Energy Consumption in the French Residential Sector: How Much do Individual Preferences Matter?

Salomé BAKALOGLOU1[*] and Dorothée CHARLIER2[†]

a) The motivations underlying the research

The aim of this research is to understand the weight of preference heterogeneity in explaining energy consumption in French homes. Energy efficiency in the residential sector is a significant lever for meeting 2020 EU energy targets. Today, the current empirical economics literature on the weight of preferences to explain energy consumption is dense but limited by the availability of appropriate data. Improving understanding of the energy consumption spectrum also requires that empirical research go further in the identification of individual determinants. More specifically, analyzing the effect of individual preferences for energy use, from which energy savings and energy-intensive behaviors are derived, is crucial to understand how important household heterogeneity is in explaining variability in energy consumption. This paper thus contributes to the large literature on the determinants of energy consumption by providing an original analytical framework thanks to the use of an innovative dataset.

b) A short account of the research performed

The main assumption of this research is that individual preference for comfort has a significant positive impact on energy consumption. To test this assumption, we use a discrete continuous choice model framework to take into account the assumed interactions between household characteristics and the dwelling's energy-efficiency level, using a conditional mixed process. These models are thus often used in the field of energy consumption because of interactions and endogeneity between independent explanatory variables.

In our research, we also consider that individual energy consumption preferences may be manifested in two ways. We consider that household preferences for comfort and socioeconomic characteristics influence both the characteristics of their homes (in this case the energy-efficiency level of the dwelling chosen by the household at the time of purchase or rental), and the amount of

[*] Salomé BAKALOGLOU, salome.bakaloglou@cstb.fr, Centre Scientifique et Technique du Bâtiment, 84 Avenue Jean Jaurès, 77420 Champs-sur-Marne, Chaire Economie du Climat, 16 Place de la bourse, 75002, Université de Montpellier

[†] hée CHARLIER, dorothee.charlier@univ-smb.f, IREGE, Université de Savoie, 74940 Annecy le Vieux Cedex. Corresponding author.

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final energy they consume. Using a discrete-continuous model and the conditional mixed-process estimator (CMP) allows us to tackle two potential endogeneities in residential energy consumption: energy prices and the choice of equipment.

In the discrete choice, we propose to use theoretical energy performance of the dwelling by energy-efficiency classification. This classification, from an EPC assessment, is chosen as a proxy for the theoretical energy-efficiency level of the dwelling. Thus, we study which characteristics determine a household's probability of belonging to an energy-efficient classification level with an ordered logit. Conditional on the discrete choice, a household decides the quantity of energy to consume. Therefore, in the continuous choice, the total energy consumption (the logarithm of the energy consumption in kWh/m^2) is estimated, conditional on the dwelling"s thermal performance (energy-efficiency classification). This is the "energy consumption choice," which we estimate using a least square model. The model contains variables which are supposed to explain both choices: the choice of a dwelling with a certain energy-efficiency level and the choice of energy use. However, some exclusion (or selection) variables are also introduced in each equation: the duration since move-in and detached house for equation 1 (discrete choice) and the number of appliances and number of days of housing vacancy during the heating period for equation 2 (continuous choice). Finally, in order to estimate jointly our three equations, we use the conditional mixed process (CMP).

Our research is based on the *PHEBUS*[‡] survey, which includes complete thermal data, Energy Efficiency Certificates (energy-efficiency classifications), and socioeconomic characteristics for more than 2000 dwellings as well as newly available information about household behaviors and preferences.

c) The main conclusions

As a major contribution, we provide evidence that preferences for comfort over energy savings do have significant direct and indirect impacts on energy consumption, especially for high-income households. Preferring comfort over economy or one additional degree of heating implies an average energy overconsumption of 10% and 7.8% respectively, up to 36% for high-income households. For low-income households, we find no significant effect of preferences but a lower

[‡] http://www.statistiques.developpement-durable.gouv.fr/sources-methodes/enquete-nomenclature/1541/0/enquete-performance-lhabitat-equipements-besoins-usages.html

energy price elasticity. We also obtain that one degree Celsius more heat implies an overconsumption of 7.8%.

Then, Energy price elasticity is significant, ranging from -0.43 to – 0.714; it is consistent with previous findings presented in our literature review. Moreover, energy price elasticity is lower for low-income households (-0.43) and higher for high-income households (-0.714), meaning that poor households are less responsive to an increase in energy prices.

Finally, the equipment rate of households has also a significant impact on energy consumption. An increase in this rate implies an overconsumption of 14.6%.

In line with these results, we advise policymakers to consider low-income and high-income households separately when developing and implementing public policy tools to reduce energy consumption in the residential sector. Moreover, through our methodology, we confirm the necessity of accounting for indirect determinants when assessing the drivers of energy demand in the residential sector.

d) Potential benefits

Our results strengthen the belief that household heterogeneity is a substantial factor in explaining energy consumption and could have meaningful implications for the design of public policy tools aimed at reducing energy consumption in the residential sector.

Keywords: Residential energy consumption; Household preferences; Discrete-continuous choice method; Conditional mixed-process.
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