RESIDENTIAL ENERGY DEMAND AND BEHAVIOR: ITS IMPLICATION FOR CLIMATE MITIGATION POLICIES AND ENERGY SUBSIDY REFORM IN THAILAND

Supawan Saelim, National Institute of Development Administration, Thailand, Phone +66951505664, Email: supawan.sae@stu.nida.ac.th

Overview

Although the residential sector is not the main contributing sector to emissions levels, the distributional incidence of the climate mitigation policies and the energy price reform on the welfare of households would be of great interests in influencing the public and political acceptance of the policies especially in developing countries. Despite the growing literature about policy impact on economy and environment, the in-depth study of household energy consumption behaviour which mainly determines the welfare incidence is relatively scarce in developing countries including Thailand. Climate mitigation policies (e.g., carbon taxes) to meet emission reduction targets and energy subsidy reform in Thailand have inevitably led to rising energy prices. This study aims to estimate household energy demand and behavioral responses to price changes at disaggregated household level in Thailand. This study estimates the expenditure and price elasticities of energy demand across Thai household groups using the estimated parameters from the demand system model based on consumer demand theory. The study utilizes the national household socio-economic survey data which represent income and expenditure of households with different socio-economic factors and monthly regional price indices. The results from the demand system estimation provide useful implications for the effectiveness of pricing instruments in reducing household energy consumption and for the distributional incidence of climate mitigation polcies on households.

Methods

This study employs the Quadratic Almost Ideal Demand System (QUAIDS) to estimate household energy demand in Thailand. The QUAIDS model allows a welfare analysis to be consistent with consumer demand theory and flexible with a rank-three demand system to incorporate the nonlinearity patterns in the observed consumption patterns from the survey data. Under the QUAIDS model, the budget shares of good i can be derived in the form of

$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2$$

The quadratic term in the budget share equation captures nonlinear behavioral changes in budget share equations in response to changes in prices or income. To be consistent with economic theory, theoretical restrictions are imposed when estimating the budget share equations with the following properties of adding-up, homogeneity and symmetry restrictions:

$$\sum_{i=1}^{k} \alpha_i = 1,\ \sum_{i=1}^{k} \beta_i = 0,\ \ \sum_{j=1}^{k} \gamma_{ij} = 0\ \ \sum_{i=1}^{k} \lambda_i = 0, and\ \gamma_{ij} = \gamma_{ji}$$

In estimating the budget share equations, a two-stage budgeting process is assumed where households decide to allocate between durable and non-durable consumption in the first stage and make the decision to allocate among the groups of non-durable consumption in the second stage. The demand system in the second stage consists of four budget share equations which are electricity, transport fuels, food and non-alcohol beverages and other non-durable goods and services. The budget share equations for electricity and transport fuels represent energy demand in Thailand. For econometric specification, demographic variables capturing heterogeneity and a residual from the reduced form equation to correct endogeneity problem are incorporated into the budget share equations. Parameters estimated from the budget share equations are then used to calculate expenditure and price elasticities.

Results

Expenditure elasticities of energy demand increase at lower income distribution, implying that the luxury of the respective energy goods rises for households at lower income distribution and those energy goods become necessity for households at higher income distribution. Transport fuels turn out to be luxurious for low-income group (1.311) but necessity for high-income group (0.735). Own-price elasticities imply that both electricity and transport fuels are inelastic to price changes, however, the demand for transport fuels is more sensitive to price

changes (-0.602) as compared to the demand for electricity (-0.506). High-income households tend to be more sensitive to energy price changes than low-income households. The results indicate that pricing policies may be ineffective in reducing energy demand as a rise in energy prices would lead to a less than proportional reduction in the energy demand given ceteris paribus.

Conclusions

Pricing instruments (e.g. through taxation) are likely to be ineffective in reducing energy consumption in the residential sector as the energy demand is inelastic. Behavioral responses to price changes are strongly dependent on the position of households in income distribution and regions of residence. The estimated price elasticities indicate that households at the top of income distribution tend to be more sensitive to changes in energy prices compared to households at the lowest quintile. This implies that households at higher income distribution may have better capabilities to reduce energy consumption in response to price increases as they may currently use energy more than necessities and may afford to switch to cleaner energy than low-income households do. In summary, a rise in energy prices induced by policies aiming at the reduction of energy consumption will cause a more pronounced reduction in energy consumption of high-income households compared to low-income households, especially a rise in prices of transport fuels for which the demand of high-income households are much more responsive. As behavioral responses vary across household groups, the application of one elasticity value for all households may underestimate or overestimate the behavioral responses at different income level and regions. Potential biases from assuming uniform elasticity in residential energy sector may alter the distributional results of energy and climate policies.

The progressive incidence of environmental policies is expected in Thailand as high-income households incur higher energy consumption than low-income households. Although transport fuels are more necessity for high-income households, high-income households are more vulnerable to reduce energy demand in response to price changes than low-income households. Such behavioral responses influence the distributional results. Therefore, the policy design should be based on a tailored approach to incorporate the characteristics of consumer behaviour in determining the distributional incidence, the fairness and the efficiency of the environmental and energy policies

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