Estimating a reasonable increasing block pricing system for Chinese households

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1. Background and research objectives

Many countries have implemented increasing block pricing (IBP) in electricity charging systems, which is considered as energy conservation promoting initiative and would have effects on decreasing household electricity consumption. The Chinese government has implemented an IBP system nationwide since 2012. China's IBP system is a three-block pricing system in which the upper limit of electricity consumption for each block is determined by the provincial government.

In this study, we estimate the impact of the IBP on household electricity consumption to answer the following research questions. Does the cognition of the IBP system cause Chinese households to save electricity or not? Since the electricity consumption ceiling of the first block was determined to account for about 80% of household electricity consumption, it is essential to investigate the efficiency of energy saving in the first stage. If the IBP system is not sufficient for household electricity conservation, what is the optimal IBP system for Chinese households?

2. Data and Empirical model

For the empirical analysis, we use micro-level data from the 2015 and 2018 Chinese General Social Survey (CGSS). The CGSS data include information on household socioeconomic characteristics and dwelling characteristics. Most importantly, the 2015 and 2018 surveys collected information on household energy consumption, including knowledge of the IBP system.

Following Lin and Zhu (2021), we apply an endogenous switching regression (ESR) model to examine the impact of IBP knowledge on household electricity consumption. Unobserved characteristics that influence households' policy cognition could also influence households' electricity consumption, therefore, sample self-selection bias should be considered. First,

$$\begin{aligned} C_i^* = \gamma Z_i + \mu_i, \quad & C_i = 1 \quad \text{if } C_i^* > 0 \\ & C_i = 0 \quad \text{otherwise} \end{aligned} \tag{1}$$

, where C_i^* is a latent variable that determines whether household i has knowledge of the IBP (policy cognition), and $C_i = 1$ indicates that household i has knowledge of the IBP, otherwise $C_i = 0$. Z_i is a variable that determines policy cognition of households, in this case, electricity payment type. Thus, the determination of electricity consumption (*ELE*) in the treatment group and control group is specified

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as

$$\ln (ELE)_{1i} = \beta_1 X_{1i} + \epsilon_{1i} \quad \text{if} \quad C_i = 1 \tag{2}$$

$$ln(ELE)_{0i} = \beta_0 X_{0i} + \epsilon_{0i} \quad \text{if} \quad C_i = 0 \tag{3}$$

, where X_{1i} and X_{0i} are variables including electricity price, household socioeconomic characteristics, and region dummies. γ, β_1, and β_0 are vectors of parameters, and μ_i, ϵ_{1i}, and ϵ_{0i} are the disturbance terms.

3. Main Results

The table shows the empirical results in the treatment group and control. The results of rho are significant at the 1% level for the treatment group and the control group, suggesting that there is sample self-selection bias in the determination of electricity consumption.

Based on the results of the ESR model shown in the table, we calculate the average treatment effect of the treatment group and the control group. The average treatment effect of the treated ATT = 0.849, suggesting that households in the treatment group would reduce their electricity consumption if they were not aware of the IBP system. The average treatment effect of the untreated ATU = 0.881, indicating that households in the control group would increase their electricity consumption if they knew about the IBP system. These results show that cognition of the IBP system does not induce households to reduce electricity consumption, but has the opposite effect.

Variables	Treatment		Control	
Price (ln)	-0.255	***	-0.248	***
	(0.017)		(0.016)	
Income (ln)	0.081	***	0.088	***
	(0.018)		(0.014)	
Size	0.088	***	0.082	***
	(0.013)		(0.011)	
Child	-0.007		-0.079	***
	(0.023)		(0.020)	
Age	0.000		-0.005	***
	(0.001)		(0.001)	
Female	0.053	*	0.043	
	(0.030)		(0.028)	
Education				
Junior high school	-0.055		-0.003	
	(0.043)		(0.036)	
Senior high school	-0.027		-0.028	
	(0.050)		(0.048)	
University or above	-0.022		-0.034	
	(0.058)		(0.064)	
Floor area (ln)	0.094	***	0.135	***
	(0.028)		(0.027)	
Rent	-0.019		-0.022	
	(0.049)		(0.052)	
Rural	-0.010		-0.169	***
	(0.046)		(0.036)	
Constant	3.543	***	2.808	***
	(0.273)		(0.225)	
sigma	0.741	***	0.763	***
	(0.027)		(0.020)	
rho	-0.588	***	-0.589	***
	(0.075)		(0.055)	

4. Conclusions

Previous studies argued that the IBP system could reduce household electricity consumption to some extent (Lin and Zhu 2021). However, the results of the ESR model using data from the CGSS do not support this view. The next step is to estimate the optimal design of the IBP system with respect to the differences between the provinces.

References

Lin B and Zhu P. 2021. Has increasing block pricing policy been perceived in China? Evidence from residential electricity use. *Energy Economics*, Vol.94. https://doi.org/10.1016/j.eneco.2020.105076.