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Religious, environmental, and political factors affecting the acceptance of nuclear power plants

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ABSTRACT

This study investigated the role of religious factors as determinants of public acceptance of nuclear power plants. Mixed views have been expressed regarding nuclear power plants, depending on whether the benefits of nuclear energy, such as economic benefits and convenience, are weighed against potential risks or vice versa. Various factors are assumed to influence views on nuclear power. Using financial panel survey data, the findings revealed that the presence of religious belief alone did not significantly impact acceptance of nuclear power plants. Nonetheless, the Catholic group exhibited a lower level of acceptance of nuclear power plants. In addition, the difference between the Buddhist and Protestant groups is not statistically significant because both religions have not established a clear view of nuclear energy. By analyzing religious factors as determinants of nuclear power acceptance in addition to environmental and political factors, this study provides evidence that individual religion or type of religion has a significant influence on nuclear power policy.

Contribution/Originality: Related studies have examined the determinants of nuclear power plant acceptance, focusing on environmental and political factors. This study contributes to related literature by suggesting that religion has an additional influence on nuclear power plant acceptance.

1. INTRODUCTION

Worldwide views on nuclear power plants stand in stark contrast to one another, that is, positive and negative (Siegrist & Visschers, 2013; Sun & Zhu, 2014). Nuclear power plants (generation) ("NPP") combine the advantages of being environmentally friendly and a source of low-cost electricity, unlike fossil fuel-based electrical energy, with the disadvantages of accident risk that may cause fatal harm to human beings. For example, the explosion at the Fukushima NPP has undermined the positive perception or sense of pride shared by Japanese people regarding the safety of NPPs (Wang & Kim, 2013).

However, no energy source can completely replace nuclear power to generate electricity, which is essentially required for the growth of the national economy. Although efforts to develop alternative energy sources such as wind power and solar energy continue, the output is still meager in the current technological and social contexts. Any attempt to reduce or dump the dependence on nuclear energy cannot therefore be a possible alternative (Cao & Mok, 2015). Indeed, many countries make policy decisions to gain public acceptance of nuclear power as a source of electricity generation despite the risks; thus, any alternatives that can promote public acceptance of NPPs are necessary. Following the nuclear accident at Fukushima, Japan, an increasing number of studies have addressed

public acceptance of NPPs and mostly analyzed environmental and political factors that influence acceptance decisions.

This study focuses on the relationship between different religious beliefs and nuclear power acceptance. Specifically, according to the literature, Buddhists may have both positive and negative views on nuclear power based on their perspectives on life, whereas Catholicism may take a negative attitude as the economic benefits of nuclear power are overly optimistic estimates derived from fetishism or fetishistic beliefs. Protestants predominantly have a negative view of nuclear power due to its possible severe impacts on humans, which they think exceed the economic benefits and convenience of nuclear power. Based on these different religious attitudes towards nuclear power, this study investigates how religious factors, that is, religiosity or type of religion; exert influence on NPP acceptance over environmental and political factors. By including religious factors as determinants of NPP acceptance, this study adopts a differentiated approach compared with previous studies. In this regard, our findings complement previous research by providing further evidence that religion has an additional impact on NPP acceptance, suggesting that the government should consider national religion influencing national consciousness when designing NPP policy.

2. LITERATURE REVIEW

2.1. Determinants of Acceptance of Nuclear Power Plants

Mazmanian, Morell, and Bryant (1993) suggested high levels of awareness among residents, threats to health, unfairness, and trust as the primary factors influencing the acceptability of nuclear energy policies. Zeiss and Atwater (1989) presented perceived benefits and risks as important causal factors affecting acceptance of environmental policy. In other words, unlike economic phenomena in which costs and benefits are calculated relatively specifically, people will consider the costs and benefits perceived in relation to the various consequences that may arise today and in the future when deciding whether to accept the science and technology at risk (Kunreuther, Easterling, Desvousges, & Slovic, 1990). Kraft and Clary (1991) observed that distrust in the government and nuclear power operators, limited information, emotional evaluation of policies, and aversion to potential risks degrade acceptability of nuclear power. In the relationship between recognition and trust, Kunreuther and Easterling (1996)argued that value is placed on education for citizens, economic provision of economic benefits based on facility location, and preparation of new procedures for location selection and research. In this context, citizen education, mitigation, trust building, and compensation are important factors influencing acceptance of nuclear policy. They also proposed justification of policy and building public confidence regarding a fair process for facility construction as factors that can enhance acceptability.

According to Starr (1985), public confidence and trust in risk management are the main factors influencing risk acceptance or rejection rather than quantitative risk evaluation. In addition, Cho and Oh (2002) suggested the necessity of nuclear power, expected benefits and costs, the possibility of controlling risks, knowledge, and trust as influencing factors on acceptability and stressed the importance of multidimensional and three-dimensional analysis. Similarly, Greenberg et al. (2007) found that risk acceptance or rejection is ultimately determined by political compromises between stakeholders, and expert advice influences judgments and decisions involved. The same study also reported that people do not trust their government if they feel that the government lacks the ability to manage nuclear power or that it is unfair for doing so, and that the government is not sharing values with the public as expected. Peters and Slovic (1996) found that the negative sentiment towards nuclear power and an equalitarian worldview is inversely correlated with NPP acceptance. Additionally, Slovic (1999) claimed that gender, education level, trust, and political ideology are still important factors, albeit not pivotal, when determining risks.

Song, Kim, Go, and Hwang (2011) looked at what makes people accept NPPs and found that people felt i) that nuclear power generation was necessary (they agreed), ii) that nuclear energy should be used (they supported it), and iii) that NPPs should be built in residential areas (they agreed). In their empirical analysis, they also used

knowledge, safety (risk), trust, and energy factors as determinants of such positive perceptions. Among these determinants, knowledge, trust, and risk significantly influenced the aforementioned positive public perceptions. In particular, a significant causal relationship was observed between trust and the construction of NPP in a specific area. Separately, Wang and Kim (2013) characterized post-Fukushima public acceptance of NPPs as stability and change in relations and structures, convergence or polarization, and an increased number of people with ambivalent attitudes, although these characteristics vary depending on acceptance levels. Regarding acceptance level, they reported a negative correlation with females, income level, perceived risk, negative emotions, and living in urban areas, and a positive correlation with age, education, perceived benefits, trust, and knowledge.

2.2. Buddhist, Catholicism, and Protestant Perspectives on NPP

In Buddhism, all living beings, including phenomenal and spiritual ones and even those yet to be born, are entitled to happiness. When nuclear energy issues are addressed from this perspective, the following question arises: Between the comfort provided by the use of nuclear energy and the possible consequences of a nuclear accident, what decisions can be made among Buddhists? They may have three choices. First, they may advocate nuclear power in favor of comfort. Second, they may oppose nuclear power in consideration of its possible severe consequences. Third, they may accept minimum nuclear power generation, if necessary, under strict restrictions, taking a neutral position (Yoon, 2014). On June 18, 2015, Pope Francis, who represents the Catholic Church, released his encyclical "Praise Be to You" (Laudato Si') to call for action to save the environment. The encyclical is the first Catholic publication proposing the imminent diagnosis of and solutions for global environmental problems, thereby having significant literary value (Francis Pope, 2015). In it, the Pope expressed his concerns over the globalization of the technological paradigm resulting from the acceptance of technology and its developments in a uniform manner. He implied that humans easily accept the idea of infinite and unlimited growth. Francis Pope (2015) also highlighted the duality of science and we have reflected your requirements. He acknowledged the advantages of science, and technology in his statement, "science and technology are wonderful products of God-given human creativity" and "technology has remedied countless evils that used to harm and limit human beings" in Section 102 of the encyclical. However, the negative impact of science and technology on human beings cannot be ruled out. He sternly warned that science and technology, when not being coupled with a wholesome mindset or spirituality, may act as boomerang and eventually destroy humans (Bae, 2018).[1] The Catholic Church also argues that there is a form of "unconditional faith" in nuclear power, derived from logical leap rather than logic in the name of "nuclear optimism" and alternatively described as "the level of belief at which no question or doubt arises." Such a high level of belief can be defined as "fetishism" or "fetishistic belief." This means that the level of belief at which nuclear power is viewed as necessary energy due to high economic efficiency born out of nuclear optimism is considered fetishism, which usually occurs in relation to the production and distribution of special energy products such as nuclear power because these products are described as being clean and safe (e.g., nuclear power and nuclear energy) while their inherent danger is obscured (Jeong, 2015).

In Christianity, based on Genesis 1:26 to 28, White (1967) claimed, "God created the world for the benefits and dominance of human beings." In this sense, he began arguing that "Judeo-Christianism is responsible for the ecological crisis facing the world today because it is a more human-centered religion than other religions." His hypothesis, "the Jewish-Christian doctrine justifies mastery over nature and eventually promotes anti-environmental behavior," has stirred up significant controversy. Recently, critics have suggested that the absolute

[1] He criticized the erroneous belief that "an infinite quantity of energy and resources are available, that it is possible to renew them quickly" and fantasies that "the negative effects of the exploitation of the natural order can be easily absorbed." Therefore, we need to have "sound ethics, culture, and spirituality capable of setting limits of the right technology and teaching clear-minded self-restraint" (Section 5).

superiority of nuclear power as an energy source given its economic benefits has been justified in Christian literature. Nuclear power is considered high-cost energy with the possibility of causing low economic efficiency. Moreover, the safety of nuclear power generation is severely low and even dangerous compared with other energy sources. Keeping the natural environment clean and healthy is essential to preserving the world created by God, and it poses an ecological responsibility that humans should fulfill. The preservation of God's created world and sustainability in this relationship are central to the spirit of Jesus in ecology. While the three pillars of the justification for nuclear power generation, that is, economic benefits, stability, and cleanliness, are elegantly discussed with scientific figures and statistics, inherent serious problems and errors remain intact. In short, nuclear power cannot become an alternative energy source of the future in the era of climate change (Kang, 2011).

3. RESEARCH METHODOLOGIES AND DATA

3.1. Research Questions and Hypotheses

As shown in Figure 1, this study analyzes how regional, environmental, and political factors influence acceptance of NPPs by defining each factor as follows:

First, religious factors are defined by two questions: Do you have a religion?" If yes, "What is your religion?" (Buddhism, Catholicism, or Protestantism).We analyzed these measured religion variables in addition to environmental and political factors to examine their impact on the acceptance degree of NPPs. Religious factors are included as the views on NPPs and the benefits and risks of nuclear power vary between religions. For example, Peters and Slovic (1996) identified that the negative sentiment towards nuclear power and the equalitarian worldview are inversely correlated with NPP acceptance.

Second, environmental factor is defined as the government's perceived responsibility for environmental protection. Specifically, we measured it as an indicator variable equal to one if respondents agree with the following question and zero otherwise: "Do you think it should or should not be the government's responsibility to impose strict laws to make industry do less damage to the environment?"

Third, political factors are defined as income reallocation through taxes and trust level in central and local governments using two questions: i) When a large income gap exists between social classes, do you agree that more tax should be collected from the affluent class to reduce the income gap?" ii) Would you say you have a great deal of confidence in central(local) government?" Citizens' trust in the actions of the government in operating, managing, and supervising nuclear power generation can be related to their public attitude towards nuclear power. Specifically, low social trust in the government is related to low trust in the management of nuclear power facilities and safety data issued by the government, whereas the perception of risks involved in nuclear power plants may be magnified relative to their low trust, leading to low NPP acceptance or negative sentiment toward NPPs (Flynn, Burns, Mertz, & Slovic, 1992; Pijawka & Mushkatel, 1991; Slovic, 1999). As shown in many previous studies, trust in the government can be one of the most important predictors of risk acceptability (Chung & Kim, 2009; Flynn et al., 1992). Accordingly, we set the following hypotheses to analyze the impact of religious belief, trust in government units, and political characteristics on NPP acceptance.

Hypothesis 1: Religion beliefs (the presence or absence of religion and Buddhism, Catholicism or Protestantism) affect NPP acceptance:

Hypothesis 2: Environmental characteristics (the level of government responsibility for environmental protection) affect NPP acceptance.

Hypothesis 3: Political orientation (income redistribution through taxes, trust in government, and conservatism) affects NPP acceptance.

3.2. Research Methodologies

Generally, most studies on respondents' perceptions of a specific concept have applied discrete models to identify factors affecting the perception level. Since the perception data are categorical in nature, Renski, Khattak, and Council (1999); Rifaat and Chin (2007); and Jun and Yoon (2018) argued that most of the literature relies on logistic regression, while others have used multinomial or nested logit models.

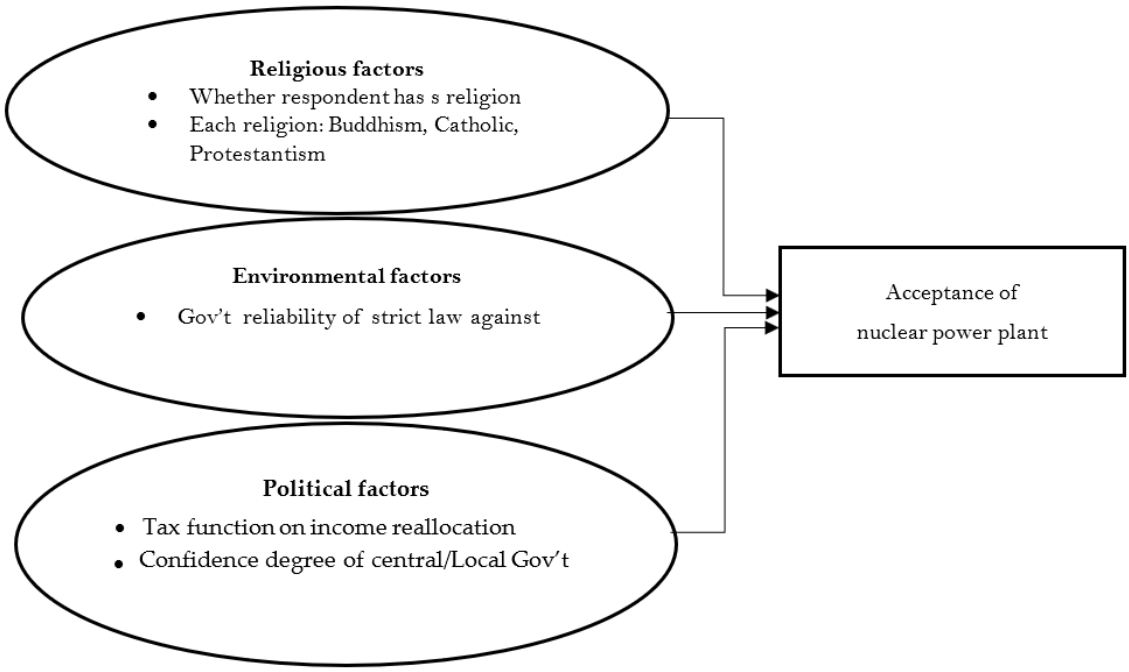

Figure 1. Frame work of research.

The main analytical subject of this study is the degree of acceptance of NPP, as it is measured by 5-level ordinal scales (Jun & Yoon, 2018; Kim & Yoon, 2017) (i.e., 1: strongly disagree, 2: disagree, 3: agree, 4: strongly agree, to the question of "I would like to have a nuclear power plant hosted in the region I reside in."Ordered discrete choice models are generally used to analyze such ordinal response data. There are the ordered probit model (OP) and the ordered logit model (OL) in the ordered discrete choice model. Among these models, the OP is the most commonly used approach (Anarkooli, Hosseinpour, & Kardar, 2017; Jun & Yoon, 2018). The OLis based on the assumption that the errors are independently and identically distributed with the logistic distribution, whereas the OP is based on the assumption that the distribution of errors is a multivariate normal distribution. However, the results from the OP can be fairly similar to those of the OL. Thus; the OP is suitable for use in this study. Let us assume that yni is the acceptance level of NPP, n, by respondent i. The OP model assumes that the acceptance level can be represented by a latent and continuous variable, (yni*), which is related to X_{ni} and is given as:

$$y^*_{ni} = X_{ni}\beta + \varepsilon_{ni} \forall_i \qquad (1)$$

Where $X_{ni}$is a vector of explanatory variables (religious, environmental, political factors, or other control variables), β is a vector of unknown parameters to be estimated, and ε_{ni} is the random error term capturing the effect of unobserved factors, which is assumed to follow a normal distribution with a zero mean and unit variance (Anarkooli et al., 2017; Jun & Yoon, 2018). For the respondent's acceptance level, n, to occur from respondent i, the observed perception level, (y_{ni}), is related to an unobserved (latent) variable, (y_{ni}*), and is expressed as follows:

$$y_{ni} = j \Rightarrow \mu_{j-1} \leq y^*_{ni} \leq \mu_j \Leftrightarrow$$

$$\begin{cases} 1 \text{ if } y_{ni}^{*} = \text{“Strongly disagree” to the question of Hosting a NPP in my region} \\ 2 \text{ if } y_{ni}^{*} = \text{“Disagree” to the question of Hosting a NPP in my region} \\ 3 \text{ if } y_{ni}^{*} = \text{“}Agree\text{” to the question of Hosting a NPP in my region} \\ 4 \text{ if } y_{ni}^{*} = \text{"Strongly agree" to the question of Hosting a NPP in my region} \\ 5 \text{ if } y_{ni}^{*} = \text{“Very high” to the question of Hosting a NPP in my region} \end{cases} \quad (2)$$

Where j is the number of respondents' acceptance levels (in this case, $j = 4$); and μ_1, μ_2, μ_3, and μ_4 are unknown threshold parameters to be estimated. The predicted probabilities of the acceptance level, j (j = 1, 2, 3, 4), can be estimated as:

$$P(Y_{ni} = j) = F(\mu_j - X'_{ni}\beta) - F(\mu_{j-1} - X'_{ni}\beta) \quad (3)$$

Where $F(\cdot)$ is the standard normal cumulative distribution function. The model parameters (e.g., β and y_{ni}^{*}) are estimated by the method of maximum likelihood. The marginal effects of the OP model with respect to explanatory variable l, (β_l), can be estimated as:

$$ME_{Jl \mid Xl} = \frac{\partial P(Y_{nl}=j \mid X_{ni})}{\partial X_{Il}} = [f(\mu_{j-1} - X'_{ni}\beta) - f(\mu_j - X'_{ni}\beta)] \cdot \beta_l \quad (4)$$

Where $f(\cdot)$ is the density function.

Prior studies mainly argued political and environmental factors as factors influencing the acceptance degree of NPP.However, this study intends to analyze the determinants of acceptance degree of NPP as shown in Equation 5 by including religious factors as well as these two factors in the research model.In addition, the research model is established as shown in Equation 6 to analyze the effect of religious factors on their acceptance through interaction with existing environmental and political factors.

$$NPP\_Acceptanc = \beta_0 + \beta_1 RELIGIOUS\_Factor + \beta_2 ENVIRONMENTAL\_Factor + \beta_3 POLITICAL\_Factor + \beta_4 DisSATFIN + \beta_5 EDU + \beta_6 AGE + \beta_7 GENDER + \varepsilon \quad (5)$$

$$NPP\_Acceptanc = \beta_0 + \beta_1 RELIGIOUS\_Factor + \beta_2 ENVIRONMENTAL\_Factor + \beta_3 POLITICAL\_Factor + \beta_4 ENVIRONMENTAL\_Factor\ X\ RELIGIOUS\_Factor + \beta_5 POLITICAL\_Factor\ X\ RELIGIOUS\_Factor + \beta_6 DisSATFIN + \beta_7 EDU + \beta_8 AGE + \beta_9 GENDER + \varepsilon \quad (6)$$

Where,

NPP Acceptance: Acceptance degree of NPP denotes the four-point scale for the question, "I would like to have a nuclear power plant hosted in the region I reside in," as follows: 1—"Strongly disagree," 2—"Disagree," 3—"Agree," and 4—"Strongly agree."

RELIGIOUS Factor:

①*RELIGION* (Religion) denotes a dummy variable, 1—"Religious group," 0—"Non- Religious group".

②*BUDDHISM*, *CATHOLICISM*, *PROTESTANTISM* (kind of religion) denotes a dummy variable for Buddhism, Catholicism or Protestantism, respectively.

ENVIRONMENTAL Factor: *ENV_GOV* (Degree of Government's Responsibility to protect the environment) denotes the answers to the question, "Do you think it should or should not be the government's responsibility to impose strict laws to make industry do less damage to the environment?" as follows: 1—"Definitely should not be," 2—"Probably should not be," 3—"Probably should be," and 4—"Definitely should be."

POLITICAL Factor:

①*TAX* (Tax function for income redistribution) denotes the answers to the question, "When a large income gap exists between social classes, do you agree that more tax should be collected from the affluent class to reduce income gap?" as follows: 1 (2,3,4, and 5) —"More tax should (shouldn't) be collected from the affluent class to reduce income gap,".

②*UnTrust_Gov*: (Average of confidence degree for central and local government) denotes the answers to the question, "Would you say you have a great deal of confidence for central (or local) government?" as follows: 1—"A great deal of confidence," 2, 3, 4, and 5—"Hardly any confidence".

③ CONSERVATIVE (Liberal or CONSERVATIVE) denotes the answers to the question, "To what degree do you think yourself politically liberal or CONSERVATIVE?" as follows: 1—"Very liberal," 2—"Somewhat liberal," 3—"Neither satisfied nor dissatisfied," 4—"Somewhat CONSERVATIVE" and 5—"Very CONSERVATIVE".

DisSATFIN: Satisfaction degree of economic condition denotes the answers to the question, "How satisfied are you with the economic condition of your family?" as follows: 1—"Very satisfied," 2—"Somewhat satisfied," 3—"Neither satisfied nor dissatisfied," 4—"Somewhat dissatisfied" and 5—"Very dissatisfied".

EDU: The highest level of school denotes the answers to the question, "What is the highest level of school you have attended?" as follows: 0—"No formal school," 1—"Elementary school," 2—"Junior high (or middle) school," 3—"High school," 4—"Junior college," 5—"College," 6—"Graduate school (Master degree)" and 7—"Graduate school (PhD)".

AGE: Age of a respondent.

GENDER: 1 if a respondent is male; 0 otherwise.

3.3. Data

This study is based on a financial panel survey conducted by the Korean General Social Survey KGSS (2017). The KGSS population consists of non-institutionalized Korean residents who are 18 years of age or older and can communicate in Korean. This survey directly selected the required number of persons if a well-defined list of all adult persons was available. If such a list was unavailable, this survey selected a set of potential respondents in four stages, utilizing an area probability sampling method (KGSS, 2017). In the current study, the first three stages select the required number of households. The fourth stage selects an eligible person from each selected household. First, the primary sampling unit (PSU) for the 2016 KGSS is a Dong, Eub, or Myon. A total of 100 PSUs are selected for the 2016 KGSS, with probability proportional to size. Second, the secondary sampling unit (SSU) is defined as Tong/Ban (for Dong) or Li (for Myun). Third, after completing the sampling frame, a fixed number of Hus is systematically selected. Finally, after compiling a list of adults 18 years of age or older for each selected household, an adult is selected using the last birthday method at the time of the interview. The KGSS institutions conducted a survey on the Korean people using these sophisticated statistical sampling methods, obtained prior consent on the use of the questionnaire from questionnaire participants, and the KGSS agency made this information available to the general public. A series of survey processes support the reliability and validity of the questionnaire data. This study has a response rate of 91.2%, with 959 respondents out of 1,052 respondents. Given that the survey requires more than 25% of the surveyed questionnaires to be valid, the questionnaire data with a high response rate used in our research is appropriate.

4. RESULTS

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics of variables. Of 959 respondents, 527 answered the questions regarding NPPs, and the mean *NPP* acceptance was 2.061, indicating almost completely negative responses. This indicates that negative public opinion is dominant when it comes to NPPs. Among religious factors, 55% of the respondents had a religion; of these, 43.6% were Buddhists, 17.8% were Catholicism's, and 38.5% were Protestants.

As an environmental factor, the mean *ENV_GOV* was 4.16, indicating that most of the respondents advocate the government's strict legal enforcement approach to protect the environment. Among political factors, the mean TAX was 1.871, showing that respondents believe that raising tax on high-income earners would reduce the income gap. This result indicates that the current tax system is not working properly as a form of income redistribution. The mean *UnTrustGOV*, which represents trust in the government, was 3.892, implying that the majority of respondents do not trust the government. As the last political factor, the mean *CONSERVATIVE*,

which represents conservatism in respondents' political orientation, was 3.036, meaning that the proportion of conservative respondents is relatively higher. The descriptive statistics of the remaining variables, that is, control variables, are shown in Table 1.

Table 1. Descriptive statistics.

Variables		N	Mean	SD	Median	Min.	Max.
NPP_acceptance		527	2.061	0.846	2.000	1.000	4.000
RELIGIOUS Factor	*RELIGION*	959	0.550	0.498	1.000	0.000	1.000
	BUDDHISM	527	0.436	0.496	0.000	0.000	1.000
	CATHOLICISM	527	0.178	0.383	0.000	0.000	1.000
	PROTESTANTISM	527	0.385	0.487	0.000	0.000	1.000
ENVIRONMENTAL Factors	*ENV_GOV*	527	4.160	0.883	3.750	1.250	5.000
POLITICAL Factors	*TAX*	527	1.871	1.062	2.000	1.000	5.000
	UnTrust Gov	527	3.892	0.908	3.333	1.667	5.000
	CONSERVATIVE	527	3.036	0.944	3.000	1.000	5.000
Controls	*DisSATFIN*	527	2.731	1.091	3.000	1.000	5.000
	EDU	527	3.545	1.718	4.000	0.000	7.000
	AGE	527	51.843	17.589	53.000	18.000	99.000
	GENDER	527	0.397	0.490	0.000	0.000	1.000

Note: Detailed variable definitions are presented in the note of Equations 5 and 6.

4.2. Correlation Analysis and Univariate Analysis

Table 2 shows Pearson correlations between variables used to measure religious factors. (2) *BUDDHISM* and (4) *PROTESTANTISM* were positively related to (1) *NPP-Acceptance* (r= 0.0545 and 0.0262, respectively), although the relationship was not statistically significant. (3) *CATHOLICISM* was negatively related to NPP-Acceptance. Specifically, (3) *CATHOLICISM* was significantly related (r= –0.104) ($p<0.1$), meaning that the Catholic group is more likely to oppose NPPs.

Table 2. Correlation analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) *NPP_acceptance*	1					
(2) *BUDDIHISM*	0.0545	1				
(3)*CATHOLICISM*	-0.1040*	-0.410***	1			
(4) *PROTESTANTISM*	0.0262	-0.6970***	-0.369***	1		
(5) *ENV_GOV*	-0.0557	-0.0949*	0.0291	0.0739	1	
(6) *TAX*	0.1360**	0.0313	-0.0508	0.00806	-0.1360**	1
(7) *UnTrust_GOV*	-0.1780***	-0.0986*	0.1230**	0.00367	0.0967*	-0.1570***
(8) *CONSERVATIVE*	0.1070*	0.0556	0.0137	-0.0675	-0.0920*	0.1260**
(9) *DisSATFIN*	0.0590	-0.0633	-0.0258	0.0848	0.0188	-0.1020*
(10) *EDU*	-0.0895*	-0.1880***	0.0601	0.1440***	0.1740***	-0.0448
(11) *AGE*	0.1570***	0.1620***	-0.0133	-0.1550***	-0.1210**	0.0398
(12) *GENDER*	0.1070*	0.0140	0.0478	-0.0519	0.0461	0.0218
Variables	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(8) *CONSERVATIVE*	0.0061	1				
(9) *Dis*SATFIN	0.1200**	0.0649	1			
(10) *EDU*	0.1120**	-0.208***	-0.104*	1		
(11) *AGE*	-0.0929*	0.2180***	0.0579	-0.6230***	1	
(12) *GENDER*	-0.0071	0.0060	0.0367	0.1560***	-0.0870*	1

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, for two-tailed test.

As an environmental factor, (5) *ENV_GOV* was not significantly related. However, all political factors, (6) TAX, (7) *UnTrust GOV*, and (8) *CONSERVATIVE* had a significant relationship with NPP acceptance (r = 0.136 ($p<0.05$), -0.178 ($p<0.001$), and 0.107 ($p<0.1$), respectively). More specifically, the respondents with a positive

perception of the current tax system as a form of income redistribution and those with a conservative orientation are more likely to accept NPPs, whereas those with low trust in the government are less likely to accept NPPs.

The control variables (10) *EDU*, (11) *AGE*, and (12) *GENDER*are also significantly correlated with NPP acceptance (r= −0.0895(p<0.1), 0.157(p<0.001), and 0.107(p<0.1), respectively).

Table 3 reports the results of the t-test performed to determine the difference in religious, environmental, and political factors with respect to higher *NPP_Acceptance* (4 or 5) and lower *NPP_Acceptance* (1 or 2). Of religious factors, *BUDDHISM* and *CATHOLICISM* showed significant differences in means (t = 1.931(p<0.1) and -2.605(p<0.01), respectively). This suggests that Buddhists are more likely to embrace nuclear power expansion policies, whereas the Catholic groupis more likely to oppose such policies. The environmental factor, *ENV_GOV*, showed no significant difference, while all political factors, *TAX*, *UnTrust_GOV*, and *CONSERVATIVE*, exhibited significant differences. The control variables also showed significant differences.

Table 3. Univariate analysis: t-test.

Variables		(A) Higher NPP_acceptance (n=147)	(B) Lower NPP_acceptance (n=380)	t-stat ((A)-(B))
RELIGIOUS factor	*RELIGION*	0.574	0.541	0.927
	BUDDHISM	0.503	0.411	1.931*
	CATHOLICISM	0.109	0.205	-2.605***
	PROTESTANTISM	0.388	0.384	0.075
ENVIRONMENTAL factors	*ENV_GOV*	4.141	4.168	-0.310
POLITICAL factors	*TAX*	2.014	1.816	1.923*
	UnTrust_Gov	3.668	3.978	-3.557***
	CONSERVATIVE	3.163	2.987	1.930*
Controls	*DisSATFIN*	2.789	2.708	0.766
	EDU	3.320	3.632	-1.873*
	AGE	56.197	50.158	3.574***
	GENDER	0.456	0.374	1.729*

Note: *, and *** indicate significance at the 10%and 1% levels, respectively, for two-tailed test.

4.3. Multivariate Analysis

As shown in Table 4, an ordered probit regression analysis was conducted to test the hypotheses. The results revealed a significant effect of environmental and political factors. For religious factors, the respondents were divided into religious and non-religious groups.

Table 4. The effect of religious, environmental and political factors on acceptance degree of nuclear power plant.

Variables	Pred.	*RELIGION* = Religious group	
		Coeff.	Z-stat
RELIGION	+	0.014	0.114
ENV_GOV	-	-0.146	-1.972**
TAX	+	0.164	2.715***
UnTrust_Gov	-	-0.234	-3.254***
CONSERVATIVE	+	0.159	2.206**
DisSATFIN	?	0.078	1.304
EDU	?	-0.048	-0.862
AGE	?	0.007	1.508
GENDER	?	0.387	3.085***
N		959	
Wald-Chi²		58.60***	
Test		Diff coeff	z
Ho: Religion =Tax		-0.145	1.27
Ho: Conservative =Tax		-0.005	3.78***
Ho: Env_Gov =Tax		-0.31	0.20
Ho: Untrust_Gov=Tax		-0.398	-0.72
Ho: ENV_GOV =Untrust_GOV		0.088	-3.72***

Note: **, and *** indicate significance at the 5%, and 1% levels, respectively, for two-tailed test.

The religious factor, *RELIGION*, was not statistically significant given that its coefficient was 0.014. However, its significance still suggests that religious respondents advocate a nuclear power expansion policy. The statistical insignificance of *RELIGION* can be explained by the fact that the level of acceptance of NPPs can vary depending on the type of religion (Buddhism, Catholicism, or Protestantism). Therefore, the NPP acceptance level of each religion needs to be analyzed.

The environmental factor, *ENV_GOV*, showed a statistically significant coefficient of −0.146 ($p<0.05$). Its negative effect suggests that an attitude in favor of a strict legal enforcement approach by the government is inversely related to the NPP acceptance level. All political factors, *TAX*, *UnTrust_GOV*, and *CONSERVATIVE*, showed a statistically significant regression coefficient of 0.164($p<0.05$), -0.234($p<0.001$), and 0.159($p<0.05$), respectively.

Table 5 presents the effect of the type of religion on NPP acceptance. For (1) *RELIGION=BUDDHISM* and (3) *RELIGION=PROTESTANTISM*, the *RELIGION* variable showed a statistically significant coefficient of −0.318 and −0.275, respectively. However, in the (2) *RELIGION=CATHOLICISM* group, the *RELIGION* had a statistically insignificant coefficient of 0.646. Thus, both Buddhism and Protestantism demonstrated a strong opposition to NPP acceptance in a negative direction, while the Catholic group exhibited strong support for NPP acceptance in a positive direction, although the direction of these relationships was not statistically significant.

The environmental factor, *ENV_GOV*, showed an insignificant coefficient of −0.118, -0.015, and −0.104, respectively.

As a political factor, *TAX* revealed a significant coefficient of 0.205($p<0.05$) in the (2) Catholic group and 0.306($p<0.01$) in the (3) Protestantism group. This indicates that there is a positive correlation between the positive perception of the current tax system as a form of income redistribution and NPP acceptance. In particular, *UnTrust_GOV* resulted in a negative coefficient in each of (1), (2) and (3) groups, underlining a positive correlation between the level of trust in government and NPP acceptance.

The *TAX*RELIGION* variable, which was designed to measure the interaction effects of religious and political factors on NPP acceptance, resulted in a coefficient of 0.352 ($p < 0.05$) in the (1) Buddhism group and −0.295($p<0.01$) in the (3)Protestantism group, and both are statistically significant. This result suggests that Buddhists with positive perception of the current tax system as a form of income redistribution and Protestants with negative perception of the same factor are more likely to display a higher level of acceptance of NPPs. Thus, the perception of income redistribution through taxes in the Buddhism and Protestantism groups exerted contrasting influences on NPP acceptance.

Table 5. The effect of religious factors on acceptance of nuclear power plant.

Variables	Pred.	(1) *Religion= BUDDHISM*		(2) *Religion= CATHOLICISM*		(3) *Religion= PROTESTANTISM*	
		Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.
RELIGION	+	-0.318	-0.237	0.646	0.363	-0.275	-0.198
ENV_GOV	-	-0.118	-0.839	-0.015	-0.124	-0.104	-0.771
TAX	+	0.03	0.323	0.205	2.357**	0.306	2.829***
UnTrust_Gov	-	-0.426	-3.535***	-0.325	-2.981***	-0.359	-3.042***
CONSERVATIVE	+	0.315	2.481**	0.100	0.933	0.033	0.262
*ENV_GOV*RELIGION*	?	0.09	0.431	-0.282	-1.035	0.078	0.369
TAX**RELIGION*	?	0.352	2.169**	-0.179	-0.898	-0.295	-1.919*
*UnTrust_Gov*RELIGION*	?	0.132	0.702	-0.121	-0.537	-0.022	-0.113
*CONSERVATIVE*RELIGION*	?	-0.383	-1.965**	0.294	1.188	0.272	1.383
DisSATFIN	?	0.146	1.755*	0.127	1.54	0.123	1.521
EDU	?	0.046	0.650	0.043	0.614	0.028	0.397
AGE	?	0.016	2.533**	0.015	2.426**	0.016	2.614***
GENDER	?	0.418	2.371**	0.428	2.447**	0.439	2.488**
N		527		527		527	
Wald-chi^2		49.69***		47.43***		46.85***	

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, for two-tailed test.

The *CONSERVATIVE*RELIGION* variable presented a statistically significant coefficient of –0.383 ($p<0.05$) in the (1) Buddhism group only, indicating that Buddhists with conservative orientation showed a negative correlation with NPP acceptance level.

Table 6 shows the results of an additional analysis in which the interaction variables were excluded from Equation 6 to address individual religions, environmental and political factors, and their effect on the acceptance degree of NPP. The BUDDHISM and PROTESTANTISM groups consistently revealed an insignificant coefficient of 0.067 and 0.216, respectively. However, the CATHOLIC group showed a significant coefficient of –0.445($p<0.05$). This indicates that there is no relationship between religion and the acceptance degree of NPPs in the Buddhism and Protestantism groups and that a statistically significant opposition to nuclear power expansion policy existed in the Catholic group.

In other words, while the Buddhism and Protestantism groups showed mixed attitudes toward nuclear power, the Catholic group demonstrated a negative attitude by weighing potential risks and destructive abilities against the benefits of nuclear power as an energy source, in line with the statement of Francis Pope (2015) encyclical.

Table 6. Additional test: The effect of each Buddhism, Catholicism and Protestantism on acceptance of nuclear power plant.

Variables	(1) *Religion= BUDDHISM*		(2) *Religion= CATHOLICISM*		(3) *Religion= PROTESTANTISM*	
	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.
RELIGION	-0.910	-1.398	1.330	1.676*	0.022	0.033
Faith	-0.020	-0.110	0.243	1.377	0.051	0.242
*RELIGION**Faith	0.347	1.113	-0.699	-1.845*	0.101	0.345
ENV_GOV	0.134	0.698	0.147	0.745	0.110	0.553
TAX	0.100	0.815	0.097	0.782	0.084	0.670
UnTrust_Gov	-0.413	-2.486**	-0.410	-2.452**	-0.386	-2.363**
CONSERVATIVE	0.188	1.024	0.144	0.774	0.184	1.002
Controls	Included		Included		Included	
N	527		527		527	
Wald-chi^2	49.69***		47.43***		46.85***	

Note: *, **, and *** indicate significance at the 5%, and 1% levels, respectively, for two-tailed test.

5. CONCLUSIONS

This study investigated how religious factors exert influence on NPP acceptance, in addition to environmental and political factors. Given that opinions about nuclear energy vary between religions, an individual's religion or type of religion appears to have an impact on NPP acceptance, as is the case for their environmental perception or political orientation.

The results of this study can be summarized as follows:

First, the analysis of religious and non-religious samples revealed that the presence or absence of religious belief did not exert a significant influence on NPP acceptance, in addition to the effects of environmental and political factors. It means that having a religious belief does not impact decisions on whether to support nuclear power expansion. Nonetheless, environmental and political factors had a significant impact on NPP acceptance, which is in line with previous research results.

The second religious factor was types of religion (Buddhism, Catholicism, or Protestantism), and we analyzed how each religion influences NPP acceptance. As a result, religion itself, regardless of whether it is Buddhism, Catholicism, or Protestantism, showed no statistically significant influences. As a political factor, the positive perception of the role of the current tax system in income redistribution showed a positive correlation with support for nuclear power expansion policy. In particular, the effect of religious factors, when combined with environmental and political factors, on NPP acceptance was analyzed, and religious and political factors were found to interactively influence NPP acceptance. That is, religious factors influenced decisions on whether to support nuclear power expansion or not in combination with political factors-tax, trust in the government, or political conservatism.

Finally, the analysis of individual religions and their independent impact on NPP acceptance revealed that only the Catholic group showed statistically significant opposition to NPP expansion policy. This implies that Catholics' view on nuclear power may be largely influenced by that of the Pope and Papal Encyclicals that stress the negative aspects of nuclear power. In contrast, the absence of significant support or opposition in the Buddhism or Protestantism groups suggests that they have mixed opinions and beliefs with regard to NPP expansion policy.

This study can contribute to providing important insights into the relationship between religious factors and the acceptance of nuclear power plants.

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