An experimental investigation of electricity conservation behavior induced effect by nudge

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1 Introduction

Some researches that analyze the effect of dynamic pricing scheme by social experiment already pointed out consumers do not well response to the price change of electricity. Also, other researches focus on different types of price-based policy do not show enough cost effectiveness. Therefore, interest has dramatically increased in non-price energy conservation programs. Recently, some countries try to implement the non-price policy that encourage the voluntary contribution behavior for the society. It is called as "Nudge. One of the effective "Nudge" to encourage voluntary electricity conservation is information provided based on social comparison.

In this study, we reveal the social comparison effect for electricity conservation using by the laboratory experiment based on hypothetical decision-making situation of electricity use. But our study is not a simple laboratory experiment. First, the experiment invites the actual residential people as subjects. Second, our experiment setting based on the situation of actual electricity use of each subject. Based on the hourly electricity use data, we set up the initial setting (electricity uses in summer season) of each subject in this experiment. Therefore, our experiments can capture the more approximative real behavior compared with a normal laboratory experiment.

2 Experiment setting

In this experiment, each subject hypothetically decides the temperature setting of an air conditioner. The subject does decision making following a hypothetical situation. The situation in the experiment is the summer of the hottest season in Japan. Each subject decides the temperature setting of the air conditioner between peak hour (from pm 1:00 to 16:00). The electricity price set as 25 Japanese yen. This price setting based on the general pricing in around Tokyo region (The consumer electricity price of Tokyo Electric Power Company Holdings, Incorporated). But electricity price randomly changes in each period, because Critical peak pricing implements when the peak demand near the capacity constraints. In this experiment, the total demand for electricity use is decided by exogenously. Each subject can choose temperature from 25℃ (Comfortable temperature) to 29℃ (discrete choice). If the subject decides not to use the air conditioner, the room temperature becomes 30℃. If the 1℃ become higher from 25℃, the subject can decrease 10 % of the total electricity usage of the subject in each period (day). Thus, if the subject chooses not to use the air conditioner, conservation amount of electricity become 50 percent of total electricity use. This set depend on the actual situation of the electricity use. Although the subject can decrease the own consumption of electricity by a higher temperature setting of the air conditioner, the subject should permit the uncomfortable situation because of the higher temperature. We need to add such preference for the comfortable temperature to live. To consider the such preference, we measure the WTA (Willingness to accept) for higher temperature by the questioner before the first period of the experiment.

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In each period, subjects can see the information about the electricity usage (The amount of own electricity usage in each period, before period and electricity price in this period). Also, each subject receives information about the other subject's electricity usage. But the detail of the information about electricity usage of other subject is a difference based on the treatment. In the control group, each subject does not receive any information about other consumer's electricity usage. On the other hand, the subjects can confirm the situation of other consumer's electricity usage in each treatment group. In treatment 1, each subject can receive information about the electricity use of "Non-efficient" person. Electricity use of "Non-efficient" subjects is the top 10 percent in the same session. Each subject can obtain information about the average electricity use of "Non-efficient" subjects. In treatment 2, the subjects can receive the average consumption amount of electricity use of all subjects in the same session. In treatment 3, each subject can receive information about the electricity use of "Efficient" subjects. Electricity use of "Efficient" subjects is the bottom 10 percent in the same session.

3 Result and Discussion

Based on the ordered logit estimation, we can calculate the conservation effect of each treatment. Table 1 show the electricity conservation amount of each treatment and CPP. Our calculation result shows that CPP scheme encourage to decrease 8.6 percent of the total electricity use. Each treatment effect also does not small. Treatment 1 can achieve to reduce 2.7 percent of total electricity use. Also, treatment 2 can decrease the 3.3 percent of it. In particular, reduction effect of treatment 3 is most remarkable. Our estimation result show treatment 3 can achieve to decrease 7.5 percent of total electricity use.

Table 1 The conservation effect of CPP and each treatment

	The electricity conservation amount per total use
CPP (+25 JP yen per kwh)	0.086
Treatment 1	0.027
Treatment 2	0.033
Treatment 3	0.075

We calculate the welfare improvement effect of the CPP and each treatment in line with the way of Ito et al. (2018). The results show the CPP increase the surplus around 22.67 million US dollars. Our results show that the improvement effect of each treatment for welfare is not small. Improvement of the welfare in treatment 1 becomes 11.98 million dollars. In treatment 2, information provision scheme can increase the welfare gain around 13.97 million dollars. In particular, treatment 3 can increase welfare around 21.92 dollars. This improvement effect by the treatment 3 shows the near value with the improvement effect of the CPP. Our results show an information provision scheme based on social comparison encourage electricity conservation behavior and improvement of social welfare.

<Reference>

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