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Attitudes toward nuclear power and energy-saving behavior among Japanese households☆

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ABSTRACT

We conducted Internet surveys to evaluate Japanese attitudes toward nuclear power and energy-saving behavior after the Fukushima Daiichi Nuclear Disaster. In the first part of the paper, we examined the relationship between socioeconomic characteristics and acceptance of nuclear power in light of global warming. Like previous researchers, we found that nuclear power was supported more by males and those who have spent longer in education. However, nuclear power received less support from seniors. In the second part of the paper, we examined the relationship between electricity demand and acceptance of nuclear power. We find that opponents of nuclear power use electrical appliances less intensively at home and reduced their electricity use during the power shortage period after the nuclear accident. By contrast, supporters of nuclear power use electrical appliances more intensively and did not engage in energy-saving behavior. The elasticity of electricity demand explains attitudes toward nuclear power.

1. Introduction

The Great East Japan Earthquake of March 11, 2011, triggered an extremely severe nuclear accident at the Fukushima Daiichi nuclear accident and sparked a huge debate among Japanese people about the use of nuclear power. Nuclear power energy policy has become the third most important issue in the 46th lower court election, following social security and economic policies [1]. Both national and local governments have introduced policy measures to reduce dependence on nuclear power [2].[1] Companies expect an increase in electricity prices and have therefore implemented various energy-efficiency practices [3].

Households have also changed their energy-consumption behavior since the nuclear accident. Jyukankyo Research Institute Inc. [4] reported, for example, that household energy consumption for the period from March to April 2011 decreased by 8% on the previous year.

Japan is a large energy consuming nation. It consumes 4.26% of the world's annual primary energy supply (U.S. Energy Information Administration [5]). The share of nuclear power in total electricity generation has decreased from 32% in 2010 to 2% in 2012 while the combined share of LNG and fossil fuel has increased from 37% to 66% (Agency of Natural Resources and Energy [6]). Therefore, it is expected that attitude toward nuclear power and energy saving behavior among Japanese households affect global energy markets.

Public opinion surveys on nuclear power use have been conducted across the world in the past four decades. Early surveys examined public support for building nuclear power plants. In the United States, a clearly declining trend in public support from the mid-1970s through 2000 has been observed [7,8]. By contrast, the Japanese were more supportive of the expansion of nuclear power during this period. For instance, 56.8% of subjects in a public opinion survey conducted by the Prime Minister's Office [9] supported

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[1] A wide variety of subsidies have been provided for energy-saving and renewable energy investments.

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the expansion of nuclear power generation. Europeans have been ambivalent about the expansion of nuclear power use [10].

Recent surveys have examined public attitudes toward nuclear power as a source of electric power. For example, the Massachusetts Institute of Technology [9] asked respondents to compare the economic costs and non-economic harms among energy alternatives. It reported that perceived costs and environmental harms were the most important determinants of nuclear power acceptance. Visschers et al. [10] found that the perceived benefits for a secure energy supply were the most important determinant of acceptance of nuclear power among the Swiss.

Growing concern about global warming caused by fossil-fuel use may expand public support for nuclear power. Researchers have been studying the connection between nuclear power acceptance and concerns over global warming in recent years. A clear connection has not yet been found, however [11–13].

Scholars have also studied nuclear acceptance among Japanese households. Both Japan and South Korea promoted nuclear power before the Fukushima Daiichi nuclear accident. Valentine and Sovacool [14] identified common socio-political economic factors underpinning nuclear power program expansion in the two countries. They argue that dominant economic priorities can nullify conditions that may otherwise prevent nuclear power development in Japan.

In September 2009, Prime Minister Yukio Hatoyama announced at the United Nations (UN) Summit on Climate Change that Japan would aim to reduce its emissions by 25% by 2020, if compared to the 1990 level [15]. However, in December 2010, at the United Nations Framework Convention on Climate Change (UNFCCC) COP16 meeting in Cancun, Japan announced that it would not accept further emission reduction targets without broader commitment from all nations. In light of such contradictory announcements, Valentine et al. [16] conducted a public opinion survey in April 2010 and assessed whether Japanese stakeholders would support a costly transition to a low-carbon energy society. They conclude that Japanese stakeholders want the government to play a role in greenhouse gas (GHG) emission abatement but not to the significant detriment of energy service affordability.

More recently, Poortinga et al. [17] used national representative surveys from before and after the Fukushima Daiichi disaster to examine how it had changed public perceptions of climate change and public acceptance of nuclear power in Britain and Japan. They found that the Japanese public has been less accepting of nuclear power than the British public, even if it contributes to climate change mitigation or energy security. The researchers also report that the Japanese public has completely lost trust in nuclear safety and regulation after the disaster.

We also examine Japanese attitudes toward nuclear power in this paper. Our approach is different from the above-mentioned studies in two ways, however. First, because we conducted an opinion survey after the Fukushima Daiichi nuclear accident, we did not ask for opinions about the expansion of nuclear power but about the continued use of nuclear energy. Second, we analyzed the relationship between attitudes toward nuclear power and energy-saving behavior. The above-mentioned studies identified the affordability of energy services as an important factor for both climate change policies and nuclear power policies. We might therefore expect energy demand to affect opinions about such policies. Even so, no study has compared energy-consumption behavior between opponents and supporters of nuclear power.

Japan's national policy promoted nuclear power because of its cost-effectiveness compared to other forms of power. The Agency of Natural Resources and Energy [18] estimated that the cost of electricity generation by nuclear power was 5–6 yen/kWh, while that generated by heavy oil was 14–17 yen/kWh.[2] As a result of government policy, nuclear reactors provided about 30% of the country's electricity prior to the nuclear accident [19]. Given the capacity and cost of other forms of power, energy saving becomes an important factor in lowering dependence on nuclear power, at least in the short run.

Public reaction to nuclear power and to the disposal of the associated wastes present the most prominent example of the importance in energy system transformation of individual's roles as citizens [20]. Therefore, proper understanding energy-consumption behavior of individuals is essential for the evaluation of nuclear power. Nevertheless, energy research has downplayed the role of choice and the human dimensions of energy use and environmental change [21]. This paper attempts to fulfill this gap by analyzing the behavior of Japanese households, who recently experienced the nuclear accident.

The Fukushima Daiichi crisis rated 7 on the scale of the International Atomic Energy Agency (IAEA) [22], the highest rating possible. After experiencing the worst nuclear accident since Chernobyl in 1986, how have the Japanese people changed their energy-consumption behavior? Who reduced their electricity consumption in order to reduce dependence on nuclear power? Did anti-nuclear protesters contribute to energy saving more than nuclear power supporters did? We conducted an Internet survey to answer these questions.

The structure of the rest of the paper is as follows. Section 2 explains our survey methodology and compares acceptance of nuclear power among the Japanese households before and after the experience of the nuclear accident. The Japan Atomic Energy Relations Organization (JAERO) [24] conducted an opinion survey about nuclear power prior to the nuclear accident; we replicated the survey's contents with our subjects to make our research comparable to the JAERO study. In Section 3, we identify the characteristics of those who oppose or support the use of nuclear power to prevent global warming. In Section 4, we examine whether an individual's attitudes toward nuclear power use determine his or her electricity-consumption behavior. Section 5 concludes the paper.

2. Survey methodology

We recruited our subjects from the consumer testers of *Cross Marketing* and asked them to access our unique PC server.[3] Our subjects ranged in age from 20 to 60 years and lived in either the Kanto or Kansai regions. These two regions are the most densely populated areas of Japan. The Kanto region includes the Tokyo area while the Kansai region includes the Osaka area. The distances from the Fukushima Daiichi plant to Tokyo and Osaka stations are 220 and 580 km, respectively. Thus, we might assume that people in the Kanto region would take the nuclear accident more seriously than would those in the Kansai region.

We conducted two series of Internet surveys to identify the type of person who engaged in energy-saving behavior during the power shortage period. The first survey was conducted from March 11 to 15, 2012. In total, 830 consumer testers accessed the server in the first survey. We examined opinions about nuclear power use in the first survey. We asked the same consumer testers to participate in the second survey. The second survey was conducted from October

[2] More recently, the Energy and Environmental Council [23] estimated the cost of electricity generation by nuclear power at 8.9 yen/kWh, assuming the cost of the damage caused by the nuclear accident to be 5.89 trillion yen.

[3] Cross Marketing is one of the most popular internet survey companies in Japan. It has more than 1.65 million consumer testers.