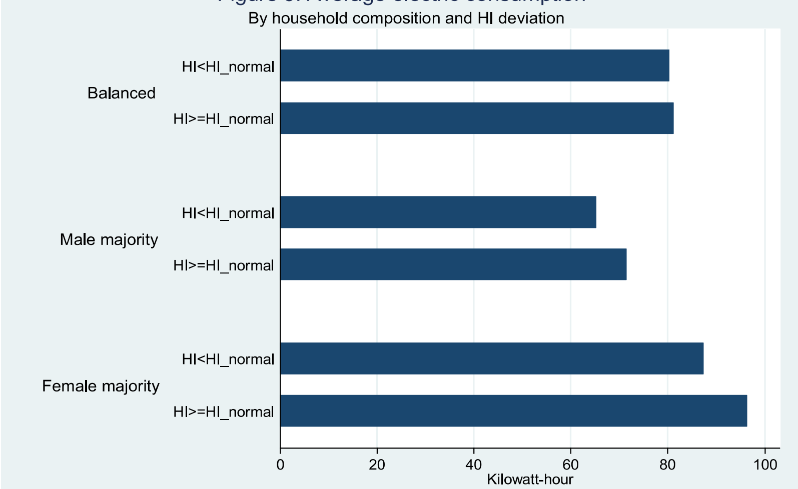
Source: Author's computation based on HECS 2011

Figure 4: Proportion of zero energy consumption



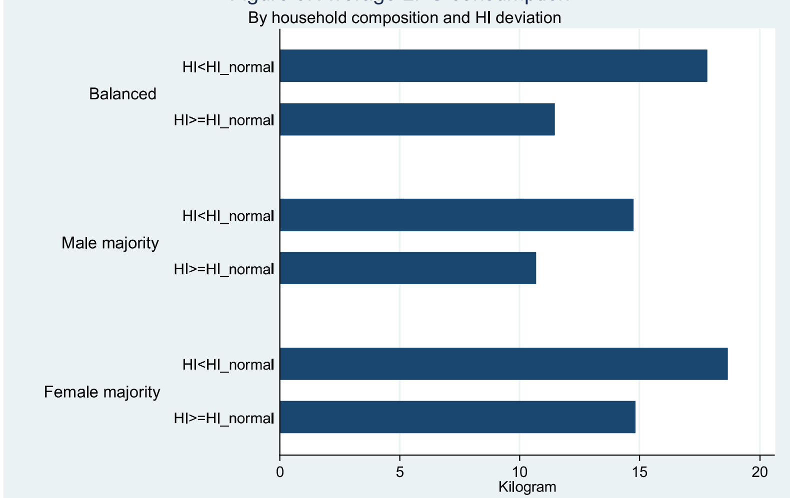
Source: Author's computation based on HECS 2011

Figure 5: Average electric consumption



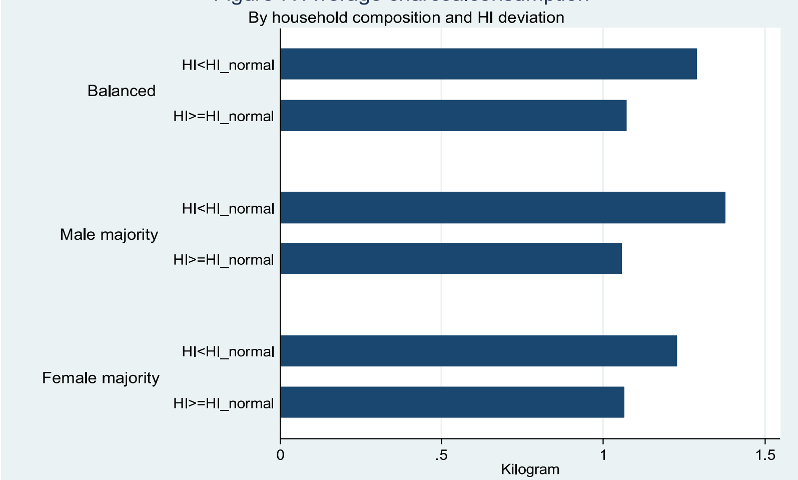
Source: Author's computation based on HECS 2011

Figure 6: Average LPG consumption



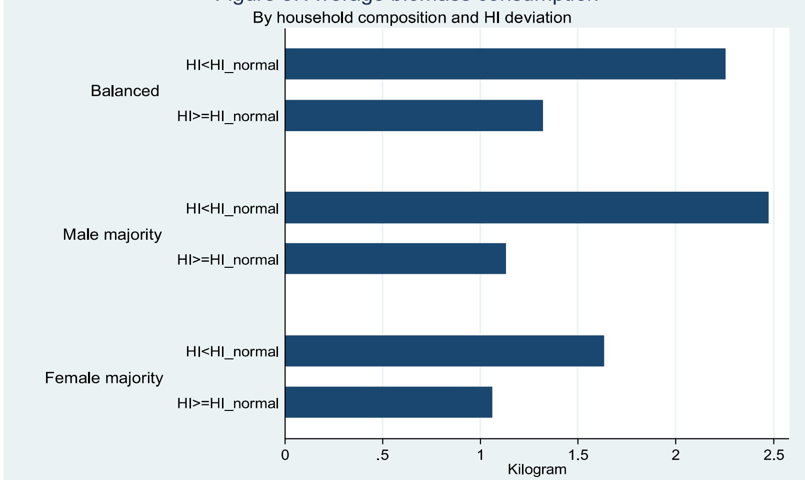
Source: Author's computation based on HECS 2011

Figure 7: Average charcoalconsumption



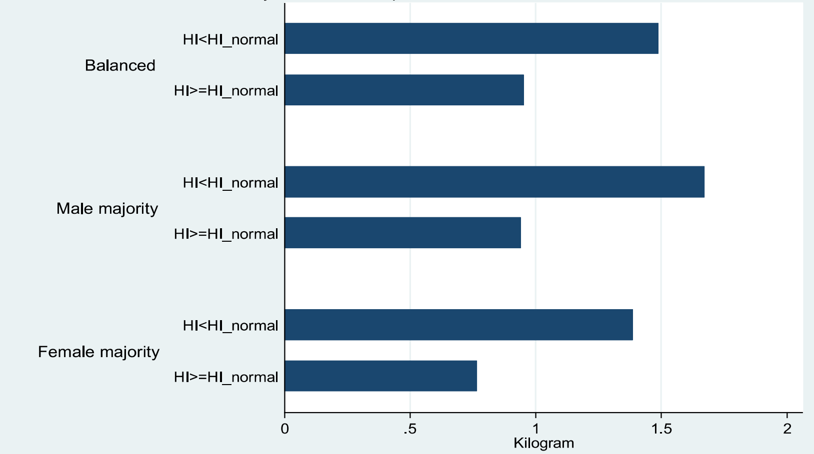
Source: Author's computation based on HECS 2011

Figure 8: Average biomass consumption



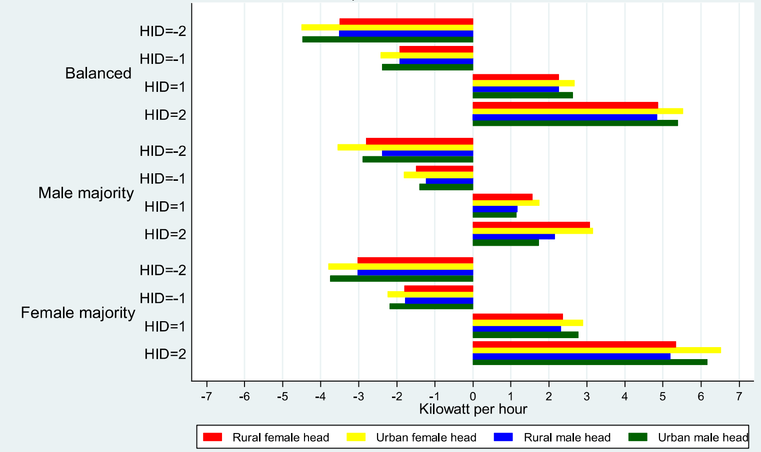
Source: Author's computation based on HECS 2011

Figure 9: Average firewood consumption
By household composition and HI deviation



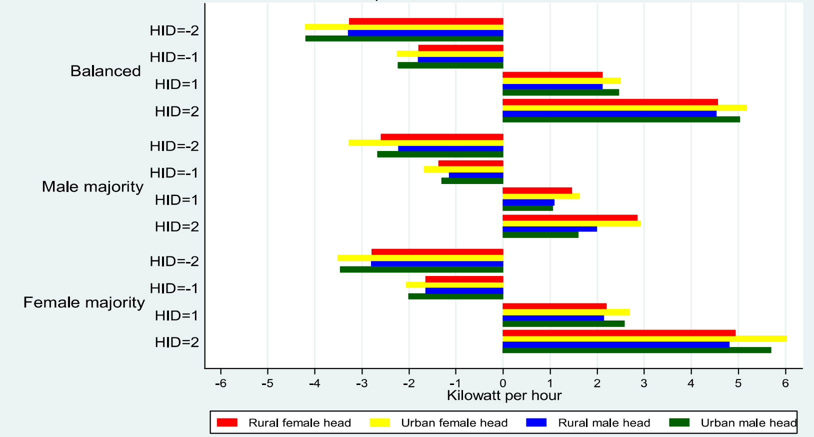
Source: Author's computation based on HECS 2011

Figure 10: Electricity consumption, Scenario 1
Difference between consumption with HI deviation and no HI shock



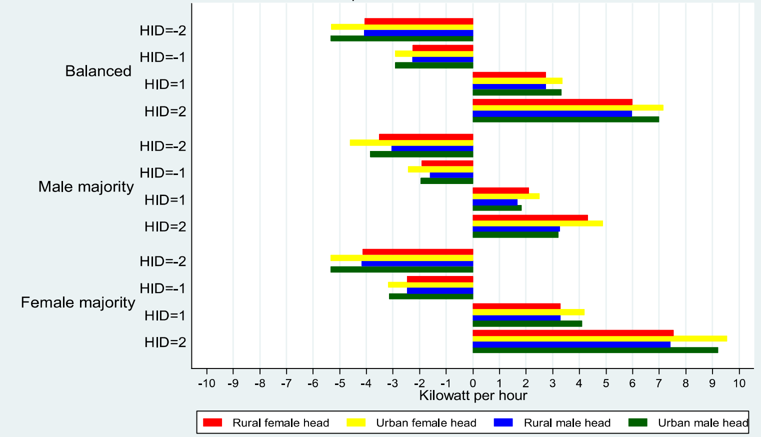
Source: Author's computation based on HECS 2011

Figure 11: Electricity consumption, Scenario 2
Difference between consumption with HI deviation and no HI shock



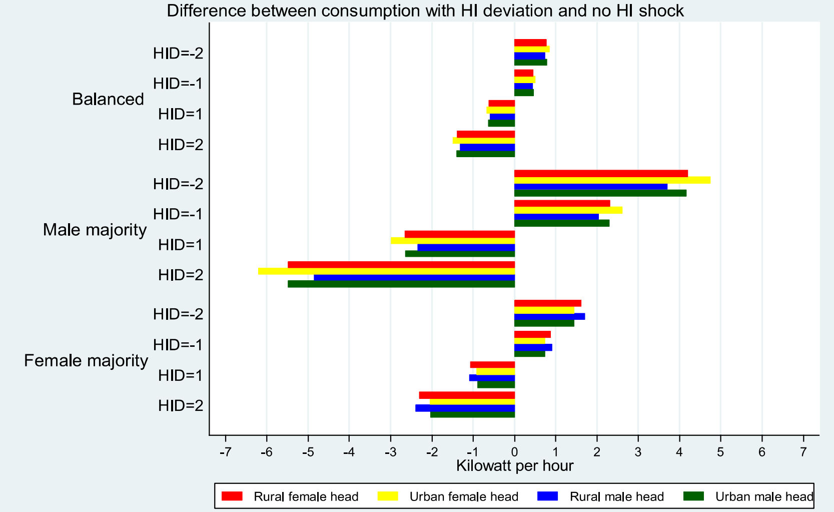
Source: Author's computation based on HECS 2011

Figure 12: Electricity consumption, Scenario 3
Difference between consumption with HI deviation and no HI shock



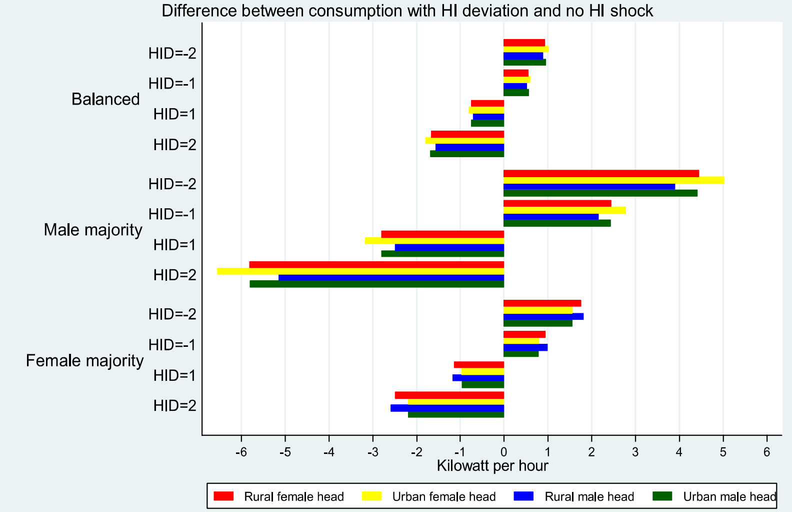
Source: Author's computation based on HECS 2011

Figure 13: LPG consumption, Scenario 1



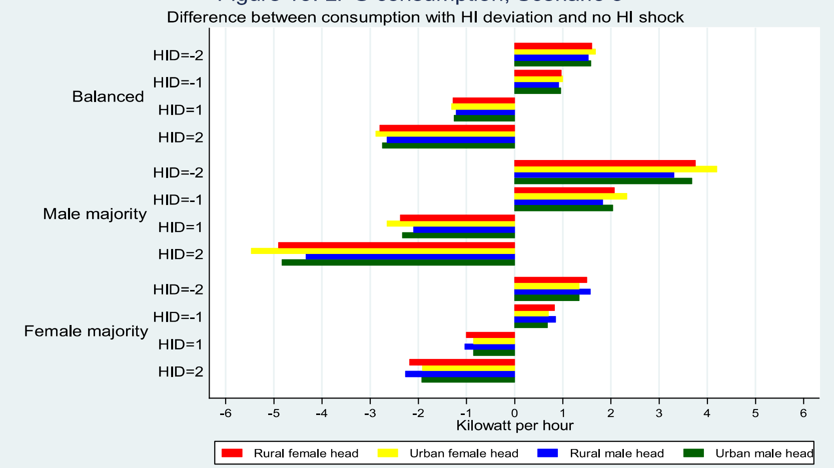
Source: Author's computation based on HECS 2011

Figure 14: LPG consumption, Scenario 2



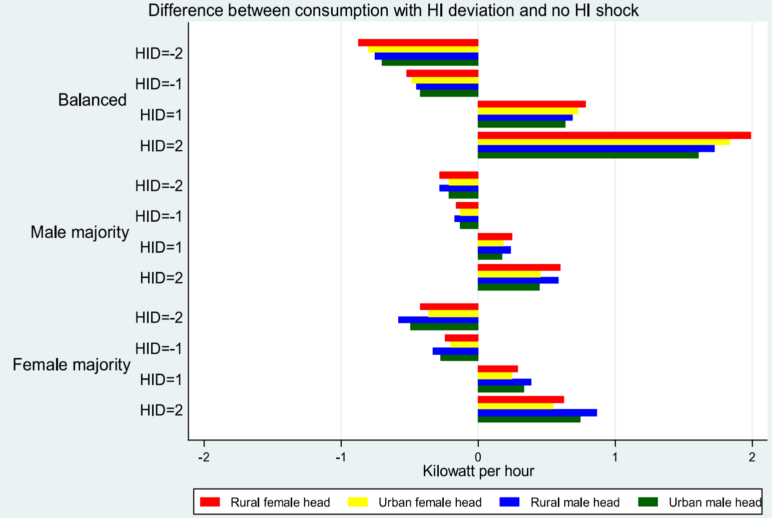
Source: Author's computation based on HECS 2011

Figure 15: LPG consumption, Scenario 3



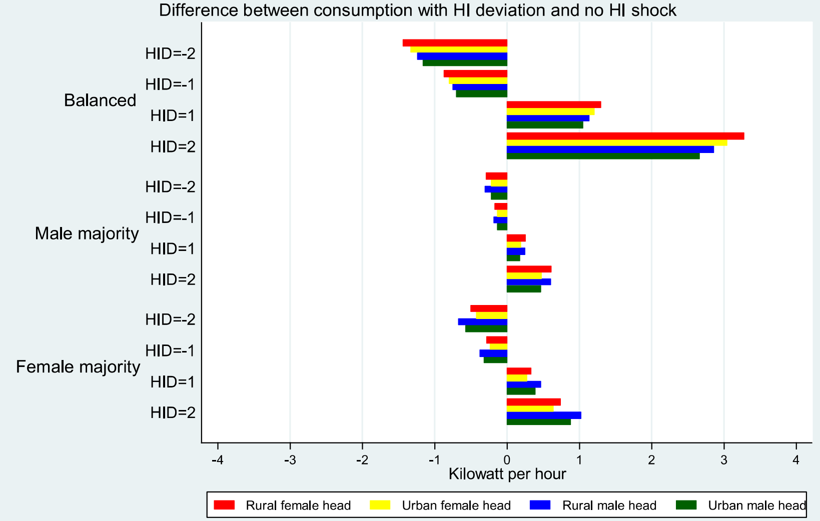
Source: Author's computation based on HECS 2011

Figure 16: Charcoal consumption, Scenario 1



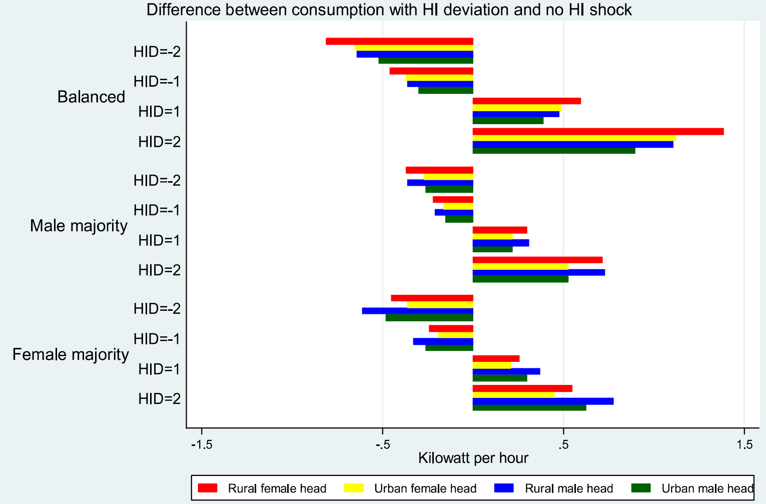
Source: Author's computation based on HECS 2011

Figure 17: Charcoal consumption, Scenario 2



Source: Author's computation based on HECS 2011

Figure 18: Charcoal consumption, Scenario 3



Source: Author's computation based on HECS 2011

APPENDIX

Table 1A: Mapping of HECS provinces with the PAGASA weather stations

HECS Province/City	Weather Station	Provincial capital to weather station	Straight line/air distance (in kms)§
Taguig	NAIA, Pasay City	Taguig-Pasay City	3.59
City of Paranaque	NAIA, Pasay City	Paranaque-Pasay City	3.91
City of Makati	NAIA, Pasay City	Makati City-Pasay City	4.55
San Juan	Science Garden, Quezon City	San Juan-Quezon City	4.94
Cagayan de Oro City	Lumbia Airport, Misamis Oriental	CDO-Lumbia Airport	5.63
Misamis Oriental (Excluding Cagayan de Oro City)	Lumbia Airport, Misamis Oriental	CDO-Lumbia Airport	5.63
Pateros	NAIA, Pasay City	Pateros-Pasay City	6.86
City of Mandaluyong	Science Garden, Quezon City	Mandaluyong City-Quezon City	7.16
City of Las Pinas	NAIA, Pasay City	Las Pina-Pasay City	8.18
City of Marikina	Science Garden, Quezon City	Marikina City-Quezon City	8.53
City of Pasig	Science Garden, Quezon City	Pasig City-Quezon City	8.69
Laguna	Sangley Point, Cavite	Imus-Sangley	10.11
Quezon (Excluding Lucena City)	Tayabas, Quezon	Lucena-Tayabas	11.04
Malabon	Science Garden, Quezon City	Malabon-Quezon City	11.49
Navotas	Science Garden, Quezon City	Navotas-Quezon City	11.59
City of Muntinlupa	NAIA, Pasay City	Muntinlupa City-Pasay City	12.09
Kalookan City	Science Garden, Quezon City	Kalookan City-Quezon City	12.54
Nueva Ecija	Cabanatuan, Nueva Ecija	Palayan City-Cabanatuan	19.76
City of Valenzuela	NAIA, Pasay City	Valenzuela City-Pasay City	21.1
Abra	Vigan, Ilocos Sur	Bangued-Vigan	23.77
Bulacan	Science Garden, Quezon City	Bulacan-Quezon City	24.32
Saranggani	General Santos, South Cotabato	Saranggani-General Santos	28.76
Rizal	Science Garden, Quezon City	Rizal-Quezon City	28.9
Sorsogon	Legaspi City, Albay	Sorosogon-Legaspi	33.55
La Union	Baguio City, Benguet	San Fernando City-Baguio City	33.68
Siquijor	Dumaguete City Negros Oriental	Siquijor-Dumaguete	33.89
Tarlac	Cabanatuan, Nueva Ecija	Tarlac City-Cabanatuan	40.43
Kalinga	Tuguegarao, Cagayan	Kalinga-Tuguegarao	41.23
Aklan	Roxas City, Capiz	Aklan-Roxas City	43.61
Leyte (Excluding Ormoc City)	Tacloban City, Leyte	Leyte-Tacloban City	44.43
Ormoc City	Tacloban City, Leyte	Ormoc-Tacloban City	44.43
Iligan City	Lumbia Airport, Misamis Oriental	Iligan City-Lumbia Airport	45
Cotabato	Davao City, Davao Del Sur	Cotabato-Davao City	46.85
South Cotabato (Exc General Santos City(Dadiangas))	General Santos, South Cotabato	Koronadal-General Santos	55.54
Basilan	Zamboanga City, Zamboanga	Basilan-Zambonaga City	55.65
Lanao del Sur (Excluding Marawi City)	Lumbia Airport, Misamis Oriental	Marawi-Lumbia Airport	56.15
Agusan del Sur	Butuan City, Agusan Del Norte	Prosperidad-Butuan City	56.9

Nueva Vizcaya	Baguio City, Benguet	Bayombong-Kennon Road	59.51
Occidental Mindoro	San Jose, Occidental Mindoro	Mamburao-San Jose	60.33
Olongapo City	Iba, Zambales	Olongapo-Iba	62.23
Angeles City	Iba, Zambales	Angeles to Iba	67.32
Catanduanes	Legaspi City, Albay	Virac-Legaspi	70.46
Biliran	Tacloban City, Leyte	Naval-Tacloban City	70.51
Eastern Samar	Guiuan, Eastern Samar	Borongan-Guiuan	71.26
Isabela (Excluding City of Santiago)	Tuguegarao, Cagayan	Isabela City-Tuguegarao	71.84
Isabela City	Tuguegarao, Cagayan	Isabela City-Tuguegarao	71.84
Compostela Valley	Davao City, Davao Del Sur	Nabunturan-Davao City	72.68
Apayao	Tuguegarao, Cagayan	Apayao-Tuguegarao	73.79
Marinduque	Tayabas, Quezon	Boac-Tayabas	74.42
Zamboanga del Sur (Excluding Zamboanga City)	Dipolog, Zambonanga Del Norte	Pagadian-Dipolog	75.66
Aurora	Casiguran, Aurora	Baler-Casiguran	75.91
Pampanga (Excluding Angeles City)	Iba, Zambales	San Fernando City-Iba	77.38
Ifugao	Baguio City, Benguet	Lagawe-Baguio City	78.65
Surigao del Sur	Hinatuan, Surigao Del Sur	Tandag-Hinatuan	80.76
Zamboanga Sibugay	Zambonaga, Zamboanga Del Sur	Ipil-Zamboanga del Sur	85.18
Mountain Province	Baguio City, Benguet	Bontoc-Baguio City	87.15
Misamis Occidental	Lumbia Airport, Misamis Oriental	Oroqieta-Lumbia Airport	89.38
Masbate	Legaspi City, Albay	Masbate City-Legaspi City	90.04
Bataan	Iba, Zambales	Balanga-Iba	91.19
Davao Oriental	Davao City, Davao Del Sur	Mati-Davao City	91.54
Camiguin	Lumbia Airport, Misamis Oriental	Mambajao-Lumbia Airport	92.3
Camarines Sur (Excluding Naga City)	Virac, Catanduanes	Pili-Virac	93.02
Lanao del Norte (Excluding Iligan City)	Lumbia Airport, Misamis Oriental	Tubod-Lumbia Airport	93.13
Sultan Kudarat	General Santos, South Cotabato	Sultan Kudarat-General Santos	94.13
Iloilo (Excluding Iloilo City)	Roxas City, Capiz	Iloilo-Roxas City	94.48
Iloilo City	Roxas City, Capiz	Iloilo City-Roxas City	94.48
City of Santiago	Tuguegarao, Cagayan	Santiago City-Tuguegarao	101.55
Bacolod City	Roxas City, Capiz	Bacolod city-Dumaguete	104.27
Negros Occidental (Excluding Bacolod City)	Roxas City, Capiz	Bacolod city-Dumaguete	104.27
Antique	Roxas City, Capiz	San Jose de Buenavista-Roxas City	124.85
Cotabato City	Davao City, Davao Del Sur	Cotabato City to Davao City	129.28
Sulu	Zamboanga City, Zamboanga	Jolo-Zambonaga City	153.13
Quirino	Tuguegarao, Cagayan	Quirino-Tuguegarao	175.05
Batangas	Ambulong, Batangas		
Baguio City	Baguio City, Benguet		
Benguet (Excluding Baguio City)	Baguio City, Benguet		
Agusan Norte (Excluding Butuan City)	Butuan City, Agusan Del Norte		
Butuan City	Butuan City, Agusan Del Norte		
Oriental Mindoro	Calapan, Oriental Mindoro		
Northern Samar	Catarman, Northern Samar		

Samar (Western)	Catbalogan, Western Samar
Camarines Norte	Daet, Camarines Norte
Pangasinan	Dagupan City, Pangasinan
Davao	Davao City, Davao Del Sur
Davao City	Davao City, Davao Del Sur
Davao Sur (Excluding Davao City)	Davao City, Davao Del Sur
Zamboanga del Norte	Dipolog, Zambonanga Del Norte
Negros Oriental	Dumaguete City Negros Oriental
General Santos City(Dadiangas)	General Santos, South Cotabato
Maguindanao	General Santos, South Cotabato
Zambales (Excluding Olongapo City)	Iba, Zambales
Ilocos Norte	Laoag, Ilocos Norte
Albay	Legaspi City, Albay
Marawi City	Lumbia Airport, Misamis Oriental
Southern Leyte	Maasin, Southern Leyte
Cebu (Excluding Cebu City)	Mactan International Airport, Cebu
Cebu City	Mactan International Airport, Cebu
Bukidnon	Malaybalay, Bukidnon
Pasay City	NAIA, Pasay City
Manila	Port Area, Manila
Palawan	Puerto Princesa, Palawan
Romblon	Romblon, Romblon
Capiz	Roxas City, Capiz
Cavite	Sangley Point, Cavite
Quezon City	Science Garden, Quezon City
Surigao del Norte	Surigao, Surigao Del Norte
Bohol	Tagbilaran City, Bohol
Cagayan	Tuguegarao, Cagayan
Ilocos Sur	Vigan, Ilocos Sur
Naga City	Virac, Catanduanes
Zamboanga City	Zamboanga City, Zamboanga
Batanes	
Guimaras	
Tawi-Tawi	

§Taken from http://distancecalculator.globefeed.com/Philippines_Distance_Calculator.asp.

Table 2A: Discrete/continuous estimates, electricity and LPG

	Electricity						LPG					
	Balanced		Male-majority		Female-majority		Balance		Male-majority		Female-majority	
	Probit	GLM	Probit	GLM	Probit	GLM	Probit	GLM	Probit	GLM	Probit	GLM
Weather variables												
HI deviation	-0.07**	0.04***	-0.09***	0.04***	-0.05	0.03**	-0.04	-0.02	-0.07	-0.09***	0.16***	-0.04
	[0.03]	[0.01]	[0.03]	[0.01]	[0.03]	[0.02]	[0.05]	[0.03]	[0.09]	[0.03]	[0.06]	[0.04]
HI deviation^2	-0.02***	0.00*	-0.02***	0.00**	-0.01***	0.00**	-0.01	0	0	-0.01***	0.04***	0
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]
Prices												
Price of electricity		-0.06***		-0.06***		-0.07***		0.15***		0.04		0.07*
		[0.02]		[0.02]		[0.02]		[0.04]		[0.04]		[0.04]
Price of LPG		0		0		0		-0.01		-0.01		-0.01*
		[0.00]		[0.00]		[0.00]		[0.01]		[0.01]		[0.01]
Price of charcoal		-0.01*		0		0		-0.02**		0.01		0
		[0.00]		[0.00]		[0.00]		[0.01]		[0.01]		[0.01]
Price of others		0.05***		0.03***		0.05***		0.01		0		0.03*
		[0.01]		[0.01]		[0.01]		[0.02]		[0.02]		[0.01]
Family income												
10,000 to 29,999		0.12***		0.17***		0.15***		0.10**		0.24***		0.10**
		[0.03]		[0.03]		[0.03]		[0.05]		[0.05]		[0.05]
30,000 to 59,999		0.15***		0.19***		0.25***		0.25***		0.27***		0.1
		[0.05]		[0.05]		[0.04]		[0.06]		[0.08]		[0.06]
60,000 to 99,999		0.22**		0.36***		0.43***		0.06		0.29**		0.06
		[0.09]		[0.12]		[0.08]		[0.10]		[0.11]		[0.09]
100,000 and over		0.65***		0.58***		0.51***		0.2		0.16		0.08
		[0.13]		[0.14]		[0.19]		[0.17]		[0.16]		[0.15]
Household head characteristics												
Male	-0.06	0.01	-0.21*	-0.05	-0.22**	0.03	0.15	-0.05	0.27	-0.12**	-0.11	0.07*
	[0.11]	[0.03]	[0.12]	[0.04]	[0.09]	[0.03]	[0.15]	[0.05]	[0.24]	[0.06]	[0.20]	[0.04]
Age	0.01***	0.00***	0.01***	0.00**	0.01***	0.00***	0	0	0.02**	0	0.01	0
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]
At least college	0.32**	0.08***	0.20**	0.07**	-0.04	0.05*	-0.08	0.03	-0.19	-0.03	-0.19	0.01
	[0.14]	[0.03]	[0.10]	[0.03]	[0.11]	[0.03]	[0.16]	[0.04]	[0.19]	[0.05]	[0.20]	[0.04]
Has a job	0.13	-0.04	0.02	-0.03	0.15	0	-0.30*	0.07	-0.07	0.01	-0.28	-0.04
	[0.12]	[0.03]	[0.11]	[0.03]	[0.11]	[0.03]	[0.17]	[0.05]	[0.21]	[0.05]	[0.22]	[0.04]
House attributes												
Total household members	-0.04**	0.03***	-0.03*	0.05***	-0.01	0.06***	-0.10***	0.09***	0.03	0.09***	-0.12***	0.11***
	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.03]	[0.01]	[0.04]	[0.01]
Number of bedrooms	0.22***	0.07***	0.18***	0.04***	0.21***	0.05***	0.13	0.04*	0.02	0.03	0.1	0.07***
	[0.05]	[0.01]	[0.04]	[0.01]	[0.05]	[0.01]	[0.09]	[0.02]	[0.11]	[0.02]	[0.11]	[0.02]
Number of bathrooms	-0.09	0.07***	0.13	0.06**	0.09	0.09***	-0.40***	0.06	0.11	0.11***	-0.06	0

	[0.08]	[0.03]	[0.09]	[0.03]	[0.09]	[0.02]	[0.12]	[0.04]	[0.27]	[0.04]	[0.15]	[0.03]
Number of storeys	-0.25**	0.05	-0.15	0.10***	-0.23**	0.08***	-0.43***	0.06	0.03	0.02	-0.2	-0.04
	[0.13]	[0.03]	[0.11]	[0.03]	[0.10]	[0.03]	[0.15]	[0.04]	[0.17]	[0.04]	[0.14]	[0.04]
Urban	-0.51***	0.31***	-0.22*	0.35***	-0.23**	0.25***	-0.31	0.06	-0.06	0.12**	-0.40*	0.02
	[0.12]	[0.04]	[0.12]	[0.03]	[0.11]	[0.03]	[0.21]	[0.06]	[0.19]	[0.05]	[0.20]	[0.06]
Energy use												
Use of electricity: heating	-0.43*	0	-0.14	0	0.05	0.06	-0.19	0.01	-0.05	-0.03	-0.12	0.07
	[0.26]	[0.05]	[0.29]	[0.05]	[0.28]	[0.04]	[0.27]	[0.08]	[0.37]	[0.09]	[0.32]	[0.06]
Use of LPG: heating	0.66***	0.01	0.01	-0.03	0.30*	-0.03	0.59	0.11**	-0.1	0.08	-0.24	0.07
	[0.24]	[0.04]	[0.17]	[0.03]	[0.18]	[0.03]	[0.58]	[0.05]	[0.20]	[0.06]	[0.24]	[0.04]
Use of firewood: heating	-0.23	0.19***	-0.1	0.08*	-0.18	0.13**	0	0.19*	0.49	0.31***	-0.77	0.19*
	[0.16]	[0.05]	[0.15]	[0.04]	[0.16]	[0.05]	[0.28]	[0.10]	[0.43]	[0.11]	[0.48]	[0.11]
Use of organic: heating	-0.14	-0.16***	-0.02	-0.08**	0	-0.11***	0.61***	-0.33***	-0.25	-0.48***	0.56	-0.29***
	[0.10]	[0.03]	[0.10]	[0.04]	[0.10]	[0.04]	[0.21]	[0.08]	[0.21]	[0.10]	[0.47]	[0.08]
Use of electricity: others (score 1)	1.55***	0.60***	1.44***	0.57***	1.38***	0.62***	-0.05	0.06	-0.15	0.11	0.16	0.26***
	[0.07]	[0.04]	[0.09]	[0.04]	[0.07]	[0.03]	[0.14]	[0.07]	[0.16]	[0.07]	[0.15]	[0.06]
Use of electricity: others (score 2)	0.24***	0.47***	0.20***	0.50***	0.24***	0.46***	0.08	0.06**	0.02	0.05*	0.13	0.11***
	[0.09]	[0.02]	[0.07]	[0.02]	[0.06]	[0.02]	[0.10]	[0.02]	[0.10]	[0.03]	[0.11]	[0.02]
Use of LPG: cooking	-0.12	0.27***	-0.31**	0.24***	-0.07	0.26***	6.38***	2.45***	6.12***	-0.49***	6.63***	3.16***
	[0.13]	[0.04]	[0.13]	[0.04]	[0.14]	[0.03]	[0.44]	[0.08]	[0.38]	[0.14]	[0.75]	[0.39]
Constant	1.19***	3.61***	1.29***	3.24***	0.99***	2.96***	-2.34***	-0.41	-4.89***	3.15***	-3.25***	-0.77
	[0.32]	[0.43]	[0.34]	[0.41]	[0.27]	[0.40]	[0.58]	[0.75]	[0.58]	[0.79]	[0.81]	[0.82]
N	4714		4868		4836		4714		4868		4836	

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

Table 3A: Discrete/continuous estimates, charcoal and biomass

	Biomass						Charcoal			
	Balanced		Male-majority		Female-majority		Balanced		Male-majority	
	Probit	GLM	Probit	GLM	Probit	GLM	Probit	GLM	Probit	GLM
Weather variables										
HI deviation	-0.11**	0.28***	-0.08*	0.31***	-0.10**	0.18	-0.01	0.22***	-0.01	0.17***
	[0.06]	[0.11]	[0.05]	[0.12]	[0.05]	[0.12]	[0.03]	[0.06]	[0.03]	[0.05]
HI deviation^2	-0.06*	0.05	-0.01*	-0.04**	-0.01	0	0	0.02***	0	0.02***
	[0.03]	[0.06]	[0.01]	[0.02]	[0.01]	[0.02]	[0.00]	[0.01]	[0.00]	[0.01]
Prices										
Price of electricity		-0.05		0.2		0.12		0.43***		0.04
		[0.17]		[0.16]		[0.17]		[0.09]		[0.09]
Price of LPG		-0.07**		-0.05		-0.05		0.04**		0.04**
		[0.03]		[0.04]		[0.06]		[0.02]		[0.02]
Price of charcoal		-0.17***		-0.06**		-0.12**		-0.05***		-0.04*
		[0.04]		[0.03]		[0.05]		[0.02]		[0.02]
Price of others		-0.14*		-0.13**		-0.06		-0.02		0.16***
		[0.08]		[0.06]		[0.11]		[0.04]		[0.05]
Family income										
10,000 to 29,999		0.17		0.16		0.05		-0.11		-0.02
		[0.33]		[0.19]		[0.33]		[0.13]		[0.14]
30,000 to 59,999		0.07		0.85		1.1		-0.15		0.07
		[0.45]		[0.66]		[1.36]		[0.20]		[0.18]
60,000 to 99,999						-6.01***		0.02		2.11***
						[0.74]		[0.35]		[0.52]
100,000 and over								-0.32		0.44
								[0.51]		[0.38]
Household head characteristics										
Male	0.09	-0.87**	0.11	-1.30***	0.16*	0.2	-0.09	-0.01	0.05	-0.09
	[0.12]	[0.35]	[0.13]	[0.46]	[0.09]	[0.31]	[0.07]	[0.12]	[0.08]	[0.20]
Age	0.01	0.01	0	0	0	0.01	0	0	0	0
	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]
At least college	0.03	0.08	-0.11	0.11	-0.09	-0.39	-0.14**	0.19	-0.03	-0.37***
	[0.12]	[0.38]	[0.11]	[0.36]	[0.12]	[0.34]	[0.07]	[0.13]	[0.07]	[0.11]
Has a job	0.14	0.64*	0.2	1.25***	0.05	0.2	0.02	-0.02	-0.03	0.29*
	[0.13]	[0.33]	[0.13]	[0.38]	[0.13]	[0.43]	[0.08]	[0.14]	[0.08]	[0.16]
House attributes										
Total household members	0.03**	0.13***	0.02	-0.02	0.04**	0.04	0.04***	0.06***	0.05***	0.01

	[0.02]	[0.05]	[0.02]	[0.05]	[0.02]	[0.05]	[0.01]	[0.02]	[0.01]	[0.03]
Number of bedrooms	-0.04	-0.03	0.02	0.69***	-0.03	0.39**	-0.06	-0.07	-0.02	0.13*
	[0.05]	[0.13]	[0.05]	[0.12]	[0.05]	[0.15]	[0.04]	[0.07]	[0.03]	[0.07]
Number of bathrooms	-0.23**	0.27	-0.33***	-0.51**	-0.17*	-0.56**	-0.02	0.28**	-0.09	0.12
	[0.10]	[0.26]	[0.11]	[0.24]	[0.10]	[0.24]	[0.07]	[0.13]	[0.06]	[0.18]
Number of storeys	0.14	-0.53	0.15	-0.35	-0.19*	0.81*	0.04	-0.05	0.1	0.08
	[0.11]	[0.34]	[0.10]	[0.36]	[0.11]	[0.45]	[0.07]	[0.14]	[0.07]	[0.15]
Urban	-0.34***	0.58*	-0.49***	0.14	-0.46***	0.11	0.08	-0.18	0.20***	-0.56***
	[0.12]	[0.33]	[0.12]	[0.33]	[0.11]	[0.34]	[0.07]	[0.15]	[0.07]	[0.13]
Energy use										
Use of electricity: heating	0.18	-2.66***	0.16	-0.64	0.27	-1.54**	0.26**	0.41*	0.06	-0.51**
	[0.20]	[0.72]	[0.21]	[0.78]	[0.21]	[0.75]	[0.11]	[0.22]	[0.13]	[0.25]
Use of LPG: heating	0.04	-0.64*	-0.3	-0.42	0.32**	-0.15	0.12	-0.15	0.17**	0.17
	[0.18]	[0.36]	[0.20]	[0.57]	[0.15]	[0.67]	[0.08]	[0.16]	[0.08]	[0.14]
Use of firewood: heating	-0.43**	0.03	-0.43**	0.97*	-0.17	0.29	0.71***	0.88***	0.66***	0.4
	[0.19]	[0.62]	[0.18]	[0.55]	[0.15]	[0.45]	[0.13]	[0.23]	[0.14]	[0.32]
Use of organic: heating	0.16	-0.2	0.31***	-0.09	0.26**	-0.4	-0.35***	-0.18	-0.22*	0.16
	[0.12]	[0.34]	[0.12]	[0.22]	[0.11]	[0.28]	[0.11]	[0.21]	[0.12]	[0.29]
Use of electricity: others (score 1)	-0.07	-0.11	0	-0.38***	-0.10*	-0.16	0.19***	0.06	0.17***	0.1
	[0.05]	[0.14]	[0.05]	[0.14]	[0.06]	[0.19]	[0.05]	[0.10]	[0.06]	[0.08]
Use of electricity: others (score 2)	0	-0.32	0.01	-1.00***	-0.08	-0.68	0.14***	-0.04	0.14***	-0.23***
	[0.08]	[0.27]	[0.07]	[0.28]	[0.07]	[0.44]	[0.04]	[0.08]	[0.04]	[0.09]
Use of LPG: cooking	-0.36**	0.46	-0.29***	-0.22	-0.29**	-0.35	0.50***	-0.14	0.46***	-0.08
	[0.15]	[0.39]	[0.11]	[0.34]	[0.12]	[0.39]	[0.08]	[0.16]	[0.08]	[0.17]
Constant	-2.10***	12.06***	-2.07***	6.68*	-1.74***	6.38	-1.59***	-3.75*	-1.87***	-1.87
	[0.32]	[3.50]	[0.32]	[3.84]	[0.31]	[4.99]	[0.19]	[1.94]	[0.20]	[1.95]
N	4714		4868		4836		4714		4868	

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

Table 4A: Discrete/continuous estimates, fuelwood

	Balanced		Male-majority		Female-majority			Balanced		Male-majority		Female-majority	
	Probit	GLM	Probit	GLM	Probit	GLM		Probit	GLM	Probit	GLM	Probit	GLM
Weather variables							**House attributes**						
HI deviation	-0.09*	0.34***	0	0.05	-0.11*	0.07	Total household members	0.03*	-0.01	0.03	0.09	0.04**	0.08
	[0.05]	[0.09]	[0.05]	[0.10]	[0.06]	[0.17]		[0.02]	[0.04]	[0.02]	[0.06]	[0.02]	[0.07]
HI deviation^2	-0.01	0.03**	0	-0.01	-0.01*	0	Number of bedrooms	0.08	-0.04	0.10**	0.16	0	0.26
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]		[0.05]	[0.07]	[0.05]	[0.11]	[0.04]	[0.18]
Prices							Number of bathrooms	-0.02	-0.01	-0.02	-0.51**	-0.12	-0.14
Price of electricity		0.29**		-0.15		0.07		[0.09]	[0.18]	[0.09]	[0.22]	[0.09]	[0.30]

		[0.12]		[0.19]		[0.33]
Price of LPG		0.05		0.04		-0.05
		[0.03]		[0.03]		[0.05]
Price of charcoal		0.06		0		0
		[0.04]		[0.05]		[0.06]
Price of others		0.06		0.12		-0.3
		[0.08]		[0.10]		[0.20]
Family income						
10,000 to 29,999		-0.19		0.73***		0.19
		[0.31]		[0.28]		[0.34]
30,000 to 59,999		-0.4		1.17**		-0.3
		[0.35]		[0.54]		[0.62]
60,000 to 99,999		-1.11		0.78		-3.34**
		[0.69]		[0.55]		[1.69]
100,000 and over				-1.69**		-0.54
				[0.78]		[0.58]
Household head characteristics						
Male	-0.06	-0.21	0.19	0.34	-0.1	0.16
	[0.12]	[0.28]	[0.14]	[0.23]	[0.09]	[0.43]
Age	0	0.02*	0	0.01	0.01**	0.02
	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]
At least college	0.11	-0.19	0.01	-0.62**	-0.09	0.4
	[0.10]	[0.27]	[0.10]	[0.26]	[0.09]	[0.34]
Has a job	0.08	0.4	0.06	0.47	0.16	0.69*
	[0.11]	[0.41]	[0.13]	[0.38]	[0.11]	[0.39]
N	4714		4868		4836	

Number of storeys	-0.07	-0.76**	-0.04	0.11	0.04	0.4
	[0.11]	[0.36]	[0.10]	[0.28]	[0.10]	[0.62]
Urban	-0.15	-0.79**	-0.03	-0.35	-0.07	0.4
	[0.10]	[0.31]	[0.10]	[0.25]	[0.11]	[0.64]
Energy use						
Use of electricity: heating	0.02	-0.36	0.14	-0.41	0.48***	-0.62
	[0.17]	[0.46]	[0.18]	[0.49]	[0.14]	[0.47]
Use of LPG: heating	0.09	-0.26	-0.14	-0.41	0.26**	0
	[0.11]	[0.39]	[0.12]	[0.33]	[0.12]	[0.44]
Use of firewood: heating	0.17	-0.29	0.30*	0.66*	-0.02	-0.25
	[0.16]	[0.37]	[0.17]	[0.40]	[0.17]	[0.70]
Use of organic: heating	0.21	0.04	0.03	0.04	0.23*	0.87*
	[0.14]	[0.29]	[0.15]	[0.31]	[0.13]	[0.45]
Use of electricity: others (score 1)	-0.09	-0.03	0.06	0.15	0.14*	0.06
	[0.07]	[0.15]	[0.07]	[0.14]	[0.08]	[0.37]
Use of electricity: others (score 2)	-0.04	0.15	-0.11*	-0.23	-0.06	-0.25
	[0.06]	[0.16]	[0.06]	[0.19]	[0.05]	[0.24]
Use of LPG: cooking	0.53***	0.15	0.53***	-0.38	0.40***	-1.00**
	[0.12]	[0.37]	[0.11]	[0.28]	[0.12]	[0.48]
Constant	-2.41***	-3.31	-2.66***	-0.08	-2.75***	6.41
	[0.31]	[2.95]	[0.34]	[2.75]	[0.26]	[5.43]

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

Table 5A: Estimates of total consumption given different HI deviation, rural female head

Scenario 1: Base scenario§

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	54.12***	44.45***	60.50***	32.74***	33.23***	29.83***	1.87**	0.81**	2.11**	0.04	0.13	0.11	1.52	0.2	1.91
	[4.28]	[4.24]	[4.18]	[4.45]	[5.00]	[3.84]	[0.83]	[0.41]	[0.87]	[0.07]	[0.19]	[0.12]	[1.27]	[0.20]	[1.82]
HI=-3	55.10***	45.43***	60.72***	32.75***	32.53***	29.39***	1.99**	0.85**	2.22**	0.07	0.22	0.13	1.61	0.22	1.93
	[4.27]	[4.20]	[4.02]	[4.35]	[4.81]	[3.63]	[0.87]	[0.42]	[0.89]	[0.10]	[0.32]	[0.14]	[1.32]	[0.21]	[1.77]
HI=-2	56.37***	46.57***	61.43***	32.60***	31.20***	28.78***	2.20**	0.92**	2.38***	0.12	0.34	0.14	1.77	0.24	1.89
	[4.25]	[4.21]	[3.85]	[4.17]	[4.47]	[3.29]	[0.95]	[0.45]	[0.92]	[0.14]	[0.50]	[0.15]	[1.43]	[0.22]	[1.68]
HI=-1	57.95***	47.89***	62.66***	32.28***	29.32***	28.03***	2.55**	1.04**	2.56***	0.16	0.45	0.14	2.01	0.25	1.79
	[4.23]	[4.29]	[3.71]	[3.94]	[4.05]	[2.92]	[1.07]	[0.49]	[0.96]	[0.17]	[0.67]	[0.15]	[1.60]	[0.23]	[1.57]
HI=0	59.87***	49.37***	64.45***	31.81***	26.99***	27.15***	3.07**	1.20**	2.80***	0.18	0.53	0.14	2.35	0.26	1.63
	[4.28]	[4.49]	[3.67]	[3.75]	[3.66]	[2.69]	[1.27]	[0.55]	[1.04]	[0.19]	[0.80]	[0.15]	[1.87]	[0.23]	[1.46]
HI=1	62.14***	50.94***	66.82***	31.19***	24.34***	26.09***	3.86**	1.45**	3.09***	0.16	0.54	0.13	2.82	0.27	1.43
	[4.48]	[4.93]	[3.93]	[3.70]	[3.40]	[2.87]	[1.62]	[0.66]	[1.18]	[0.18]	[0.85]	[0.14]	[2.32]	[0.24]	[1.38]
HI=2	64.75***	52.45***	69.80***	30.42***	21.51***	24.84***	5.06**	1.80**	3.43**	0.12	0.48	0.12	3.46	0.28	1.19
	[4.97]	[5.74]	[4.70]	[3.90]	[3.33]	[3.51]	[2.27]	[0.86]	[1.45]	[0.15]	[0.79]	[0.13]	[3.08]	[0.25]	[1.32]
HI=3	67.64***	53.60***	73.41***	29.53***	18.61***	23.42***	6.92**	2.31*	3.86**	0.06	0.37	0.1	4.32	0.27	0.93
	[5.89]	[7.10]	[6.14]	[4.40]	[3.42]	[4.46]	[3.49]	[1.20]	[1.92]	[0.11]	[0.66]	[0.12]	[4.39]	[0.27]	[1.24]
HI=4	70.67***	53.93***	77.64***	28.51***	15.77***	21.88***	9.86*	3.07*	4.36	0.02	0.24	0.07	5.47	0.27	0.68
	[7.37]	[9.17]	[8.35]	[5.17]	[3.58]	[5.56]	[5.83]	[1.81]	[2.66]	[0.06]	[0.48]	[0.11]	[6.60]	[0.30]	[1.13]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 2: 25% increase in the price of electricity

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	50.57***	41.18***	55.96***	39.12***	35.16***	32.09***	3.09**	0.85**	2.47**	0.03	0.16	0.13	2.13	0.17	2.06
	[4.01]	[3.96]	[3.79]	[5.26]	[5.41]	[3.81]	[1.39]	[0.42]	[0.99]	[0.07]	[0.24]	[0.15]	[1.84]	[0.18]	[1.82]
HI=-3	51.49***	42.09***	56.16***	39.13***	34.42***	31.62***	3.29**	0.89**	2.61**	0.07	0.28	0.14	2.27	0.18	2.08
	[4.00]	[3.92]	[3.65]	[5.14]	[5.22]	[3.60]	[1.47]	[0.44]	[1.02]	[0.10]	[0.42]	[0.16]	[1.93]	[0.19]	[1.75]
HI=-2	52.68***	43.15***	56.82***	38.95***	33.01***	30.96***	3.65**	0.97**	2.78***	0.11	0.43	0.16	2.49	0.2	2.03
	[3.98]	[3.93]	[3.53]	[4.96]	[4.90]	[3.30]	[1.59]	[0.46]	[1.05]	[0.13]	[0.65]	[0.17]	[2.09]	[0.20]	[1.63]
HI=-1	54.16***	44.37***	57.96***	38.57***	31.02***	30.16***	4.22**	1.09**	3.00***	0.15	0.58	0.16	2.82	0.21	1.93
	[3.99]	[4.01]	[3.44]	[4.76]	[4.52]	[3.01]	[1.80]	[0.51]	[1.11]	[0.16]	[0.89]	[0.18]	[2.35]	[0.21]	[1.49]
HI=0	55.95***	45.74***	59.61***	38.01***	28.56***	29.21***	5.09**	1.26**	3.28***	0.17	0.68	0.16	3.3	0.22	1.76
	[4.06]	[4.21]	[3.48]	[4.63]	[4.17]	[2.95]	[2.15]	[0.58]	[1.21]	[0.18]	[1.06]	[0.18]	[2.76]	[0.21]	[1.35]
HI=1	58.07***	47.20***	61.80***	37.26***	25.76***	28.07***	6.39**	1.52**	3.62***	0.16	0.7	0.15	3.96	0.22	1.54
	[4.29]	[4.62]	[3.82]	[4.70]	[3.95]	[3.32]	[2.75]	[0.71]	[1.40]	[0.17]	[1.12]	[0.17]	[3.43]	[0.22]	[1.26]
HI=2	60.51***	48.59***	64.56***	36.35***	22.75***	26.72***	8.38**	1.88**	4.02**	0.12	0.62	0.13	4.85	0.23	1.28

	[4.80]	[5.38]	[4.62]	[5.05]	[3.90]	[4.12]	[3.84]	[0.92]	[1.74]	[0.15]	[1.05]	[0.16]	[4.54]	[0.23]	[1.22]
HI=3	63.21***	49.66***	67.90***	35.28***	19.69***	25.20***	11.45*	2.42*	4.52*	0.06	0.47	0.11	6.06	0.23	1
	[5.70]	[6.64]	[6.02]	[5.73]	[3.97]	[5.19]	[5.91]	[1.30]	[2.32]	[0.11]	[0.87]	[0.14]	[6.42]	[0.25]	[1.19]
HI=4	66.04***	49.97***	71.81***	34.06***	16.69***	23.54***	16.33*	3.22	5.11	0.02	0.3	0.08	7.67	0.22	0.74
	[7.11]	[8.56]	[8.11]	[6.68]	[4.10]	[6.37]	[9.85]	[1.97]	[3.21]	[0.06]	[0.63]	[0.13]	[9.59]	[0.27]	[1.11]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 3: 25% increase in the price of LPG

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	53.95***	46.55***	63.75***	29.15***	29.52***	25.54***	3.16**	1.18*	2.98**	0.03	0.08	0.05	2.03	0.34	1.07
	[4.80]	[4.73]	[5.11]	[4.20]	[4.91]	[3.30]	[1.59]	[0.62]	[1.29]	[0.06]	[0.13]	[0.07]	[1.90]	[0.35]	[1.03]
HI=-3	54.94***	47.59***	63.99***	29.21***	28.88***	25.16***	3.35**	1.24*	3.15**	0.05	0.15	0.06	2.13	0.37	1.09
	[4.77]	[4.68]	[4.94]	[4.08]	[4.73]	[3.13]	[1.65]	[0.64]	[1.32]	[0.08]	[0.23]	[0.08]	[1.95]	[0.37]	[1.00]
HI=-2	56.31***	48.90***	64.92***	28.91***	27.68***	24.61***	3.60**	1.34**	3.33**	0.08	0.24	0.07	2.31	0.4	1.06
	[4.74]	[4.70]	[4.79]	[3.87]	[4.42]	[2.92]	[1.73]	[0.68]	[1.36]	[0.10]	[0.36]	[0.09]	[2.07]	[0.39]	[0.94]
HI=-1	58.11***	50.51***	66.59***	28.26***	26.00***	23.92***	3.95**	1.49**	3.54**	0.1	0.33	0.07	2.58	0.42	1.01
	[4.74]	[4.79]	[4.71]	[3.61]	[4.05]	[2.72]	[1.85]	[0.73]	[1.42]	[0.12]	[0.48]	[0.09]	[2.29]	[0.40]	[0.86]
HI=0	60.36***	52.41***	69.04***	27.29***	23.92***	23.09***	4.41**	1.71**	3.78**	0.1	0.38	0.07	2.96	0.45	0.93
	[4.82]	[5.02]	[4.77]	[3.39]	[3.67]	[2.69]	[2.02]	[0.82]	[1.50]	[0.13]	[0.56]	[0.09]	[2.63]	[0.40]	[0.79]
HI=1	63.11***	54.53***	72.34***	26.02***	21.55***	22.09***	5.01**	2.01**	4.04**	0.1	0.37	0.07	3.5	0.47	0.81
	[5.09]	[5.51]	[5.18]	[3.30]	[3.37]	[2.95]	[2.32]	[0.96]	[1.67]	[0.12]	[0.57]	[0.08]	[3.18]	[0.41]	[0.73]
HI=2	66.37***	56.74***	76.58***	24.50***	19.02***	20.91***	5.80**	2.43**	4.33**	0.08	0.31	0.05	4.22	0.48	0.68
	[5.68]	[6.42]	[6.15]	[3.41]	[3.20]	[3.49]	[2.85]	[1.20]	[1.96]	[0.11]	[0.50]	[0.07]	[4.07]	[0.43]	[0.69]
HI=3	70.10***	58.71***	81.82***	22.79***	16.45***	19.58***	6.83*	3.02*	4.66*	0.04	0.22	0.04	5.18	0.49	0.53
	[6.74]	[7.96]	[7.90]	[3.72]	[3.15]	[4.23]	[3.77]	[1.61]	[2.44]	[0.08]	[0.37]	[0.06]	[5.55]	[0.47]	[0.65]
HI=4	74.18***	59.94***	88.14***	20.93***	13.92***	18.14***	8.2	3.86*	5	0.02	0.13	0.03	6.44	0.49	0.39
	[8.43]	[10.36]	[10.61]	[4.17]	[3.17]	[5.04]	[5.29]	[2.32]	[3.16]	[0.05]	[0.24]	[0.04]	[8.01]	[0.53]	[0.60]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

§The marginal effects are evaluated at the following profiles: means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1) and use of LPG to cook foods (=1) and at various HID values.

Table 6A: Estimates of total consumption given different HI deviation, urban female head

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
Scenario 1: Base scenario§															
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	72.18***	61.26***	77.16***	34.70***	37.40***	30.01***	1.72**	0.62**	1.75**	0.02	0.04	0.05	0.53	0.13	2.59
	[6.02]	[6.40]	[5.23]	[4.74]	[5.68]	[3.93]	[0.79]	[0.31]	[0.70]	[0.05]	[0.06]	[0.06]	[0.45]	[0.14]	[2.43]
HI=-3	73.72***	62.75***	77.51***	34.71***	36.59***	29.42***	1.83**	0.65**	1.85**	0.06	0.07	0.05	0.56	0.14	2.61
	[5.98]	[6.34]	[5.03]	[4.63]	[5.48]	[3.74]	[0.83]	[0.31]	[0.72]	[0.09]	[0.11]	[0.06]	[0.47]	[0.15]	[2.34]
HI=-2	75.51***	64.35***	78.45***	34.54***	35.08***	28.76***	2.03**	0.71**	1.97***	0.09	0.1	0.06	0.61	0.16	2.54
	[5.94]	[6.37]	[4.83]	[4.43]	[5.10]	[3.39]	[0.90]	[0.33]	[0.74]	[0.12]	[0.16]	[0.07]	[0.50]	[0.16]	[2.14]
HI=-1	77.60***	66.08***	80.01***	34.20***	32.95***	28.06***	2.35**	0.79**	2.13***	0.13	0.14	0.06	0.69	0.16	2.4
	[5.92]	[6.51]	[4.67]	[4.18]	[4.62]	[2.96]	[1.00]	[0.36]	[0.77]	[0.15]	[0.22]	[0.07]	[0.56]	[0.16]	[1.88]
HI=0	80.01***	67.89***	82.24***	33.69***	30.32***	27.31***	2.83**	0.92**	2.33***	0.14	0.15	0.05	0.8	0.17	2.18
	[6.01]	[6.86]	[4.66]	[3.95]	[4.16]	[2.62]	[1.17]	[0.41]	[0.83]	[0.17]	[0.25]	[0.06]	[0.64]	[0.16]	[1.60]
HI=1	82.69***	69.64***	85.15***	33.02***	27.33***	26.40***	3.56**	1.11**	2.58***	0.13	0.15	0.05	0.94	0.18	1.89
	[6.34]	[7.56]	[5.05]	[3.86]	[3.85]	[2.68]	[1.46]	[0.49]	[0.94]	[0.15]	[0.26]	[0.06]	[0.77]	[0.17]	[1.38]
HI=2	85.54***	71.05***	88.76***	32.20***	24.12***	25.27***	4.67**	1.38**	2.88**	0.08	0.13	0.04	1.14	0.18	1.56
	[7.12]	[8.82]	[6.10]	[4.04]	[3.76]	[3.29]	[1.98]	[0.63]	[1.15]	[0.12]	[0.23]	[0.05]	[0.99]	[0.17]	[1.27]
HI=3	88.32***	71.64***	93.05***	31.22***	20.86***	23.91***	6.39**	1.77**	3.25**	0.04	0.09	0.03	1.4	0.18	1.21
	[8.57]	[10.87]	[8.03]	[4.54]	[3.85]	[4.28]	[2.99]	[0.88]	[1.53]	[0.08]	[0.18]	[0.04]	[1.38]	[0.18]	[1.23]
HI=4	90.59***	70.71***	97.90***	30.11***	17.66***	22.37***	9.11*	2.36*	3.69*	0.01	0.05	0.02	1.74	0.18	0.88
	[10.93]	[13.87]	[10.97]	[5.33]	[4.02]	[5.43]	[4.97]	[1.32]	[2.14]	[0.03]	[0.12]	[0.04]	[2.05]	[0.20]	[1.16]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836
Scenario 2: 25% increase in the price of electricity															
	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	67.45***	56.75***	71.36***	41.46***	39.57***	32.29***	2.84**	0.65**	2.05**	0.02	0.05	0.05	0.74	0.11	2.79
	[5.73]	[6.00]	[4.94]	[5.64]	[6.25]	[4.04]	[1.34]	[0.32]	[0.81]	[0.05]	[0.08]	[0.07]	[0.66]	[0.12]	[2.90]
HI=-3	68.89***	58.14***	71.69***	41.47***	38.72***	31.65***	3.03**	0.68**	2.16***	0.05	0.09	0.06	0.79	0.12	2.81
	[5.69]	[5.95]	[4.77]	[5.51]	[6.04]	[3.86]	[1.41]	[0.33]	[0.84]	[0.08]	[0.14]	[0.08]	[0.69]	[0.13]	[2.81]
HI=-2	70.56***	59.62***	72.56***	41.27***	37.12***	30.94***	3.36**	0.74**	2.31***	0.09	0.13	0.06	0.86	0.13	2.74
	[5.67]	[5.98]	[4.63]	[5.31]	[5.68]	[3.55]	[1.52]	[0.35]	[0.87]	[0.12]	[0.22]	[0.08]	[0.74]	[0.14]	[2.58]
HI=-1	72.52***	61.22***	74.01***	40.86***	34.86***	30.19***	3.89**	0.83**	2.50***	0.12	0.17	0.07	0.97	0.14	2.58
	[5.69]	[6.12]	[4.55]	[5.08]	[5.24]	[3.20]	[1.71]	[0.38]	[0.92]	[0.15]	[0.29]	[0.08]	[0.82]	[0.14]	[2.26]
HI=0	74.77***	62.90***	76.07***	40.26***	32.08***	29.38***	4.69**	0.96**	2.73***	0.13	0.2	0.06	1.12	0.14	2.35
	[5.81]	[6.45]	[4.65]	[4.91]	[4.82]	[3.02]	[2.00]	[0.44]	[1.00]	[0.16]	[0.34]	[0.08]	[0.94]	[0.15]	[1.89]
HI=1	77.27***	64.52***	78.76***	39.45***	28.91***	28.41***	5.90**	1.16**	3.02***	0.12	0.19	0.06	1.32	0.15	2.04
	[6.18]	[7.11]	[5.13]	[4.94]	[4.55]	[3.27]	[2.50]	[0.53]	[1.15]	[0.15]	[0.34]	[0.07]	[1.14]	[0.15]	[1.58]

HI=2	79.94***	65.82***	82.10***	38.47***	25.53***	27.19***	7.74**	1.44**	3.37**	0.08	0.16	0.05	1.6	0.15	1.68
	[6.95]	[8.28]	[6.19]	[5.28]	[4.45]	[4.02]	[3.41]	[0.68]	[1.42]	[0.12]	[0.30]	[0.06]	[1.47]	[0.16]	[1.38]
HI=3	82.54***	66.37***	86.06***	37.30***	22.07***	25.72***	10.58**	1.86*	3.80**	0.04	0.12	0.04	1.96	0.15	1.31
	[8.33]	[10.17]	[8.02]	[5.96]	[4.51]	[5.09]	[5.14]	[0.96]	[1.89]	[0.07]	[0.24]	[0.05]	[2.04]	[0.17]	[1.29]
HI=4	84.66***	65.51***	90.55***	35.98***	18.69***	24.06***	15.08*	2.47*	4.32*	0.01	0.07	0.03	2.44	0.15	0.95
	[10.55]	[12.94]	[10.76]	[6.94]	[4.63]	[6.30]	[8.49]	[1.45]	[2.63]	[0.03]	[0.16]	[0.04]	[2.99]	[0.18]	[1.21]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 3: 25% increase in the price of LPG

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	73.24***	65.57***	83.72***	29.89***	32.87***	25.21***	2.54*	0.86**	2.32**	0.02	0.02	0.02	0.64	0.23	1.37
	[6.80]	[7.19]	[6.52]	[4.39]	[5.43]	[3.38]	[1.30]	[0.44]	[0.97]	[0.04]	[0.04]	[0.03]	[0.61]	[0.25]	[1.32]
HI=-3	74.80***	67.19***	84.11***	29.96***	32.15***	24.72***	2.69**	0.91**	2.44**	0.04	0.04	0.03	0.67	0.25	1.39
	[6.73]	[7.12]	[6.28]	[4.27]	[5.23]	[3.22]	[1.35]	[0.45]	[1.00]	[0.07]	[0.07]	[0.03]	[0.62]	[0.27]	[1.28]
HI=-2	76.77***	69.07***	85.38***	29.65***	30.80***	24.14***	2.90**	0.98**	2.59**	0.06	0.06	0.03	0.72	0.27	1.35
	[6.68]	[7.16]	[6.07]	[4.04]	[4.88]	[2.97]	[1.41]	[0.48]	[1.02]	[0.09]	[0.10]	[0.04]	[0.65]	[0.28]	[1.18]
HI=-1	79.19***	71.24***	87.55***	28.98***	28.91***	23.50***	3.18**	1.09**	2.76***	0.08	0.09	0.03	0.8	0.29	1.28
	[6.69]	[7.32]	[5.93]	[3.74]	[4.44]	[2.70]	[1.49]	[0.52]	[1.06]	[0.10]	[0.13]	[0.04]	[0.71]	[0.29]	[1.04]
HI=0	82.09***	73.67***	90.72***	27.97***	26.58***	22.79***	3.55**	1.25**	2.95***	0.08	0.1	0.03	0.91	0.31	1.17
	[6.83]	[7.73]	[5.98]	[3.46]	[4.00]	[2.53]	[1.61]	[0.58]	[1.12]	[0.11]	[0.15]	[0.03]	[0.80]	[0.29]	[0.89]
HI=1	85.47***	76.20***	94.93***	26.66***	23.94***	21.94***	4.04**	1.47**	3.16**	0.07	0.09	0.02	1.06	0.32	1.02
	[7.25]	[8.53]	[6.49]	[3.30]	[3.65]	[2.67]	[1.80]	[0.67]	[1.23]	[0.10]	[0.15]	[0.03]	[0.94]	[0.29]	[0.77]
HI=2	89.24***	78.56***	100.27***	25.09***	21.12***	20.88***	4.67**	1.78**	3.40**	0.05	0.07	0.02	1.25	0.33	0.84
	[8.15]	[9.98]	[7.76]	[3.35]	[3.44]	[3.16]	[2.16]	[0.84]	[1.44]	[0.08]	[0.12]	[0.02]	[1.18]	[0.30]	[0.69]
HI=3	93.16***	80.20***	106.79***	23.32***	18.24***	19.61***	5.51**	2.21**	3.67**	0.02	0.05	0.01	1.52	0.33	0.66
	[9.80]	[12.36]	[10.11]	[3.64]	[3.39]	[3.89]	[2.81]	[1.11]	[1.81]	[0.05]	[0.09]	[0.02]	[1.59]	[0.33]	[0.66]
HI=4	96.79***	80.31***	114.45***	21.39***	15.43***	18.20***	6.61*	2.84*	3.96*	0.01	0.03	0.01	1.85	0.34	0.48
	[12.47]	[15.92]	[13.76]	[4.07]	[3.42]	[4.72]	[3.92]	[1.60]	[2.36]	[0.02]	[0.05]	[0.01]	[2.26]	[0.37]	[0.62]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

§The marginal effects are evaluated at the following profiles: means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1) and use of LPG to cook foods (=1) and at various HID values.

Table 7A: Estimates of total consumption given different HI deviation, rural male head

Scenario 1: Base scenario§

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male majority	Female-majority	Balance	Male majority	Female-majority
HI=-4	54.41***	41.11***	61.47***	31.09***	29.76***	31.74***	1.63**	0.81**	2.83***	0.02	0.04	0.18	1.1	0.42	1.95
	[4.18]	[3.94]	[4.26]	[3.98]	[4.17]	[4.06]	[0.71]	[0.35]	[1.09]	[0.03]	[0.06]	[0.19]	[0.88]	[0.37]	[1.71]
HI=-3	55.41***	42.10***	61.75***	31.10***	29.16***	31.24***	1.73**	0.85**	2.98***	0.04	0.08	0.21	1.17	0.46	1.96
	[4.16]	[3.88]	[4.08]	[3.87]	[3.99]	[3.84]	[0.74]	[0.36]	[1.11]	[0.05]	[0.11]	[0.21]	[0.92]	[0.39]	[1.66]
HI=-2	56.69***	43.18***	62.50***	30.95***	28.01***	30.58***	1.92**	0.92**	3.19***	0.06	0.12	0.23	1.28	0.5	1.91
	[4.12]	[3.89]	[3.90]	[3.68]	[3.67]	[3.48]	[0.80]	[0.38]	[1.15]	[0.06]	[0.16]	[0.23]	[0.99]	[0.41]	[1.57]
HI=-1	58.28***	44.34***	63.75***	30.65***	26.36***	29.80***	2.22**	1.03**	3.44***	0.08	0.16	0.24	1.44	0.53	1.8
	[4.08]	[3.98]	[3.74]	[3.46]	[3.29]	[3.06]	[0.90]	[0.41]	[1.20]	[0.08]	[0.22]	[0.24]	[1.10]	[0.41]	[1.44]
HI=0	60.20***	45.56***	65.52***	30.21***	24.31***	28.88***	2.67**	1.20**	3.77***	0.09	0.19	0.24	1.68	0.56	1.63
	[4.11]	[4.22]	[3.70]	[3.27]	[2.93]	[2.80]	[1.06]	[0.47]	[1.29]	[0.09]	[0.27]	[0.23]	[1.26]	[0.41]	[1.32]
HI=1	62.47***	46.75***	67.85***	29.62***	21.97***	27.79***	3.36**	1.44***	4.16***	0.09	0.2	0.23	2	0.57	1.41
	[4.29]	[4.70]	[3.97]	[3.23]	[2.71]	[2.96]	[1.35]	[0.56]	[1.48]	[0.08]	[0.29]	[0.22]	[1.53]	[0.42]	[1.23]
HI=2	65.05***	47.71***	70.73***	28.90***	19.46***	26.49***	4.40**	1.79**	4.64**	0.07	0.18	0.2	2.44	0.58	1.16
	[4.78]	[5.56]	[4.78]	[3.45]	[2.69]	[3.64]	[1.90]	[0.73]	[1.84]	[0.07]	[0.27]	[0.21]	[2.00]	[0.44]	[1.17]
HI=3	67.90***	48.14***	74.16***	28.05***	16.88***	24.99***	6.02**	2.30**	5.23**	0.04	0.14	0.17	3.03	0.58	0.9
	[5.71]	[6.92]	[6.28]	[3.97]	[2.81]	[4.68]	[2.96]	[1.04]	[2.47]	[0.06]	[0.23]	[0.20]	[2.83]	[0.49]	[1.11]
HI=4	70.83***	47.55***	78.05***	27.09***	14.35***	23.35***	8.58*	3.06*	5.94*	0.01	0.09	0.14	3.8	0.57	0.65
	[7.22]	[8.90]	[8.59]	[4.74]	[3.00]	[5.86]	[5.00]	[1.63]	[3.48]	[0.03]	[0.17]	[0.18]	[4.27]	[0.56]	[1.01]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 2: 25% increase in the price of electricity

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male majority	Female-majority
HI=-4	50.84***	38.08***	56.86***	37.14***	31.49***	34.15***	2.70**	0.85**	3.31***	0.02	0.06	0.21	1.54	0.35	2.1
	[3.95]	[3.68]	[3.89]	[4.73]	[4.46]	[4.05]	[1.19]	[0.37]	[1.27]	[0.03]	[0.08]	[0.22]	[1.28]	[0.33]	[1.75]
HI=-3	51.78***	39.01***	57.11***	37.15***	30.86***	33.61***	2.87**	0.89**	3.50***	0.04	0.1	0.24	1.64	0.38	2.11
	[3.93]	[3.63]	[3.73]	[4.61]	[4.28]	[3.83]	[1.25]	[0.38]	[1.31]	[0.05]	[0.14]	[0.25]	[1.33]	[0.35]	[1.68]
HI=-2	52.97***	40.00***	57.80***	36.98***	29.63***	32.89***	3.18**	0.96**	3.74***	0.06	0.15	0.26	1.79	0.41	2.06
	[3.90]	[3.64]	[3.59]	[4.42]	[3.99]	[3.51]	[1.35]	[0.40]	[1.35]	[0.06]	[0.22]	[0.27]	[1.44]	[0.37]	[1.55]
HI=-1	54.46***	41.08***	58.96***	36.62***	27.89***	32.06***	3.67**	1.08**	4.04***	0.08	0.21	0.27	2.03	0.44	1.94
	[3.89]	[3.73]	[3.50]	[4.22]	[3.64]	[3.19]	[1.52]	[0.44]	[1.43]	[0.07]	[0.30]	[0.28]	[1.60]	[0.38]	[1.39]
HI=0	56.26***	42.22***	60.60***	36.09***	25.73***	31.07***	4.42**	1.26**	4.41***	0.09	0.25	0.27	2.36	0.46	1.75
	[3.95]	[3.95]	[3.54]	[4.10]	[3.34]	[3.09]	[1.80]	[0.51]	[1.57]	[0.08]	[0.36]	[0.27]	[1.85]	[0.38]	[1.23]
HI=1	58.37***	43.31***	62.75***	35.39***	23.25***	29.90***	5.56**	1.51**	4.88***	0.08	0.25	0.26	2.81	0.47	1.52
	[4.17]	[4.41]	[3.89]	[4.18]	[3.17]	[3.47]	[2.30]	[0.61]	[1.82]	[0.07]	[0.39]	[0.26]	[2.25]	[0.39]	[1.13]
HI=2	60.79***	44.21***	65.42***	34.53***	20.59***	28.49***	7.29**	1.87**	5.44**	0.06	0.23	0.23	3.43	0.48	1.25
	[4.67]	[5.20]	[4.72]	[4.55]	[3.17]	[4.32]	[3.24]	[0.81]	[2.29]	[0.07]	[0.37]	[0.25]	[2.94]	[0.41]	[1.09]
HI=3	63.45***	44.60***	68.59***	33.51***	17.86***	26.88***	9.96**	2.41**	6.13**	0.03	0.17	0.2	4.25	0.48	0.97
	[5.58]	[6.47]	[6.17]	[5.24]	[3.30]	[5.46]	[5.03]	[1.17]	[3.06]	[0.05]	[0.31]	[0.23]	[4.14]	[0.45]	[1.06]
HI=4	66.19***	44.06***	72.19***	32.37***	15.18***	25.12***	14.20*	3.20*	6.96	0.01	0.11	0.15	5.34	0.47	0.7
	[7.02]	[8.29]	[8.34]	[6.19]	[3.45]	[6.73]	[8.47]	[1.81]	[4.27]	[0.03]	[0.23]	[0.22]	[6.19]	[0.51]	[1.00]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 3: 25% increase in the price of LPG

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	54.40***	43.39***	65.04***	27.83***	26.43***	27.08***	2.55**	1.19**	3.99**	0.02	0.02	0.1	1.36	0.7	1.1
	[4.73]	[4.43]	[5.22]	[3.86]	[4.10]	[3.54]	[1.25]	[0.55]	[1.65]	[0.04]	[0.03]	[0.13]	[1.21]	[0.64]	[0.93]
HI=-3	55.41***	44.46***	65.35***	27.89***	25.88***	26.65***	2.69**	1.25**	4.21**	0.03	0.04	0.12	1.42	0.76	1.1
	[4.68]	[4.37]	[5.02]	[3.74]	[3.94]	[3.37]	[1.30]	[0.56]	[1.69]	[0.04]	[0.06]	[0.15]	[1.24]	[0.69]	[0.90]
HI=-2	56.80***	45.70***	66.32***	27.60***	24.85***	26.06***	2.89**	1.35**	4.46**	0.05	0.07	0.14	1.54	0.83	1.08
	[4.64]	[4.38]	[4.86]	[3.53]	[3.66]	[3.13]	[1.36]	[0.59]	[1.74]	[0.05]	[0.09]	[0.17]	[1.31]	[0.71]	[0.83]
HI=-1	58.61***	47.14***	68.02***	26.98***	23.37***	25.34***	3.17**	1.50**	4.74***	0.06	0.09	0.15	1.71	0.88	1.02
	[4.62]	[4.48]	[4.75]	[3.28]	[3.32]	[2.91]	[1.43]	[0.64]	[1.81]	[0.06]	[0.13]	[0.17]	[1.44]	[0.72]	[0.74]
HI=0	60.88***	48.75***	70.48***	26.05***	21.54***	24.48***	3.53**	1.71**	5.07***	0.06	0.11	0.14	1.96	0.93	0.92
	[4.67]	[4.74]	[4.81]	[3.06]	[2.99]	[2.85]	[1.56]	[0.71]	[1.92]	[0.07]	[0.15]	[0.17]	[1.63]	[0.73]	[0.66]
HI=1	63.63***	50.44***	73.76***	24.84***	19.45***	23.45***	4.01**	2.02**	5.44**	0.06	0.11	0.13	2.3	0.97	0.8
	[4.92]	[5.28]	[5.22]	[2.98]	[2.74]	[3.09]	[1.78]	[0.83]	[2.13]	[0.06]	[0.15]	[0.15]	[1.95]	[0.74]	[0.60]
HI=2	66.87***	52.02***	77.92***	23.40***	17.21***	22.22***	4.64**	2.44**	5.85**	0.05	0.09	0.11	2.76	0.99	0.66
	[5.49]	[6.23]	[6.23]	[3.12]	[2.62]	[3.65]	[2.19]	[1.05]	[2.52]	[0.06]	[0.14]	[0.13]	[2.47]	[0.77]	[0.57]
HI=3	70.57***	53.14***	82.99***	21.76***	14.92***	20.82***	5.47*	3.04**	6.30**	0.03	0.07	0.09	3.36	1.01	0.51
	[6.55]	[7.79]	[8.04]	[3.45]	[2.62]	[4.43]	[2.91]	[1.43]	[3.16]	[0.05]	[0.10]	[0.11]	[3.36]	[0.85]	[0.56]
HI=4	74.57***	53.26***	88.97***	19.99***	12.67***	19.30***	6.57	3.89*	6.79*	0.01	0.04	0.06	4.15	1.01	0.37
	[8.27]	[10.09]	[10.86]	[3.90]	[2.67]	[5.30]	[4.13]	[2.11]	[4.12]	[0.03]	[0.07]	[0.09]	[4.86]	[0.98]	[0.52]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

§The marginal effects are evaluated at the following profiles: means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1) and use of LPG to cook foods (=1) and at various HID values.

Table 8A: Estimates of total consumption given different HI deviation, urban male head

Scenario 1: Base scenario§															
	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	72.36***	55.97***	77.96***	32.97***	33.52***	31.81***	1.51**	0.61**	2.33***	0.01	0.01	0.08	0.38	0.28	2.63
	[5.72]	[6.09]	[5.39]	[4.26]	[4.73]	[4.22]	[0.68]	[0.26]	[0.88]	[0.03]	[0.02]	[0.10]	[0.33]	[0.26]	[2.62]
HI=-3	73.94***	57.50***	78.42***	32.98***	32.85***	31.12***	1.60**	0.64**	2.46***	0.03	0.03	0.09	0.4	0.31	2.64
	[5.64]	[6.02]	[5.15]	[4.15]	[4.53]	[4.03]	[0.72]	[0.27]	[0.90]	[0.04]	[0.04]	[0.11]	[0.34]	[0.28]	[2.54]
HI=-2	75.75***	58.99***	79.42***	32.82***	31.54***	30.39***	1.78**	0.70**	2.63***	0.05	0.04	0.1	0.44	0.33	2.56
	[5.56]	[6.05]	[4.93]	[3.94]	[4.17]	[3.66]	[0.77]	[0.29]	[0.93]	[0.06]	[0.06]	[0.11]	[0.36]	[0.29]	[2.35]
HI=-1	77.85***	60.48***	80.99***	32.50***	29.67***	29.68***	2.06**	0.78**	2.85***	0.07	0.05	0.1	0.49	0.35	2.4
	[5.51]	[6.22]	[4.75]	[3.68]	[3.72]	[3.18]	[0.86]	[0.31]	[0.97]	[0.07]	[0.08]	[0.11]	[0.40]	[0.29]	[2.06]
HI=0	80.23***	61.88***	83.17***	32.02***	27.36***	28.94***	2.48**	0.91***	3.12***	0.07	0.06	0.1	0.56	0.37	2.16
	[5.57]	[6.60]	[4.76]	[3.45]	[3.31]	[2.78]	[0.99]	[0.35]	[1.04]	[0.08]	[0.09]	[0.11]	[0.44]	[0.29]	[1.74]
HI=1	82.87***	63.03***	85.96***	31.39***	24.72***	28.05***	3.12**	1.09***	3.46***	0.07	0.06	0.09	0.66	0.38	1.86
	[5.90]	[7.34]	[5.18]	[3.37]	[3.04]	[2.80]	[1.23]	[0.42]	[1.19]	[0.07]	[0.09]	[0.10]	[0.52]	[0.29]	[1.46]
HI=2	85.62***	63.61***	89.34***	30.62***	21.88***	26.91***	4.09**	1.36**	3.87***	0.05	0.05	0.08	0.8	0.38	1.51
	[6.72]	[8.60]	[6.31]	[3.57]	[3.00]	[3.44]	[1.68]	[0.54]	[1.47]	[0.06]	[0.08]	[0.09]	[0.66]	[0.30]	[1.28]
HI=3	88.24***	63.15***	93.24***	29.70***	18.97***	25.49***	5.59**	1.75**	4.38**	0.02	0.04	0.06	0.97	0.38	1.16
	[8.26]	[10.53]	[8.35]	[4.09]	[3.14]	[4.49]	[2.56]	[0.76]	[1.98]	[0.04]	[0.07]	[0.08]	[0.90]	[0.33]	[1.19]
HI=4	90.26***	61.01***	97.47***	28.67***	16.12***	23.87***	7.96*	2.33**	5.00*	0.01	0.02	0.04	1.2	0.38	0.83
	[10.77]	[13.21]	[11.42]	[4.90]	[3.34]	[5.73]	[4.29]	[1.18]	[2.80]	[0.02]	[0.05]	[0.07]	[1.33]	[0.37]	[1.09]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836
Scenario 2: 25% increase in the price of electricity															
	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	67.62***	51.86***	72.11***	39.39***	35.47***	34.22***	2.50**	0.64**	2.73***	0.01	0.02	0.1	0.53	0.23	2.83
	[5.50]	[5.72]	[5.11]	[5.10]	[5.16]	[4.36]	[1.16]	[0.28]	[1.05]	[0.03]	[0.03]	[0.12]	[0.47]	[0.23]	[3.16]
HI=-3	69.10***	53.27***	72.53***	39.40***	34.75***	33.48***	2.66**	0.67**	2.89***	0.03	0.03	0.11	0.56	0.25	2.84
	[5.43]	[5.65]	[4.91]	[4.97]	[4.96]	[4.19]	[1.22]	[0.29]	[1.08]	[0.04]	[0.05]	[0.13]	[0.49]	[0.24]	[3.07]
HI=-2	70.79***	54.66***	73.46***	39.22***	33.37***	32.69***	2.95**	0.73**	3.09***	0.05	0.05	0.11	0.61	0.27	2.76
	[5.38]	[5.68]	[4.75]	[4.76]	[4.62]	[3.86]	[1.31]	[0.30]	[1.13]	[0.05]	[0.08]	[0.13]	[0.53]	[0.26]	[2.84]
HI=-1	72.75***	56.03***	74.91***	38.83***	31.40***	31.93***	3.41**	0.82**	3.34***	0.06	0.07	0.12	0.69	0.29	2.58
	[5.37]	[5.84]	[4.66]	[4.53]	[4.22]	[3.47]	[1.46]	[0.33]	[1.19]	[0.07]	[0.10]	[0.13]	[0.58]	[0.26]	[2.49]
HI=0	74.98***	57.33***	76.92***	38.26***	28.95***	31.13***	4.11**	0.95**	3.66***	0.07	0.07	0.11	0.79	0.3	2.33
	[5.47]	[6.21]	[4.77]	[4.37]	[3.86]	[3.23]	[1.71]	[0.38]	[1.30]	[0.07]	[0.12]	[0.13]	[0.65]	[0.27]	[2.09]
HI=1	77.44***	58.39***	79.50***	37.51***	26.15***	30.17***	5.16**	1.14**	4.05***	0.06	0.07	0.1	0.93	0.31	2
	[5.83]	[6.89]	[5.28]	[4.41]	[3.64]	[3.45]	[2.13]	[0.46]	[1.51]	[0.07]	[0.13]	[0.12]	[0.77]	[0.27]	[1.71]
HI=2	80.01***	58.93***	82.63***	36.58***	23.15***	28.95***	6.77**	1.42**	4.54**	0.04	0.06	0.09	1.12	0.32	1.63
	[6.64]	[8.06]	[6.40]	[4.76]	[3.61]	[4.23]	[2.91]	[0.60]	[1.88]	[0.06]	[0.11]	[0.10]	[0.97]	[0.28]	[1.44]
HI=3	82.46***	58.51***	86.24***	35.49***	20.07***	27.42***	9.25**	1.83**	5.13**	0.02	0.05	0.07	1.37	0.32	1.25
	[8.11]	[9.84]	[8.32]	[5.46]	[3.73]	[5.37]	[4.41]	[0.86]	[2.50]	[0.04]	[0.09]	[0.09]	[1.33]	[0.30]	[1.27]
HI=4	84.34***	56.52***	90.16***	34.25***	17.05***	25.67***	13.18*	2.44*	5.85*	0.01	0.03	0.05	1.68	0.31	0.89
	[10.44]	[12.32]	[11.17]	[6.44]	[3.89]	[6.67]	[7.35]	[1.33]	[3.49]	[0.02]	[0.06]	[0.08]	[1.94]	[0.34]	[1.15]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

Scenario 3: 25% increase in the price of LPG

	Electricity			LPG			Charcoal			Biomass			Fuelwood		
	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority	Balanced	Male-majority	Female-majority
HI=-4	73.64***	60.39***	84.93***	28.56***	29.46***	26.63***	2.06**	0.86**	3.08**	0.01	0.01	0.04	0.43	0.48	1.39
	[6.52]	[6.89]	[6.69]	[4.04]	[4.53]	[3.66]	[1.04]	[0.38]	[1.24]	[0.03]	[0.01]	[0.06]	[0.39]	[0.47]	[1.35]
HI=-3	75.25***	62.06***	85.46***	28.62***	28.85***	26.06***	2.17**	0.90**	3.25**	0.02	0.01	0.05	0.44	0.53	1.4
	[6.42]	[6.81]	[6.41]	[3.92]	[4.34]	[3.51]	[1.08]	[0.40]	[1.27]	[0.04]	[0.02]	[0.07]	[0.40]	[0.50]	[1.32]
HI=-2	77.24***	63.82***	86.79***	28.32***	27.68***	25.42***	2.34**	0.98**	3.45***	0.04	0.02	0.06	0.47	0.57	1.36
	[6.34]	[6.85]	[6.17]	[3.68]	[4.02]	[3.25]	[1.12]	[0.42]	[1.30]	[0.05]	[0.03]	[0.07]	[0.42]	[0.52]	[1.21]
HI=-1	79.67***	65.72***	88.99***	27.69***	26.03***	24.77***	2.56**	1.09**	3.67***	0.05	0.03	0.06	0.52	0.61	1.28
	[6.30]	[7.04]	[6.01]	[3.39]	[3.62]	[2.93]	[1.18]	[0.45]	[1.35]	[0.05]	[0.04]	[0.07]	[0.45]	[0.53]	[1.06]
HI=0	82.57***	67.67***	92.12***	26.73***	23.98***	24.07***	2.86**	1.24**	3.93***	0.05	0.03	0.06	0.59	0.64	1.16
	[6.40]	[7.48]	[6.06]	[3.12]	[3.23]	[2.72]	[1.26]	[0.50]	[1.42]	[0.06]	[0.04]	[0.07]	[0.50]	[0.53]	[0.88]
HI=1	85.91***	69.51***	96.23***	25.48***	21.65***	23.22***	3.25**	1.46**	4.23***	0.05	0.03	0.05	0.69	0.67	1
	[6.80]	[8.32]	[6.60]	[2.97]	[2.93]	[2.82]	[1.40]	[0.58]	[1.57]	[0.05]	[0.04]	[0.06]	[0.59]	[0.53]	[0.73]
HI=2	89.59***	70.89***	101.34***	23.99***	19.15***	22.15***	3.76**	1.77**	4.56**	0.03	0.02	0.04	0.81	0.69	0.82
	[7.73]	[9.78]	[7.95]	[3.05]	[2.79]	[3.31]	[1.68]	[0.73]	[1.84]	[0.04]	[0.04]	[0.05]	[0.73]	[0.55]	[0.64]
HI=3	93.35***	71.26***	107.45***	22.30***	16.59***	20.84***	4.44**	2.21**	4.94**	0.02	0.01	0.03	0.98	0.7	0.63
	[9.45]	[12.05]	[10.42]	[3.35]	[2.78]	[4.08]	[2.19]	[0.98]	[2.32]	[0.03]	[0.03]	[0.04]	[0.97]	[0.59]	[0.60]
HI=4	96.72***	69.84***	114.42***	20.47***	14.08***	19.35***	5.33*	2.83*	5.35*	0.01	0.01	0.02	1.18	0.7	0.45
	[12.26]	[15.26]	[14.25]	[3.80]	[2.86]	[4.97]	[3.08]	[1.45]	[3.06]	[0.02]	[0.02]	[0.03]	[1.37]	[0.67]	[0.56]
N	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836	4714	4868	4836

***/**/* Significant at 1/5/10%. Figures in parentheses are standard errors. Standard errors are clustered around the enumeration area. Estimates are weighted.

§The marginal effects are evaluated at the following profiles: means of all the continuous dependent variables, household heads with a job (=1), use of electricity to heat water (=1), use of LPG to heat water (=1) and use of LPG to cook foods (=1) and at various HID values.