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Paper Title
An Econometric Analysis of Irish Residential Energy Expenditures

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Abstract

Overview

The objective of this paper is to analyse the determinants of residential energy expenditures in Ireland using a large micro data set, the Irish Household Budget Survey. This data set contains information on household expenditures on various commodities, including energy items along with household and housing characteristics. The energy items that will be analysed include gas, electricity, oil, coal, turf, lpg, petrol and diesel. Expenditures for these items will be related to a variety of house and house characteristics and well as information on the type and extent of energy durable devices in the home, for example, gas or oil central heating, electric or lpg cooker etc. The main focus on the paper is the estimation of the most recent survey, the 2004/05 HBS but the previous survey (1999/00) will be also be analysed for comparison purposes.

The methodology that is employed assumes households undertake a two step decision process in their purchase of an energy commodity. Firstly, households decide on what type of fuel to use, for example, for central heating purposes. This can be referred to as the participation decision. Once this decision has been made, the household then decides on how much of this fuel to purchase or the consumption decision. As a consequence of the above, households may have zero expenditure for some fuels. The

modelling approach is driven by these two issues and focuses on the use of censored regression techniques such as the Tobit model and extensions to the Tobit that include Cragg's double hurdle model, Heckmans sample selection model and the two-part model. While such an approach has used by previous researchers on Irish household food expenditures (Newman et al, 2001 and 2003) and Irish cigarette and alcohol consumption (Madden, 2008), it has never been considered before in the case of Irish micro data on energy expenditures.

Empirical Methodology

As mentioned above, the methodology employed in this paper assumes households first decide on whether to purchase the good and then decide on how much of the good to purchase. The factors affecting both decisions may be largely similar but since the decision is defined differently in both steps (i.e. the dependent variable is defined differently) the interpretation of these factors will not be the same. A second consideration, related in part to the above discussion, is the possibility of zero expenditure for some households on certain energy commodities. Conventional utility theory would suggest that zero observations occur because of a corner solution, that is, a good is part of the individuals bundle of goods but the individual does not purchase because of their budget constraint. However it is plausible that zero observations occur for non-economic reasons such as preferences related to individual characteristics. For example, age can play a part in the decision to purchase a MP3 player.

A number of different models have been developed to account for a two-step decision process and the incidence of zero values in the dependent variable. The Tobit Model developed by James Tobin (Tobin, 1958) was the original model developed to analyse censored dependent variables. The model however suffers from two problems. Firstly it assumes that the same stochastic process determines both the consumption and participation decision. In other words they are modelled as one equation. Secondly, the tobit model assumes that the zeros arise purely because of economic reasons, that is, they are corner solutions. Given these problems, many generalisations to the tobit model have been developed ranging from Cragg's (1971) double-hurdle model to Heckmans (1979) sample selection model to finally the more flexible two-part model.

Cragg's double hurdle model, postulates that individuals must pass two separate hurdles before they are observed with a positive level of consumption. The first hurdle corresponds to factors affecting participation in the market for the good and the second to the level of consumption of the good. A different latent variable is used to model each decision process, with a probit determining the participation process and a tobit determining the expenditure level.

The Heckman sample selection model assumes that the participation decision dominates the consumption decision, also known as first hurdle dominance. This would imply that the consumption variable is only observed if the participation variable is positive. If the participation variable does not meet this criterion, the consumption variable is simply not observed. Thus for the Heckman model a probit is estimated for the first stage and an OLS estimation on the positive values only is carried out for the second stage.

Finally the two-part model assumes both independence between the error terms and first hurdle dominance, also known as complete dominance. In this case the bivariate model reduces to a probit for participation and ordinary least squares for the consumption equation over those for whom positive consumption is observed. Both of these can be estimated separately hence the term two part model.

Each of the above models, tobit, double-hurdle, heckman and two-part will be analysed and applied to the data to see which is most appropriate to describe household purchases of energy products.

Results:

Initial regressions have been run for the two part model. The preliminary results from these regressions suggest the following:

- The decision to separate the decision process into a participation element and a consumption element seems to be justified as it is found that different factors

affect the two decisions. For example for gas, location affects the decision to purchase but not to consume.

- The type of household durable item through which energy is used e.g. type of central heating, appears to be most important factor in determining energy purchases, especially in the decision to participate. For example having a solid fuel based central heating system or having no central heating means that you are more likely to purchase coal, while having a gas based central heating system means that you are less likely to purchase coal and more likely to purchase gas.

- For petrol and diesel, possession of cars and annual mileage done by the household were significant factors in affecting both petrol and diesel in both participation and consumption equations.

- Location factors appear significant for all energy items with a significant urban rural divide and regional differences. Additionally, household size (measured by the number of persons) and house size (measured by the number of rooms) were significant in all consumption equations with the exception of turf and LPG.

- Besides the general consistent results for household durables, location, household size and house size, other socio-economic characteristics that were included in the regression were for the most part insignificant. Therefore the age of the head of house, the education of the head of house, gender of the head of house, social status of the head of house, working status of the head of house, tenure and period when the dwelling was built are all insignificant in explaining a household decision to purchase an energy item. The type of dwelling, especially if the house was detached was significant in many regressions but it is presumed that this is a hidden rural effect as most households in rural areas are detached.

- Finally, the estimated income elasticities are significant and low indicating that all of the energy items analysed are necessities. The values are much lower in comparison to previous Irish studies which may be due to the reduced importance of energy in the household budget during the Celtic tiger period when the survey took place and/or may be due to the inclusion of socio-economic characteristics in

the estimated regressions which have removed some of the influence of the income variable. Further work is required on the specification of the models in order to throw more light on this issue.

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