MPRA
Munich Personal RePEc Archive

Effect of transparency on changing views regarding nuclear energy before and after Fukushima accident

Yamamura, Eiji

20. October 2011

Effect of transparency on changing views regarding nuclear energy before and after Fukushima accident

Eiji Yamamura

Department of Economics, Seinan Gakuin University

6-2-92 Sawara-ku, Nishijin, Fukuoka 814-8511, Japan

Tel: +81-(0)92-823-4543, Fax: +81-(0)92-823-2506, E-mail: yamaei@seinan-gu.ac.jp

Abstract

Using cross-country data, this paper examines the influence of government transparency on changing views regarding nuclear energy before and after Japan's natural and nuclear disasters of 2011. It was observed that in the majority of countries the rate of favoring nuclear energy declined after the disaster. However, empirical results have shown that this rate is less likely to decrease in a more transparent country, even after a disaster. This implies that views regarding nuclear energy were less elastic to the news of the Fukushima incident when people were more certain about nuclear energy prior to the Fukushima incident.

Keywords: Natural disaster, Nuclear energy, Transparency

JEL classification: D73, D82, H12, Q54

1. Introduction

On March 11, 2011, one of the worst natural disasters in modern times hit Japan—a devastating earthquake accompanied by a tsunami. As a consequence, a number of serious accidents occurred at the Fukushima Daiichi nuclear power plant, resulting in nuclear leakage. This combination of disasters caused tremendous damage to the Japanese economy. Furthermore, economic globalization meant that the effects of the disaster were felt worldwide. In terms of the political consequences, approximately two weeks after the disaster, with nuclear energy becoming a hotly debated international topic, a German political party that opposed nuclear energy won their state election (Baden-Wurttemberg state). This result would indicate that Japan's nuclear disaster has influenced views regarding nuclear energy in countries some distance from Japan.

A growing number of researchers are investigating the outcomes of natural disasters (e.g., Skidmore and Toya 2002; Toya and Skidmore 2007; Yamamura 2010). Existing literature has shown that democratic nations and those with effective governments suffer less damage from natural disasters compared with other countries. (Kahn 2005; Escaleras et al., 2007). Eisensee and Stromberg (2007) have stated that information obtained through the news media can play a critical role in disaster relief. Berger (2010) found that in Germany, nuclear incidents such as Chernobyl can increase an individual's concern for the environment. Both democratic institutions and the mass media play lead roles in ensuring that the preferences of citizens are reflected in policy (Besley and Burgess 2002).[1] Education and media played significant roles in forming citizens' views regarding the events of September 11, 2001 (Gentzkow and Shapiro

[1] Government transparency contributes to increasing economic efficiency (Alt and Lassen 2006; Bruns and Himmler 2011).

2004). The quality and quantity of information regarding nuclear energy was important in forming views about nuclear energy after the incident on March 11, 2011. Yamamura (2012) examined the role of media and its effect on the perceived safety of nuclear energy after the Fukushima accident. He provided evidence that, with the presence of a free media and higher levels of freedom of expression, citizens are less likely to agree that nuclear power plants are properly secured against accidents.

Aside from private mass-media firms, the present paper also focuses on the role of government in providing sufficient information regarding nuclear energy to enable the public to form opinions. The Fukushima incident is considered to be a natural experiment to examine how an unpredicted event can change the views of citizens and the extent to which that influence depends on institution. The persuasion approach offers a useful framework with which to consider the role of government in providing information about nuclear energy (DellaVigna and Gentzkow 2010). According to the belief-based model of persuasion (DellaVigna and Gentzkow 2010), people would be less likely to be affected by news of the Fukushima incident if government had already provided sufficient information regarding nuclear energy. Islam (2006) developed an indicator that measures the frequency with which governments update data to be released to the public. The indicator is considered to represent government transparency (Islam 2006). Data regarding views on nuclear energy before and after the Fukushima incident in each county were sourced from WIN-Gallup International (2011). This paper used these data to investigate the effect of prior information provided by government on any changes in the views of citizens regarding nuclear energy before and after the Fukushima incident. The key finding is that people were less likely to be affected by the Fukushima incident if they had received more frequent government updates, although the rate of favoring nuclear energy declined after the disaster in the majority of countries.

The remainder of the paper is structured as follows: Section 2 outlines the simple empirical model. Data and regression equations are presented in Section 3. Section 4 provides the estimation results and their interpretation. Section 5 concludes.

2. Simple model and hypothesis

To describe the empirical model in a simplistic form, I used a persuasion model framework. As shown by DellaVigna and Gentzkow (2010), persuasion models are generally divided into two categories: belief-based models (Stigler 1961, Telser 1964) and preference-based models (Stigler and Becker 1977; Becker and Murphy 1993). In a belief-based model, which is largely based on Bayesian theory, the weaker the priors of the individuals who receive additional information, the greater the influence that the information will have on their beliefs. To put it differently, new information has a weak influence on the attitudes and behaviors of individuals who are close to certain about the state ex ante.

The effects of receiving prior information are often examined in the domain of political persuasion (Prior 2006; Enikolopov et al. 2009). On this topic, Zaller (1992) found that the Iran-Contra affair did not change individuals' views regarding Ronald Regan, partly because individuals had prior knowledge of his performance. The frequency with which governments update data to be released to the public can be considered the degree of prior knowledge regarding nuclear energy. When the Fukushima incident occurred, citizens received new information regarding nuclear energy via various media sources, such as the Internet. The use of a belief-based framework model would be appropriate to analyze the subject matter of this study. Hence, in a manner similar to previous works of political persuasion, this paper attempts to explore the impact of the Fukushima incident on the views of individuals regarding nuclear energy. A simple empirical model would assume:

$$view(0) = a0 + a1 \times netben(0) + e, \qquad (1)$$

where view(0) are those favoring nuclear power after the incident and netben(0) is the perceived net benefits of nuclear power after the incident. The variable netben(0) also incorporates the perceived risk of a nuclear accident. We would expect $a1 > 0$, i.e., higher perceived net-benefits imply that more people favor nuclear power. In addition:

$$netben(0) = netben(-1) + dnetben, \qquad (2)$$

where netben(–1) is the perceived net-benefits prior to the incident and dnetben is the perceived change in netben after the incident, i.e., dnetben = netben(0) – netben(–1). Note that the variables netben(i) and dnetben are unobservable. We can use view(–1) as a proxy for netben(–1) under the assumption that:

$$netben(-1) = d0 + d1 \times view(-1) + u, \qquad (3)$$

where $d1 > 0$. Further, under additional informational assumptions, to be discussed below, we can also assume that TRAN affects dnetben:

$$dnetben = c0 + c1 \times TRAN + w. \qquad (4)$$

As will be discussed below, it is unclear what sign to expect for c1. However, substituting (2)–(4) into (1) and subtracting view (–1) on both sides, we get our estimated equation:

$$view(0) - view(-1) = b0 + b1 \times view(-1) + b2 \times TRAN + r. \qquad (5)$$

It is unclear what signs to expect for b1 and b2 without further restrictions on the model. To obtain consistent estimates, however, w and u should be uncorrelated with the explanatory variables used in (5).

As previously mentioned, I believe that we can learn more about (4) and (5) by adding further informational structure to the model. To illustrate, let Q be a variable on the [0,1]-interval representing the degree of transparency, where Q = 1 is fully transparent and Q = 0 is entirely non-transparent (e.g., North Korea). Then, Q can be interpreted as the amount of information that passes through to the public. Moreover, let c* be the expected costs of nuclear power under full information (in the following, we ignore benefits that we assume will not be affected by the disaster). Peoples' perceptions of the cost prior to the tsunami could then be represented as:

$$c(-1) = Q \times c^*. \qquad (5)$$

Thus, entirely transparent countries ($Q = 1$) correctly perceive $c(-1) = c^*$, whereas non-transparent countries ($Q = 0$) perceive $c(-1) = 0$. Next, we consider what happens after the disaster, distinguishing between three cases.

CASE 1: All information is revealed

This case assumes that the “full information” cost, c^*, does not change after the disaster. However, it is assumed that the public in all countries can now observe the actual potential costs of nuclear power. That is, regardless of transparency, people can obtain accurate information regarding the nuclear incident after the incident occurs. The emergence and development of cross-border media enables people to obtain the information, even in less transparent countries. The supply of information regarding nuclear energy is drastically increased when the incident takes place. Hence, the amount of information obtained by people via the media, for example, using the Internet, is greater after the incident than before. Hence, before the accident, the information obtained is considered to largely depend on the degree of transparency. This assumption is considered to reflect the real situation in 2011, where the Internet is widely available worldwide.

$$c(0) - c(-1) = c^* - Q \times c^* = c^* (1-Q).$$

Notice that the perceived costs increase in all countries (except those that are fully transparent), but more so in the non-transparent countries. Thus, the change in the perceived costs of nuclear power is negatively related to transparency. In terms of equations (4) and (5), this implies that $c1 > 0$ and $b2 > 0$. From this, I propose Hypothesis 1.

Hypothesis 1:

Views regarding nuclear energy are less likely to change in more transparent countries even after the occurrence of a nuclear accident.

CASE 2: Shock to cost and imperfect pass-through

This case assumes that the disaster resulted in a general shock, w, to the "full information" cost of nuclear power, i.e., costs increase to $c^* + w$. However, a lack of transparency implies that this is not fully revealed in all countries. In contrast to CASE 1, cross-border media has not been well developed and people are unable to obtain information via cross-border media. Therefore, transparency of country is considered to influence the circulation of information after the incident occurs. Thus:

$$c(0) - c(-1) = Q \times (c^* + w) - Q \times c^* = Q \times w.$$

This means that perceived costs increase in all countries, but in contrast to CASE 1 the change is greater in more transparent societies. Thus, the change in the perceived costs of nuclear power is positively related to transparency. In terms of equations (4) and (5), this implies that $c1 < 0$ and $b2 < 0$. Thus, Hypothesis 2 is postulated as follows:

Hypothesis 2:

Views regarding nuclear energy are more likely to change in more transparent countries after the occurrence of a nuclear accident.

CASE 3: Shock to cost and perfect pass-through of shock

This case is similar to CASE 2, but it is now assumed that the shock—and only the shock—is fully observed in all countries. In this situation, cross-border media has not been sufficiently developed, nor is it widespread, although some media is present. Hence, people do receive information regarding the shock, but not regarding nuclear energy.

$$c(0) - c(-1) = Q \times c^* + w - Q \times c^* = w.$$

Now the perceived cost increases in all countries by the same amount, w. Moreover, transparency has no effect on the change, i.e., c1 = b2 = 0. This leads to Hypothesis 3.

Hypothesis 3:

Views regarding nuclear energy are affected by transparency even after the occurrence of a nuclear accident.

3. Data and Specification

In March 2011, approximately two weeks after Japan's natural disaster, WIN-Gallup International (2011) conducted a survey regarding nuclear energy in 47 countries. The survey contained the following questions: "What was your view about nuclear energy prior to the Japan earthquake?" and "What was your view about nuclear energy after the Japan earthquake?" Respondents were given two response options: "favorable" or "unfavorable". The results regarding the favoring of nuclear energy before and after the natural disaster in each county are available from WIN-Gallup International (2011)[2]. The data from this survey were used to calculate any changes in the rate of favoring nuclear energy and the results are presented in Table 1. With the exception of Azerbaijan, Fiji, Morocco, South Africa, and Spain, the rates of favoring nuclear energy are represented by a negative value for the surveyed countries. These results suggest that the nuclear accident in Japan has made people more cautious about nuclear energy. Thus, the accident has had an obvious impact on views regarding nuclear energy worldwide. Respondents may, however, not accurately recall what their views on the matter were prior to the incident. Further, their post-earthquake view may have been only temporarily affected. These possibilities can result in measurement errors, which will then bias the estimation results. This bias, however, is expected to work in the opposite direction, as it will push the coefficient estimates downwards. When coefficient estimates are biased downwards, this is formally known as attenuation bias. Hence, what I estimate in the presence of measurement error is in fact less in magnitude than the true effect. Further, if the measurement errors do not vary systematically across the countries, then the measurement error does not necessary pose a great problem.

The frequency with which government-update data is available to the public is used to represent government transparency (Islam 2006). Therefore, government

---

[2] It is available at http://www.nrc.co.jp/report/pdf/110420_2.pdf (accessed 29 April 2011).

transparency plays a significant role in forming the prior knowledge of citizens. For the 11 representative economic variables, Islam (2006) observed the actual frequency level with which the data are published to create the index of government transparency (TRANS). However, non-economic factors are not taken into account in creating the index because the index is calculated using economic variables. Thus, non-economic factors, such as political issues and whether a Freedom of Information Act (FOI) has been adopted, should be also considered when creating the index. That is, "the transparency index indicates how much economic information governments are willing to disclose—but the FOI law gives access to more than just economic data" (Islam 2006, 131). To this end, Islam (2006) constructed two alternative measures of government transparency, TRANS1 and TRANS2. TRANS1 combines TRANS and a dummy for the adoption of the FOI. TRANS2 is a linear combination of TRANS and a measure for the length of time that FOI has been enacted. Citizens' knowledge of nuclear energy is considered to depend on political accountability. As a robustness check on the impact of government transparency (considered as an effect of citizens' prior knowledge), this paper uses TRANS, TRANS1, and TRANS2 as proxies for government transparency.

Definitions and the basic statistics for the variables used in the estimations are presented in Table 2. The estimated function takes the following form:

$$DVIEW_i = \alpha_0 + \alpha_1 TRANS_i + \alpha_2 BVIEW_i + \alpha_3 NCLEAR_i + \alpha_4 Ln(POP)_i + \alpha_5 GDP_i + \alpha_6 GOVSIZ_i + \alpha_7 EASIA_i + \alpha_8 EUROP_i + \alpha_9 NDIS_i + u_{it},$$

where DVIEW represents a change in the rate of favoring nuclear energy before and after the natural disaster in country i, α represents regression parameters and u is an error term. The rate of favoring nuclear energy before the natural disaster has been included (BVIEW) to control for the initial level of favoring nuclear energy. As nuclear energy plants increase, the likelihood of nuclear accidents also rises. The number of nuclear energy plants is included to control for this effect. Economic factors are captured by including population, GDP per capital, and government expenditure (% of GDP). These data were sourced from the Penn World Table (PWT 6.3) [3]. There appears to be a negative externality with regard to nuclear leakage caused by natural disaster. The possibility of suffering such an externality varies with regard to a nation's distance from Japan. Thus, the location of countries with regard to Japan influences changes in views about nuclear energy. Dummies for East Asian countries and European countries were incorporated into this model to capture such effects. The experience of natural disasters is thought to be related to predictions regarding the outcome of natural disasters and, in turn, influence views regarding nuclear power. To capture this effect, the total number of disasters that have occurred since 1970 are incorporated in the function.

It is likely that nuclear plants will exist in the countries where people favor nuclear energy. The OLS estimation results above possibly suffer from endogeneity bias because there appears to be a reverse causality between the dependent variable (DVIEW) and independent variable (NCLEAR). To control for this bias, instrumental variables were used to conduct the Limited Maximum Likelihood (LIML) Fuller version estimation. The building of nuclear energy plants requires sufficient land area. Furthermore, it is difficult to find the space to build plants in more densely populated countries. Therefore, population density and land area were used as instrumental variables in the LIML estimations. Staiger and Stock (1997) and Stock and Yogo (2005) show that the estimates are likely to be biased if the instruments in a regression are

[3] The data are available from the Center of International Comparisons at the University of Pennsylvania. http://pwt.econ.upenn.edu/ (accessed 28 March 2011).

only weakly correlated with the suspected endogenous variables. The LIML Fuller version of the instrumental variable methods is robust with weak instruments. Furthermore, as the sample size in this paper is only 45, it can be considered a small sample. LIML estimates are robust with small samples, and so the risk of a significantly large bias is minor. Data were obtained from the World Development Indicators.[4]

4. Results

The estimation results for OLS are reported in Table 3. The results for the LIML estimation are exhibited in Table 4, while its first-stage results are in Table 5. In each table, the results using TRANS as a proxy for government transparency are shown in columns (1)–(3), whereas results using TRANS1 and TRANS2 as proxies are in columns (4)–(6) and columns (7)–(9), respectively.

First, I will discuss the results in Table 3. The results for TRANS, TRANS1 and TRANS2 yielded positive signs and were statistically significant in all estimations. The absolute values for TRANS ranged between 1.73 and 1.76, indicating that a 1-point increase in the government transparency index increased DVIEW by 1.73%–1.76%. It follows from this that the influence of government transparency does not vary according to specifications. Results for TRANS1 and TRANS2 are similar to those of TRANS. This implies that citizens' views regarding nuclear energy were less likely to be influenced by the Fukushima accident with a more transparent government. Further, the signs for the coefficients of BVIEW are negative and statistically significant in all columns. Its absolute values are between 0.14 and 0.16, showing that a 1-point higher BVIEW results in an approximately 0.15-point lower DVIEW. I interpreted this result to suggest

[4] The data are available from HP of World Bank http://databank.worldbank.org/ddp/home.do (accessed 28 March 2011).

that citizens who favor nuclear energy were more likely to be affected by the Fukushima accident. With the exception of columns (1) and (2), coefficients for GDP yield the negative sign while being statistically significant. In my interpretation, this means that nuclear energy is necessary for countries with lower GDP levels because citizens in these countries are more likely to believe that nuclear energy is necessary for further economic development. That is, in less developed countries, the benefit of nuclear energy outweighs the cost of nuclear energy (being the negative externality caused by the nuclear incident). In contrast, for those countries with higher GDP levels, citizens are more inclined to believe that the negative externality of nuclear energy outweighs its benefit (being to further economic growth). Most of the other control variables were not statistically significant and did not affect changes in views regarding nuclear energy.

With regard to the LIML estimation results exhibited in Table 4, an over-identification test provided a method of testing for exogeneity in instrumental variables. Test statistics were not significant in columns (1)-(9) and, therefore, do not reject the null hypothesis that the instrumental variables are uncorrelated with the error term. This suggests that the instrumental variables are valid. Further, an endogeneity test shows whether LIML is even necessary. Test statistics were not significant in columns (1)–(9) and do not reject the null hypothesis that NCLEAR is uncorrelated with the error term. Accordingly, the number of nuclear plants is not an endogenous independent variable when DVIEW is the dependent variable. This suggests that OLS is valid and so LIML is not necessary. However, to check the robustness of the OLS results, the LIML results are exhibited. In Table 5, the first-stage results show that the coefficients for land area take the predicted positive sign, whereas the coefficients for population density take the expected negative sign. Further, the coefficients for population density are statistically significant in all columns, although those for land area are not statistically significant. The results for the instrumental variables are consistent with the prediction. In all columns in Table 4, TRANS, TRANS1, and TRANS2 yielded a significant positive sign, which is similar to the results in Table 3. Coefficients for BVIEW and GDP produced negative signs, while being statistically significant in all estimations. All in all, the results in Table 4 are very similar to those in Table 3. The estimation results are considered to be robust. These results strongly support Hypothesis 1.

The above evidence can be interpreted to indicate that citizens' views were not influenced by the Fukushima incident in countries with more transparent governments. Thus, it can be argued that government transparency played a critical role in the formation of views regarding nuclear energy before the Fukushima incident. This is so because information regarding nuclear energy after the Fukushima incident did not change their views, which is consistent with previous research on political persuasion (e.g., Zaller 1992; Prior 2006; Enikolopov et al., 2009).

In the case where cross-border media does not exist, governments can enjoy monopolistic power in the "information market". Even if domestic media exists, governments can still exercise strict control over the media. Hence, transparency reduces the benefit to governments. In other words, the monopolistic power of governments over the "information market" reduces the incentive to become transparent. Furthermore, as suggested by the simple model, transparency reduced the benefit to citizens. The role of transparency becomes important when cross-border media, such as the Internet, is used worldwide. Because of the media, it is difficult for governments to conceal and manipulate information. That is, governments lose monopolistic power in the "information market" because the "spread of the Internet" has made the market competitive. Such competitive pressure increases the incentive of governments to become more transparent. To put it another way, transparency leads to an increase in the benefit to governments, such as support by citizens. In contrast, as exhibited in the basic model, transparency increases the benefit to citizens.

5. Conclusions

News of the Fukushima incident, as a result of a natural disaster, increased the level of information released regarding nuclear energy via various media sources. Even in countries where information is restricted or controlled by government, there was a cross-border information flow via the Internet, enabling citizens to access information. The Fukushima incident renewed the debate regarding the issue of nuclear energy. The views of citizens regarding nuclear energy are thus believed to have been affected by the Fukushima incident. This study used cross-country data from 45 countries to examine how government transparency influenced changes in views regarding nuclear energy before and after the 2011 Japanese disasters. It was observed that in the majority of countries studied in this paper that the rate of favoring nuclear energy declined after the disaster. However, empirical results have shown that this rate is less likely to decrease when governments more frequently update the data to be released to the public, although the rate of favoring nuclear energy declined after the disaster in the majority of countries.

This finding clearly states that views regarding nuclear energy were less elastic to the news of the Fukushima incident in situations where people already held supportive views about the nuclear energy as a result of information provided by their government before the incident. This is in line with belief-based models of persuasion (DellaVigna and Gentzkov, 2010). Based on this key finding, I derive the argument that not only citizens but also governments can increase the benefit of transparency. The importance of transparency, however, appears to depend on the condition of the "information market". The development and diffusion of cross-border media has created a competitive information market, resulting in greater benefits from transparency for both citizens and governments. In other words, government transparency has become more important than ever before, not only for citizens but also for governments.

The sample of data used in this paper is very small and aggregated. For a closer examination of the effect of the incident on citizens' views, individual-level data are required, and as such individual data should be used to examine the hypotheses raised in this paper. This remaining issue is to be addressed in future work.

References

Alt, J.E., Lassen, D.D. (2006). Fiscal transparency, political parties, and debt in OECD countries. *European Economic Review, 50,* 1403-1439.

Becker, G., Murphy, K. 1993. A simple theory of advertising as a good or bad. Quarterly Journal of Economics 108, 942-964.

Besley, T., Burgess, R. 2002. The political economy of government responsiveness: theory and evidence from India. Quarterly Journal of Economics 117, 1415-1451.

Berger, E.M. 2010. The Chernobyl disaster, concern about the environment and life satisfaction. Kyklos 63, 1-8.

Bruns, C., Himmler, O. 2011. Newspaper circulation and local government efficiency. Scandinavian Journal of Economics 113(2), 470-492.

DellaVigna, S., Gentzkow, M. 2010. Persuasion: Empirical evidence. Annual Review of Economics 2, 643-669.

Eisensee, T., Strömberg, D. 2007. News droughts, news floods, and U.S. disaster relief. Quarterly Journal of Economics 122(2), 693-728.

Enikolopov, R., Petrova, M., Zhuravskaya, E.V. 2009. Media and political persuasion: Evidence from Russia. CEPR Discussion papers 7257.

Escaleras, M.,Anbarci, N., Register,C. 2007. Public sector corruption and major earthquakes: A potentially deadly interaction. Public Choice 132(1), 209-230.

Gentzkow, M., Shapiro, J.M. 2004. Media, education and anti-americanism in the Muslim world. Journal of Economic Perspectives, 18(3), 117-133.

Islam, R. 2006. Does more transparency go along with better governance? Economics and Politics 18, 121-167.

Kahn, M. 2005. The death toll from natural disasters: The role of income, geography and institutions. Review of Economics and Statistics 87(2), 271-284.

Prior, M. 2006. The incumbent in the living room: The rise of television and the incumbency advantage in U.S. house elections. Journal of Politics 68, 657-673.

Skidmore, M., Toya,H. 2002. Do natural disasters promote long-run growth?," Economic Inquiry 40(4),664-687.

Staiger, D., Stock, J. 1997. Instrumental variables regression with weak instruments. Econometrica, 65, 557-586.

Stigler, G.J. 1961. The economics of information. Journal of Political Economy 69, 213-225.

Stigler, G.J., Becker, G. 1977.De gustibus non est dsuputandum. American Economic Review 67, 76-90.

Stock, J., Yogo, M. 2005. Testing for weak instruments in linear IV regression. in D. Andrews and J. Stock, eds., Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg, Cambridge: Cambridge University Press, 80-108.

Telser, L.G. 1964. Advertising and competition. Journal of Political Economy 72, 537-562.

Toya, H., Skidmore, M. 2007. Economic development and the impacts of natural disasters. Economics Letters 94(1), 20-25.

WIN-Gallup International. 2011. Impact of Japan earthquake on views about nuclear energy: Findings from a Global Snap Poll in 47 countries by WIN-Gallup International.

Yamamura, E. 2010. Effects of interactions among social Capital, income and learning from experiences of natural disasters: A case study from Japan. Regional Studies, 44(8), 1019-1032.

Yamamura, E, 2012. Effect of free media on views regarding the safety of nuclear energy after the 2011 disasters in Japan: evidence using cross-country data. Forthcoming in Kyklos.

Zaller, J.R. 1992. *The Nature and Origins of Mass Opinion.* Cambridge University Press.

Table 1 Change in views regarding nuclear energy
(rate of favoring nuclear energy after a natural disaster) – (rate of favoring nuclear energy before a natural disaster)

Country	Difference	Country	Difference
Austria	–4	Italy	–4
Azerbaijan	3	Japan	–23
Bangladesh	–13	Kenya	–11
Belgium	–9	South Korea	–1
Bosnia and Herzegovina	–3	Latvia	–1
Brazil	–2	Macedonia	–2
Bulgaria	–6	Morocco	19
Cameroon	–4	Netherlands	–7
Canada	–8	Nigeria	–2
China	–13	Pakistan	–2
Colombia	–1	Palestine	–9
Czech	–2	Poland	–6
Egypt	–13	Romania	–10
Fiji	1	Russia	–11
Finland	–6	Saudi Arabia	–9
France	–8	Serbia	–4
Georgia	–9	South Africa	4
Germany	–8	Spain	2
Greece	–2	Switzerland	–6
Hong Kong	–8	Tunisia	–5
Iceland	–6	Turkey	–4
India	–9	United States	–6
Iraq	–13	Vietnam	–5
Ireland	–4		

Note: Serbia and Palestine are excluded in the regression estimation because independent variable data was not available.

Table 2 Definition of variables and its descriptive statistics

	Definition	Mean	Standard deviation
BVIEW	Rate of favoring nuclear energy before earthquake (%)	44.5	17.4
AVIEW	Rate of favoring nuclear energy after earthquake (%)	39.2	15.3
DVIEW	AVIEW – BVIEW (%)	–5.3	6.1
TRANS	Government transparency indicator: 1(low)–6(high)	5.1	1.0
TRANS1	TRANS + dummy for Freedom of Information Act: 1(low)–7(high)	5.7	1.4
TRANS2	TRANS + measure of length of time country has had Freedom of Information Act: 1(low)–11(high)	6.3	2.2
NCLEAR	Number of nuclear power plants in operation	7.7	19.1
POP	Population (Millions)	101.5	251.1
GDP	GDP per capita (million dollars)	1.9	1.4
GOVSIZ	Government expenditure of GDP (%)	16.0	8.4
NDIS	Total number of natural disasters since 1970	96.5	139.9
EASIA	Dummies for East Asian countries (Japan, China, and Korea).	---	---
EUROP	Dummies for European countries.	---	---

Note: BVIEW, AVIEW and DVIEW were obtained from WIN-Gallup International (2011). TRANS was sourced from Islam (2006) and NCLEAR from HP of European nuclear society (http://www.euronuclear.org/info/npp-ww.htm accessed at April 30, 2011). POP, GDP and GOVSIZ were obtained from Penn World Table 6.3. (http://pwt.econ.upenn.edu/php_site/pwt_index.php. accessed at April 30, 2011). NDIS was obtained from the International Disaster Database (http://www.emdat.be. accessed at April 30, 2011).

Table 3 OLS estimation

Dependent variable: DVIEW(the difference in views regarding nuclear energy)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TRANS	1.73**	1.73**	1.76**						
	(2.18)	(2.20)	(2.14)						
TRANS1				1.60**	1.59**	1.60**			
				(2.54)	(2.51)	(2.55)			
TRANS2							0.97*	0.97*	0.96*
							(1.83)	(1.87)	(1.86)
BVIEW	-0.14*	-0.14**	-0.14**	-0.15**	-0.15**	-0.15**	-0.16**	-0.16**	-0.16**
	(-2.01)	(-2.05)	(-2.09)	(-2.17)	(-2.21)	(-2.24)	(-2.15)	(-2.18)	(-2.20)
NCLEAR	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.04	-0.04	-0.04
	(-0.24)	(-0.33)	(-0.36)	(-0.43)	(-0.52)	(-0.60)	(-0.72)	(-0.94)	(-1.02)
Ln (POP)	-0.57	-0.59	-0.59	-0.47	-0.45	-0.43	-0.35	-0.37	-0.35
	(-0.97)	(-1.20)	(-1.21)	(-0.89)	(-1.02)	(-0.98)	(-0.68)	(-0.93)	(-0.87)
GDP	-1.21	-1.22	-1.17*	-1.38*	-1.37*	-1.17*	-1.43*	-1.43*	-1.20*
	(-1.52)	(-1.52)	(-1.83)	(-1.73)	(-1.69)	(-1.88)	(-1.71)	(-1.74)	(-1.83)
GOVSIZ	-0.01	-0.01		-0.05	-0.05		-0.05	-0.05	
	(-0.13)	(-0.14)		(-0.45)	(-0.45)		(-0.50)	(-0.52)	
EASIA	-3.68	-3.70	-3.76	-3.85	-3.82	-3.97	-2.42	-2.44	-2.62
	(-0.60)	(-0.64)	(-0.66)	(-0.64)	(-0.67)	(-0.71)	(-0.43)	(-0.46)	(-0.50)
EUROP	-2.64	-2.62	-2.76	-2.83	-2.85*	-3.21*	-2.11	-2.09	-2.49
	(-1.49)	(-1.64)	(-1.62)	(-1.55)	(-1.70)	(-1.81)	(-1.19)	(-1.29)	(-1.48)
NDIS	$-0.45*10^{3}$			$0.65*10^{3}$			$-0.46*10^{3}$		
	(-0.04)			(0.07)			(-0.05)		
Constant	2.47	2.63	2.17	2.85	2.62	1.43	4.70	4.87	3.53
	(0.44)	(0.45)	(0.43)	(0.50)	(0.44)	(0.27)	(0.83)	(0.80)	(0.66)
Adjusted R^2	0.35	0.35	0.35	0.37	0.37	0.36	0.37	0.37	0.36
Observations	45	45	45	45	45	45	45	45	45

Note: Values in parentheses are t-statistics calculated by robust standard errors. * and ** denote significance at the 10% and 5% levels, respectively.

Table 4 LIML estimation

Dependent variable: DVIEW(the difference in views regarding nuclear energy)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TRANS	1.65** (2.24)	1.71** (2.37)	1.77** (2.33)						
TRANS1				1.33** (2.17)	1.45** (2.36)	1.46** (2.38)			
TRANS2							0.71* (1.75)	0.7 9 * (1.77)	0.79* (1.72)
BVIEW	-0.15*** (-2.61)	-0.15** (-2.49)	-0.15** (-2.50)	-0.17*** (-2.83)	-0.16*** (-2.71)	-0.16*** (-2.70)	-0.17*** (-2.73)	-0.17*** (-2.63)	-0.16*** (-2.61)
NCLEAR	0.08* (1.79)	0.04 (0.67)	0.04 (0.59)	0.10** (2.07)	0.05 (0.77)	0.05 (0.66)	0.06 (1.24)	0.02 (0.31)	0.01 (0.19)
Ln (POP)	-0.68 (-1.24)	-0.88* (-1.72)	-0.86* (-1.67)	-0.58 (-1.16)	-0.82* (-1.75)	-0.77 (-1.64)	-0.43 (-0.89)	-0.63 (-1.46)	-0.59 (-1.33)
GDP	-1.82** (-2.31)	-1.72* (-1.86)	-1.58** (-2.14)	-2.02*** (-2.65)	-1.96** (-2.16)	-1.65** (-2.39)	-1.80** (-2.43)	-1.76** (-2.23)	-1.45** (-2.42)
GOVSIZ	-0.03 (-0.26)	-0.03 (-0.31)		-0.06 (-0.60)	-0.07 (-0.68)		-0.06 (-0.61)	-0.07 (-0.69)	
EASIA	-3.43 (-0.55)	-3.72 (-0.67)	-3.83 (-0.68)	-3.44 (-0.54)	-3.79 (-0.67)	-4.01 (-0.70)	-2.38 (-0.41)	-2.59 (-0.49)	-2.81 (-0.53)
EUROP	-2.48 (-1.45)	-2.33 (-1.49)	-2.61* (-1.66)	-2.47 (-1.37)	-2.36 (-1.39)	-2.89* (-1.71)	-1.84 (-1.13)	-1.70 (-1.12)	-2.23 (-1.45)
NDIS	-0.007 (-0.83)			-0.007 (-0.86)			-0.006 (-0.82)		
Constant	5.61 (1.05)	6.67 (1.08)	5.48 (1.08)	7.21 (1.29)	8.28 (1.26)	6.27 (1.12)	8.16 (1.58)	9.24 (1.47)	7.27 (1.34)
Over-identification test	0.50 P-value =0.47	1.19 P-value =0.27	1.34 P-value =0.24	0.47 P-value =0.49	1.13 P-value =0.28	1.35 P-value =0.24	0.44 P-value =0.50	1.15 P-value =0.28	1.41 P-value=0.23
Endogeneity test	1.67 P-value =0.19	0.90 P-value =0.34	0.80 P-value =0.37	1.80 P-value =0.17	0.94 P-value =0.33	0.76 P-value =0.38	1.86 P-value =0.17	0.88 P-value =0.34	0.70 P-value =0.40

Centered R^2	0.19	0.33	0.33	0.29	0.33	0.33
Observations	45	45	45	45	45	45

Note: Values in parentheses are t-statistics calculated by robust standard errors obtained. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Instrumental variables are population density and land area.

Table 5 LIML estimation (First Stage)

Dependent variable: NCLEAR (Number of nuclear plants)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Land area	0.38	1.00	1.07	0.26	0.92	0.97	0.20	0.78	0.82
	(0.36)	(0.96)	(1.06)	(0.25)	(0.90)	(0.97)	(0.19)	(0.79)	(0.85)
Population density	-4.51**	-4.05*	-4.07*	-4.71**	-4.19*	-4.23**	-4.20**	-3.75*	-3.77*
	(-2.34)	(-1.82)	(-1.84)	(-2.39)	(-1.84)	(-2.12)	(-2.37)	(-1.79)	(-1.81)
TRANS	0.61	-0.01	-0.43						
	(0.31)	(-0.01)	(-0.19)						
TRANS1				2.24	1.57	1.57			
				(1.08)	(0.85)	(0.87)			
TRANS2							2.19	2.30	2.35
							(1.27)	(1.39)	(1.43)
BVIEW	0.14	0.13	0.13	0.14	0.14	0.13	0.12	0.12	0.12
	(1.11)	(1.03)	(0.99)	(1.12)	(1.09)	(1.07)	(1.02)	(1.02)	(0.99)
Ln (POP)	0.34	3.23*	3.24*	0.11	3.06*	3.00*	0.19	2.89*	2.83*
	(0.17)	(1.82)	(1.84)	(0.05)	(1.82)	(1.81)	(0.10)	(1.84)	(1.83)
GDP	7.01**	8.56*	7.98*	6.07**	7.76*	7.02*	4.84*	6.01	5.30
	(2.46)	(1.88)	(1.87)	(2.37)	(1.83)	(1.83)	(1.72)	(1.57)	(1.55)
GOVSIZ	0.10	0.22		0.08	0.22		0.06	0.19	
	(0.54)	(1.32)		(0.46)	(1.26)		(0.37)	(1.11)	
EASIA	-3.86	-0.27	0.57	-4.94	-1.13	-0.41	-2.16	1.14	1.80
	(-0.18)	(-0.02)	(0.03)	(-0.24)	(-0.06)	(-0.02)	(-0.11)	(0.07)	(0.11)
EUROP	-5.13	-7.40	-5.68	-6.68	-8.87	-7.39	-5.70	-8.40	-7.13
	(-0.67)	(-0.82)	(-0.70)	(-0.84)	(-0.92)	(-0.84)	(-0.82)	(-0.92)	(-0.85)
NDIS	0.06			0.06			0.06		
	(1.37)			(1.46)			(1.38)		
Constant	23.1	-47.8**	-41.7**	-27.4	-52.9**	-47.9**	-26.4	-52.6**	-48.4**
	(0.87)	(-2.09)	(-2.00)	(-1.05)	(-2.17)	(-2.12)	(-1.11)	(-2.27)	(-2.22)
F-test	F=3.89	F=1.78	F=1.84	F=4.01	F=1.81	F=1.84	F=3.53	F=1.64	F=1.68
	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value
	=0.03	=0.18	=0.17	=0.02	=0.17	=0.17	=0.04	=0.20	=0.20
Partial R^2 of	0.09	0.10	0.11	0.10	0.10	0.11	0.08	0.08	0.08

excluded instruments				
Observations	45	45	45	45

Note: Values in parentheses are t-statistics calculated by robust standard errors. * and ** denote significance at the 10% and 5% levels, respectively. Instrumental variables are population density and land area.