Information Effects on Residential Energy Conservation: A Japanese Experiment

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OVERVIEW

- **Kyushu experiment**
- **Discrete-continuous model of display usage and electricity demand**
- **Data and estimation method**
- **Information effects on energy conservation**

The Kyushu experiment(1)

- **The New Energy and Industrial Technology Development Organization and the Kyushu Electric Power Company jointly conducted an experiment.**
- **Households could obtain information on efficient usage of electric appliances through a display at their dwellings.**

The Kyushu Experiment(2)

- **Eight programs of efficient usage of electric appliances were provided through the display.**
- **Usage of the display was recorded when participants activated the display at least once each month.**

Table 1. Examples of Information on Efficient Usage of Electric Appliances

Appliances	Items	Suggestions
Room air conditioners	Filters	Clean up a filter of an air conditioner at least once in two weeks.
	Timers	Use a timer to operate an air conditioner only when heating or cooling is necessary.
Refrigerators	Food Storage	Do not store too much food in a refrigerator.
	Cleaning	Keep clean the door packing of a refrigerator.
TV sets	Brightness	Do not make the screen too bright.
	Operation	Turn off a TV set when not watching.
	Standby Power	Unplug a TV set to save standby power.

Discrete-Continuous Model of Display Usage and Electricity Demand

- **No costs of display installation and usage**
- **Costs of time and efforts vs. energy cost savings through efficient usage of appliances**
- **Discrete choice of display usage: described by a conditional indirect utility function**
- **Continuous demand for electricity: applying Roy's identity to the conditional indirect utility function and consistent with economic theory**

Translog Indirect Utility Function of Display Usage and Electricity Consumption

$$V^{k}_{it} = - a_e \log(p_{eit}/y_i) - a_z \log(p_{zit}/y_i) - 0.5\, b_{ee} [\log(p_{eit}/y_i)]^2$$

$$- 0.5\, b_{zz} [\log(p_{zit}/y_i)]^2 - 0.5(b_{ez}+b_{ze})[\log(p_{eit}/y_i)] [\log(p_{zit}/y_i)]$$

$$- a_{em}\log(p_{eit}/y_i)M^k - (a_{ex} X1_{it})\log(p_{eit}/y_i) - (a_{zx} X1_{it})\log(p_{zit}/y_i)$$

$$+ c^k X2_{it} - w_{eit} \log(p_{eit}) - w_{zit}\log(p_{zit}) + e^k_{it} \qquad (2)$$

Cost Share Equation of Electricity

$$CS_{it} = [a_e + b_{ee}\log(p_{eit}) - (b_{ee}+b_{ez})\log(y_i) + a_{em}(d_{it}M^1 + (1-d_{it})M^0) + a_{ex}X1_{it}]/D + (w_{eit}/D) \quad (4)$$

$$D = 1 + (b_{ee} + b_{ez})\log(p_{eit}) - (b_{ee}+b_{zz}+2b_{ez})\log(y_i)$$

Econometric Considerations

- **Marginal price of electricity: using a predicted value to correct for bias**
- **Display usage dummy: adding a Heckman-type correction term to the cost share equation to correct for bias**
- **Full information maximum likelihood estimation: asymptotically unbiased and efficient**

Data

- **Pooled data of 194 households and three months (July, August and Sept.) in 1996**
- **Random sampling: households living in Fukuoka City, Japan**
- **Average electricity usage: 10~16 kWh/day**
- **Households using the display: 60~80 %**

Estimation Results of Electricity Cost Share Equation

item	estimate	significance
a_{em}: display usage	-0.132	1%
a_e: constant	0.202	1%
b_{ee}: log price	0.349	1%
Price elasticity	-0.61	1%
Income elasticity	0.55	1%

Conservation Effects of Information Provision

- **Information provision: reduce daily electricity usage by 0.14 kWh (1.1%)**
- **Engineering estimate of conservation for a refrigerator: 4~5% through appropriate storage of food**
- **Difference between econometric and engineering estimates: information associated only with some major appliances, not perfectly implement energy conservation activities**

Conservation Effect of Information : Comparison

- **Sexton et al. (1989): information on *electricity costs* reduced peak usage of electricity**
- **Matsukawa (2004): information on *hourly electricity usage* reduced summer electricity consumption**
- **This paper: information on *efficient usage of appliances* reduced summer electricity consumption**

Conclusion

- **The Kyushu experiment: providing households with information on efficient usage of electric appliances**
- **Conservation effect: relatively modest effect of information provision on energy conservation**