Study of the Residential Energy Demand Model Based on Multi-economy Samples

Lei CHEN*, Researcher
Asia Pacific Energy Research Centre, Tokyo, Japan

Abstract:

Residential energy consumption plays an important role in the energy consumption structure. According to IEA statistics, residential energy consumption accounted for 24.4% of the world's total final energy consumption in 2009. Residential energy model not only explain the rule of residential energy's changing, but also provide a reference for demand forecasting and policy formulation. The researches related to this field can be divided into two categories: the top-down approach, which mainly used econometric methods to analyze the relationship between residential energy and external drivers; and bottom-up approach, which exhaustively analyzed all kinds of energy-using equipment and its energy consumption in the residential model. All the existed models have a common characteristic that they are originally within one economy, and then are extended to a larger scale by reselecting parameter and re-judging the assumption which have been proved to be effective in one economy. In this process, different decisions may give occasion to very different predictions, increasing difficulties to find a widely acceptable result.

This study attempts to use multi-economies samples for analyzing the changes the basic rule of residential energy demand. For research purposes, we apply the concept of effective energy demand per capita in residential sector, which try to eliminate the differences in economies' population and unify the various types of final energy regarding the actual efficiency in the end-using. We consider the index of GDP per capita in PPP as independent variable which reflecting the resident's needs for energy consumption and eliminating energy prices' effects from actual energy demand; regarding energy prices generally influence the economy's wholesale price level.

However, economic factors such as income or price does not explain the effective energy demand per capita completely, it is difficult to find a direct relationship between effective energy demand per capita and GDP per capita in PPP. To this end, we further analyzed effective energy demand elasticity based on GDP per capita in PPP. Such elasticity makes it possible to compare energy demand variation only affected by GDP per capita in PPP without considering the unique factors for each economy. Then, we constructed elasticity data in the APEC region. Finally after several regression analyses, we found that the samples of electricity in terms of 50% growth of GDP per capita in PPP have a linear correlation with GDP per capita in PPP. The R^2 is about 0.7, which seems to be acceptable. Then equation

about effective energy demand per capita and GDP per capita in PPP was found after mathematical conversion for above linear correlation. At this stage, we found that different economies share the same coefficient coming from regression analysis, which represents the general trend for effective energy consumption per capita; and every economy has its own coefficient which determines its deviation to general energy demand. This particular coefficient reflects two categories of factors for each economy, the natural factors or so-called external uncontrollable factors such as population density, temperature, wind speed, and social factors or so-called internal controllable factors such as living habits, energy saving efforts.

In conclusion, this model could cover varies of factors that influencing the energy demand in residential sector in a simple form, verifying the universality of economic factors, as well as considering the influence of respective characteristics. The model can be employed in two different areas. First, it could contribute to energy demand analysis in residential sector, especially for the prediction in the BAU scenario, which has common assumptions. Second, the natural factors in the short term for each economy can be treated as a constant to avoid the difficulty in quantifying the impact of social factor. With this, further research can be conducted in tracking the changes of social factors for one economy or comparing difference within a region.

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*Corresponding Author
Lei CHEN
E-mail: chen@aperc.ieej.or.jp
Tel: +81-3-5144-8541