Effect of free media on views regarding nuclear energy after the Fukushima accident

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SUMMARY

Using cross-country data, this paper investigates how governance influenced views regarding the security of nuclear energy after the Fukushima accident in Japan. Key findings are: (1) citizens are less likely to agree that nuclear power plants are properly secured against accidents with the presence of a free media and higher levels of freedom of expression; and (2) freedom of expression and free media are positively associated with the presence of nuclear plants. These findings indicate that sufficient information leads citizens to both understand the risk of nuclear energy and to accept the existence of nuclear plants.

Keywords: Natural disaster, Nuclear energy, Governance, Information asymmetry.

JEL classification: D73, D82, H12, Q54.

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I. INTRODUCTION

Japan was struck by one of the largest earthquakes in recorded history on March 11, 2011. Following the earthquake, a devastating tsunami arrived at the northeastern coast of Japan. The combination of earthquake and tsunami resulted in catastrophic damage. The Fukushima Daiichi nuclear plants, located on the coast of Fukushima Prefecture in northeastern Japan, were crippled by the disasters, causing Japanese citizens to confront the danger of nuclear leakage. Just a month before a powerful earthquake and tsunami crippled the plant, government regulators approved a 10-year extension for the oldest of the six reactors at the power station despite warnings about its safety. Nuclear leakage appears to be caused not only by natural disasters but also human error. Political factors are considered to play an important role in reducing economic loss when unexpected events occur (Kahn, 2005; Escaleras et al., 2007).[1] The Japanese government, however, provided confusing and inappropriate information regarding the Fukushima accident. As a result, citizens distrust the Japanese government and have criticized government policy concerning nuclear energy.

Japan's nuclear disaster is believed to affect citizens' perceptions and views regarding the security of nuclear energy, not only in Japan but worldwide.[2] Under-perception about disasters leads to inappropriate actions when preventive measures could be taken (Zeckhauser, 1996). Media is considered to play an important

[1] As well as political institutions, unwritten social norms also play a key role in saving the lives of females and children before males and adults, as in the Titanic disaster (Frey et al., 2010; 2011).

[2] Since Three Mile Island and Chernobyl accidents, the security of nuclear energy has been at the fore of public attention. More recently, data regarding the long-term effect of the Chernobyl disaster has been accumulated, enabling the economic and political outcomes of the Chernobyl accident to be analyzed in the field of social science (Danzer and Weisshaar 2009; Almond et al. 2009). In Germany, people became more likely to worry about the environment after the Chernobyl disaster, even though the disaster did not reduce the life satisfaction of German citizens (Berger, 2010).

role in economic development (Coyne and Leeson, 2004). Free media has been allowed to flourish, contributing to greater political accountability and improving citizens' perceptions. Under such conditions, politicians who are aware that voters are well-informed regarding politicians' activities have a greater incentive to offer benefits to all citizens rather than just to small pressure groups (Besley and Burgess, 2002). Citizens can also form an informed view regarding the security of nuclear power if freedom of media enables citizens to obtain sufficient information. The nuclear energy market is considered to lack healthy competition, partly because of rent-seeking behavior. For example, a firm may engage in rent-seeking behavior so that the government will allow it to operate as a monopoly (Krueger 1974; Tullock 1967). In response to that behavior, the government favors the firm. Hence, the government tends to conceal negative information regarding the security of nuclear energy. In this situation, freedom of media enables citizens to obtain relevant information and to therefore determine that nuclear energy is not properly secured. Thus, I propose the hypothesis that freedom of media will decrease the likelihood that citizens will agree that nuclear power plants are properly secured.

Using cross-country data collected after the 2011 Japan disaster, this paper attempts to examine the above hypothesis. The structure of this paper is as follows. Data and empirical strategy are explained in section II. The results of the estimations are reported in section III. The final section presents my conclusions.

II. DATA AND EMPIRICAL STRATEGY

WIN-Gallup International (2011) conducted a survey regarding nuclear energy approximately 2 weeks after Japan's natural disaster. Thirty-seven countries were

asked 'To what extent do you agree or disagree that nuclear power plants in your country (or near countries) are properly secured against accidents?' There were five response options: 'strongly agree', 'agree', 'neither agree nor disagree', 'disagree', and 'strongly disagree'. Response rates from each county are available from WIN-Gallup International (2011).[3] The World Bank conducted a World Governance Indicators (WGI) project and provided the governance indicator of 'Voice and Accountability'.[4] Kaufmann et al. (2010 p. 4) state that 'Voice and Accountability' captures the 'perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.' The value of 'Voice and Accountability' becomes larger as the country's citizens are more able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.[5]

Table 1 shows the definitions of the variables used in this paper, and their mean differences between countries with nuclear plants and those without. SECURE for countries with nuclear plants is significantly larger than those without nuclear plants. I interpret this result as suggesting that the citizens who live in countries with nuclear plants are more likely to believe nuclear energy to be secure and hence support pro-nuclear policy. 'Voice and Accountability' (MEDIA) for countries with nuclear plants is larger than those without plants and the difference is statistically significant. This leads me to argue that citizens who obtain appropriate levels of information regarding nuclear energy via the media are more inclined to support nuclear energy.

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[3] List of countries is available upon request from the author.
[4] Data is available from http://info.worldbank.org/governance/wgi/index.asp (accessed April 28, 2011).
[5] Coyne and Leeson (2009) argue that media changes the existing institution. A country's level of media freedom is influenced by media from neighboring countries (Sobel et al., 2010).

The relationship between SECURE and MEDIA is illustrated in Figure 1. Figure 1 shows that the governance of media is negatively related to views regarding security. China is, however, considered an outlier because 80% of citizens in China agree that nuclear energy is properly secured, which is a significantly greater percentage than in other countries. For a closer examination, I will investigate causality using regression estimations later in the paper. The estimated function of the regression analysis takes the following form:

$$SECURE_i = \alpha_0 + \alpha_1 NUCLE_i + \alpha_2 MEDIA_i + \alpha_3 DISAST_i + \alpha_4 GDP_i + \alpha_5 GOVSIZ_i + \alpha_6 EASIA_i + u_{it},$$

where $SECURE_i$ represents the rate of those agreeing that nuclear plants are secured in country i. α represents regression parameters and u is an error term. Independent variables are NUCLE, to control for the presence of nuclear plants, and MEDIA, the key variable to capture the degree of governance regarding media. The hypothesis proposed in the previous section expects the coefficient of MEDIA to take the negative sign. DISAST is incorporated to control for the experience of natural disasters because experience influences perceptions regarding accidents caused by natural disasters (Viscusi and Zeckhauser, 2006). Economic factors are controlled by the inclusion of GDP and GOVSIZ. The location of countries appears to be related with the change in perceptions caused by the Japan disaster. Neighboring countries to Japan, such as Korea and China, are more likely to be affected by the Japanese accident. For the purpose of capturing this effect, EASIA is included.

Information asymmetry between government (or media) and citizens is thought to influence citizens' views regarding the security of nuclear energy, especially when unexpected nuclear incidents occur. 'Voice and Accountability' is used as a proxy in this

study for the degree of information symmetry between government and citizens in each country.

As seen in Table 1, nuclear energy is likely to exist when people consider nuclear energy to be secured. OLS estimation results are believed to suffer from endogeneity bias because reverse causality appears to exist between the dependent variable SECURE and the independent variable NUCLE. With the aim of controlling for this bias, I used instrumental variables to conduct 2SLS estimations. Sufficient land area is required to build nuclear energy plants. In addition, it is more difficult to find the space to build plants in more densely populated countries. Hence, population density, land area, and a log of population are used as instrumental variables for the 2SLS estimations. These variables were obtained from the World Development Indicators.[6]

III. RESULTS

The OLS estimation results are reported in Table 2. The second stage 2SLS results appear in Table 3. Table 4 presents the first stage results of the 2SLS estimations. In each table, results using the full sample are reported in columns (1)–(3), while results using the sample excluding the outlier (China) are in columns (4)–(6). There are a total of 37 observations, reduced to 36 when the outlier (China) is excluded. As the sample size is small the jackknife method was used to calculate the standard error to ensure that the results were not spurious.

To follow is a discussion of the OLS estimations. Table 2 shows that NUCLE takes the positive sign and is statistically significant at the 1% level in all columns. After excluding the outlier, the absolute values of NUCLE are approximately 27,

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

suggesting that SECURE for countries with nuclear plants is 27% larger than those without nuclear plants. MEDIA yields the negative sign and is statistically significant in all columns. Hence, freedom of media reduces the rate of citizens' believing that nuclear energy is secure. The absolute values of MEDIA are approximately 0.5 when the full sample is used, and approximately 0.4 when China is excluded from the sample. This means that an outlier such as China increases the effect of MEDIA on SECURE. The significant negative effect of MEDIA, however, continues to exist after removing the outlier effect. EASIA is not statistically significant in column (1), but produces a significant negative sign in column (4). This suggests that citizens living in a neighboring country to Japan are less likely to agree that nuclear energy is secure when China is excluded. Other control variables were not statistically significant and they do not influence SECURE, with the exception of GDP in columns (3) and (6).

Looking at the results of the 2SLS estimation shown in Table 3, an overidentification test provided a method of testing for exogeneity in the instrumental variables. Test statistics are not significant in columns (1)–(6) and thus do not reject the null hypothesis that the instrumental variables are uncorrelated with the error term. This suggests that the instrumental variables are valid. I see from Table 3 that the sign of NUCLE is statistically significant at the 1% level in all columns. Absolute values of NUCLE range from 28.4 to 30.3, which are larger than those in Table 2. MEDIA yields the negative sign and is statistically significant at the 1% level in all columns. Absolute values range from 0.42 to 0.55, which are almost the same as those in Table 2. Concerning the other control variables, and in line with Table 2, the results are not statistically significant, with the exception of GDP in columns (3) and (6). Therefore, on the whole, the combined results from Tables 2 and 3 lead me to argue that the

estimation results are robust when alternative specifications are used.[7]

As is exhibited in Table 4, results of the first stage estimation show that 'land area' and 'population density' take the positive and negative signs, in all columns, respectively, which is consistent with the proposition, although 'population density' is not statistically significant. The increasing demand for electricity reflects the growing population. The significant positive sign of Ln (population) is believed to reflect that a greater demand for electricity is a greater demand for nuclear energy. As with the results of the instrumental variables, it is also interesting to observe that MEDIA yields the positive sign and is statistically significant. Hence, freedom of media leads citizens to support the presence of nuclear energy.

V. CONCLUSION

How a country is to cope in a state of emergency, such as a nuclear disaster, is a very important issue. Japan's example suggests the importance of governance regarding disaster information when a state of emergency arises. Furthermore, it is worth exploring how freedom of media influences views and perceptions concerning the security of nuclear energy against accidents. This study used cross-country data from 37 countries to examine how freedom of media affected views on the security of nuclear energy after the Fukushima nuclear accident in Japan. After controlling for various factors and endogeneity bias, estimation results showed that (1) citizens are less likely to agree that nuclear power plants are properly secured against accidents when freedom

[7] The World Bank has constructed various measures of quality of governance, such as 'regulatory quality', 'rule of law', and 'control of corruption'. In addition to 'Voice and control', this paper also examined the effects of other proxy variables as above, regarding views on nuclear energy although the results were not reported. No significant effects were found. The results are available upon request from the author.

of expression and a free media are assured to a greater degree, and (2) freedom of expression and free media are positively associated with the presence of nuclear plants.

Greater freedom of expression and free media are believed to reduce information asymmetry between government and citizens. Hence, the findings of this study imply that information asymmetry has a critical influence on the presence of nuclear plants as well as perceptions regarding the security of nuclear energy against accidents. That is, the appropriate information enables citizens to understand more fully the risk of nuclear energy, whereas citizens accept the presence of nuclear plants when insufficient information has been provided. From this I derive the argument that freedom of media enables citizens to calculate the benefits and costs of the presence of nuclear energy, and then to properly make an informed decision regarding nuclear policy.

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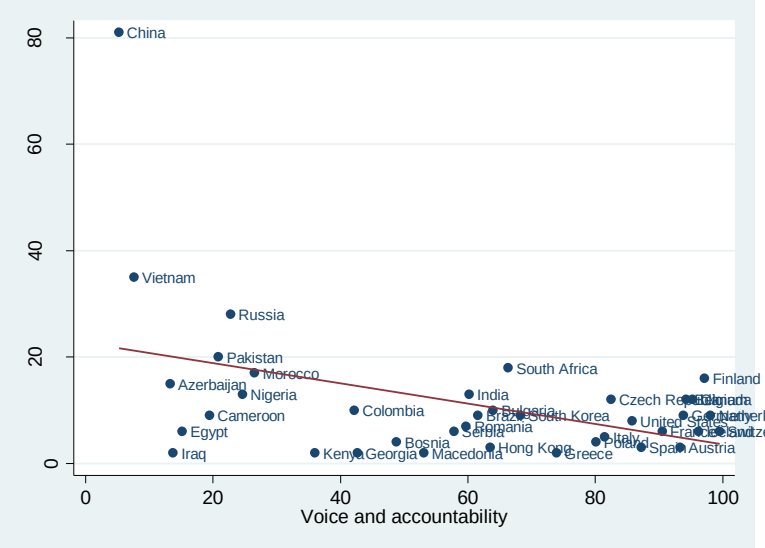

Figure 1

Relationship between views regarding security and governance (full sample)

Table 1

Definition of variables and descriptive statistics

	Definition	With nuclear plants	Without nuclear plants.	t-statistics
SECURE	Rate of agreeing (or strongly agreeing) that nuclear power plants in your country (or nearby country) are properly secured against accidents (%)	44.0	22.7	4.35***
NUCLE	Dummy variable for the presence of nuclear plants: country having nuclear plants takes 1, otherwise 0	---	---	---
MEDIA	Indicator for governance, 'Voice and Accountability' of the Worldwide Governance Indicators (World Bank)	71.2	46.8	2.29**
DISAST	Total number of natural disasters since 1970	152.7	49.3	1.85*
GDP	GDP per capita (million dollars)	2.3	1.5	1.85*
GOVSIZ	Government expenditure of GDP (%)	15.8	16.9	0.37
EASIA	Dummies for East Asian countries (China and Korea).	---	---	---

Note: Values in parentheses are absolute t-statistics. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. SECURE is obtained from WIN-Gallup International (2011). MEDIA is obtained from http://info.worldbank.org/governance/wgi/index.asp (accessed April 28, 2011). NUCLE is collected from HP of European Nuclear Society (http://www.euronuclear.org/info/npp-ww.htm (accessed April 30, 2011). GDP and GOVSIZ are sourced from Penn World Table 6.3. http://pwt.econ.upenn.edu/php_site/pwt_index.php (accessed April 30, 2011). DISAST is obtained from the International Disaster Database http://www.emdat.be (accessed April 30, 2011).

Table 2

OLS estimation; dependent variable: SECURE (rate of agreeing (or strongly agreeing) with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	27.1***	28.3***	28.5***	27.0***	26.1***	26.3***
	(5.84)	(5.17)	(5.37)	(6.41)	(6.24)	(6.47)
MEDIA	–0.48**	–0.51**	–0.54***	–0.40***	–0.39**	–0.42***
	(–2.44)	(–2.54)	(–2.91)	(–2.72)	(–2.61)	(–2.96)
DISAST	–0.0001	0.003	0.002	–0.01	–0.01	–0.01
	(–0.00)	(0.08)	(0.07)	(–1.03)	(–0.97)	(–0.96)
GDP	5.41	5.81	6.57**	4.31	4.26	5.43**
	(1.33)	(1.43)	(2.20)	(1.60)	(1.48)	(2.70)
GOVSIZ	–0.14	–0.14		–0.24	–0.22	
	(–0.22)	(–0.24)		(–0.57)	(–0.46)	
EASIA	9.78			–11.8***		
	(0.24)			(–3.33)		
Constant	39.8***	40.7***	38.0***	40.3***	39.5***	35.6***
	(3.28)	(3.44)	(5.27)	(4.01)	(3.79)	(5.58)
Adjusted R^2	0.52	0.52	0.53	0.45	0.45	0.45
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3

2SLS estimation; dependent variable: SECURE (rate of agreeing (or strongly agreeing) with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	28.4***	28.5***	29.3***	29.3***	29.0***	30.3***
	(4.06)	(3.87)	(3.93)	(4.07)	(4.54)	(4.89)
MEDIA	–0.50***	–0.52***	–0.55***	–0.43***	–0.42***	–0.47***
	(–2.85)	(–2.82)	(–3.23)	(–3.31)	(–3.34)	(–3.77)
DISAST	–0.001	0.002	0.001	–0.02	–0.02	–0.02
	(–0.04)	(0.07)	(0.03)	(–1.04)	(–1.07)	(–1.15)
GDP	5.56	5.83	6.65**	4.61*	4.61*	5.84***
	(1.49)	(1.52)	(2.39)	(1.89)	(1.79)	(3.23)
GOVSIZ	–0.14	–0.14		–0.24	–0.21	
	(–0.23)	(–0.24)		(–0.89)	(–0.48)	
EASIA	9.14			–12.9***		
	(0.23)			(–3.13)		
Constant	40.0***	40.7*	38.1***	40.5***	39.7***	36.1***
	(3.34)	(3.42)	(5.30)	(4.21)	(3.97)	(5.83)
Overidentification (Sargan) Test	0.05 P-value=0.97	0.04 P-value=0.97	0.03 P-value=0.98	0.05 P-value=0.97	0.01 P-value=0.99	0.07 P-value=0.96
Adjusted R^2	0.60	0.59	0.58	0.54	0.52	0.50
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated by standard errors obtained by the jackknife method. *, ** and *** denote significance at the 10%, 5 % and 1% levels, respectively. Instrumental variables are land area, population density and log of population in 2009. These variables are obtained from World Development Indicators 2010 (CD-Rom version).

Table 4

First stage 2SLS estimations presented in *Table 3(1)* and *Table 3(2)*; dependent variable: NUCLE (country with nuclear energy takes 1, otherwise 0)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
Land area	0.43*	0.40*	0.40*	0.43*	0.43*	0.40*
	(1.87)	(1.69)	(1.75)	(1.82)	(1.70)	(1.76)
Population density	–0.005	–0.01	–0.01	–0.004	–0.005	–0.005
	(–0.07)	(–0.20)	(–0.20)	(–0.06)	(–0.08)	(–0.08)
Ln (population)	0.12**	0.13**	0.12**	0.12**	0.13**	0.13**
	(1.91)	(2.00)	(2.00)	(1.88)	(2.05)	(2.13)
MEDIA	0.01***	0.01**	0.01***	0.01***	0.01***	0.01***
	(2.86)	(2.54)	(2.75)	(2.78)	(2.75)	(2.96)
DISAST	–0.0004	–0.0001	–0.0001	–0.0004	–0.0005	–0.0004
	(–0.57)	(–0.27)	(–0.23)	(–0.58)	(–0.66)	(–0.66)
GDP	–0.07	–0.05	–0.06	–0.07	–0.07	–0.07
	(–0.68)	(–0.44)	(–0.61)	(–0.68)	(–0.61)	(–0.76)
GOVSIZ	0.001	0.001		0.001	0.001	
	(0.21)	(0.21)		(0.19)	(0.13)	
EASIA	0.48			0.44		
	(1.56)			(0.19)		
Constant	–1.48**	–1.53**	–1.46**	–1.58**	–1.58**	–1.54**
	(–2.05)	(–2.06)	(–2.24)	(–2.13)	(–2.13)	(–2.36)
Adjusted R^2	0.41	0.38	0.40	0.39	0.39	0.38
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Instrumental variables are land area, population density, and log of population in 2009. These variables were obtained from the World Development Indicators 2010 (CD-Rom version).