ANALYSIS ON THE RELATIONSHIP BETWEEN LITERACY AND ENERGY CHOICES IN JAPAN

Miwa Nakai, The University of Tokyo, Phone: +81-3-5841-1596, Email: nakai@platinum.u-tokyo.ac.jp
Tatsuya Okubo, The University of Tokyo, Phone: +81-3-5841-1596, Email: okubo@platinum.u-tokyo.ac.jp
Yasunori Kikuchi, The University of Tokyo, Phone: +81-3-5841-1596, Email: kikuchi@platinum.u-tokyo.ac.jp

Overview

Japan needs to overcome the challenges of energy issues such as a high dependency on fossil resources from abroad and the slow introduction of renewable energy. Although technological progress is important for solving these issues, energy literacy is also an inevitable foundation to achieve acceptability for novel energy systems (DeWaters and Powers, 2013). Applying the energy literacy questionnaire developed especially for measuring the energy literacy of high school and junior high school students in the United States (DeWaters and Powers, 2011), some studies conducted a survey to grasp the energy literacy levels in other contexts, for example in Taiwan (Lee et al., 2015) and Malaysia (Lay et al., 2013). Studies on energy literacy in Japan are urgently required, where laws and regulations on energy systems are currently changing over 2012 to 2020. For discussion of a smooth transition of energy system considering its social acceptability, this paper aims at developing an energy literacy index reflecting the current energy situation in Japan, measuring the energy literacy of Japanese residents, and investigating how it relates to their preferences towards the main attributes of electricity such as energy mix and CO_2 intensity through generating electricity, applying a discrete choice experiment.

Methods

We conducted an internet survey, administered by a research company between 17 and 21 March 2017. Our respondents were registered research participants and randomly drawn corresponding to the actual proportions of age and gender of residents in all of 47 Japanese prefectures, although we set the range of their ages from 20 to 65 years old. We amassed 1,452 valid responses. The questionnaire consisted of four parts. In the first part of the questionnaire, there were 30 questions regarding energy to measure the respondents' literacy. Discussions with energy experts, referring to the Energy White Paper (Agency for Natural Resources and Energy, 2016), and the Strategic Energy Plan (Agency for Natural Resources and Energy, 2014) led to the development of those 30 questions, which were divided into five sections: *basic knowledge regarding energy*, *energy security*, *economy and energy*, *environment and energy* and s*afety and energy*. Each section contained six questions. We also referred to questionnaires developed by the energy literacy assessment project of Clarkson University (DeWaters, 2009; DeWaters et al., 2013). Second, there were 8-choice experiment questions, leading to 11,616 choices. Respondents were asked to choose thier most preferred electricity plan over the alternatives. Each electricity plan had four attributes that were *Energy Mix*, *Monthly Electricity Fee*, *Power Provider* and *CO_2 Intensity* through generating electricity (Table 1). Applying a random parameter logit model, we examined whether and how such attribute(s) significantly affect decision-making for an electricity contract and whether the degree of energy literacy relates to the heterogeneity of electricity preferences. Third, respondents were asked their average electricity usage per month. Finally, we asked them their individual attributes including gender, age, their residential prefecture, family structure, and education background.

Table 1：An example of a choice set in the choice experiment

	Plan A	Plan B	Plan C
Power provider	Major provider	Regional Firm	Major provider
Energy Mix	Fossil Fuels 80% Nuclear 20%	Fossil Fuels 80% Renewables 20%	Fossil Fuels 100%
Electricity Fee (300 kWh/month)	5,700 JPY (19 JPY /kWh)	6,000 JPY (20 JPY /kWh)	6,000 JPY (20 JPY /kWh)
CO_2 Emission	170 kg	170 kg	210 kg
Choose One		✔	

Results

Figure 1 shows the distribution of the number of correct answers out of 30 questions. It is found that, on average, respondents answered 12 out of 30 questions (42%) correctly in the questionnaire. Disaggregating the proportion of correct answers in each section, on average we have the following: *basic knowledge regarding energy*, *energy security*, *economy and energy*, *environment and energy* and *safety and energy* are 54%, 43%, 36%, 35% and 43%, respectively. We also conducted regression analysis to examine which factor(s) are related to respondents'

energy literacy. The estmation results show that people who completed undergraduate university education or higher, are older, and men tend to have higher energy literacy. Regarding the choice experiment results, the coefficient of energy mix consisting of fossil fuels and renewable resources is positively estimated at the 1% level. We also found that people have a positive preference towards an energy mix that contains fossil fuels, renewable resources and nuclear power that resembles the projected energy mix for 2030 announced by the government (METI, 2015). On the other hand, the coefficients of electricity generated by foreign firms and emitting a greater amount of CO_2 through generating electricity are estimated negatively at the 1% level. We found that the literacy level significantly affects attribute preferences. People with higher scores in the energy literacy questionnaire are likely to have stronger preferences to those just discussed.

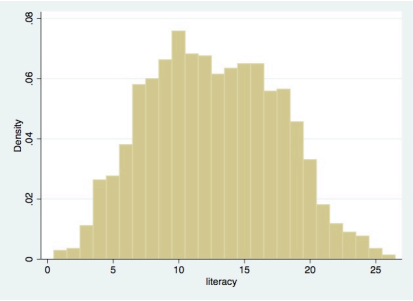

Figure 1: The distribution of the number of correct answers

Conclusions

We conducted a web-based survey to measure energy literacy of people in Japan and examined how it affects consumers' preferences towards *Energy Mix*, *Power provider*, *Monthly Electricity Fee* and *CO_2 intensity*. Regarding energy literacy levels, people in Japan do not have sufficient knowledge of energy; *economy and energy* and *environment and energy* seemed to be particularly difficult for our respondents.

As for preferences towards the attributes of electricity plans, we summarise the estimation results as follows. First, the estimated coefficient for *Energy Mix* of fossil fuels and renewables, and fossile fuels, renewables and nuclear power are positively estimated and statistically significant. Respondents also exhibited negative preferences towards electricity generated by foreign firms and emitting a greater amount of CO_2. Second, it was found that the level of energy literacy significantly affects preferences for some attributes. People with more knowledge about energy prefer the well-balanced energy mix and tend to avoid the high CO_2 emssions options relative to those with a lower literacy. Hence, it is expected that more people would be willing to pay more for a balanced and environmentally friendly energy mix if they become more energy literate. We also found that such people would not like to purchase the electricity from regional firms, which could be induced due to the NIMBY (Not-In-My-Back-Yard) effect. Thus, information on environmental and economic impacts of electricity generations by regional firms on their residential area could be provided in order to maximise acceptability across all types of people.

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