Article Type: Research Paper

Assessing Public Willingness to Pay for Earthquake Disaster Insurance in Yogyakarta, Indonesia: An Economic Valuation Using Contingent Valuation Method

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Abstract: Jetis District, Bantul Regency, is the area that experienced the most casualties and the worst damage to buildings after the earthquake on May 27, 2006. One of the worst earthquakes of the twenty-first century was the 5.9-magnitude one. The existence of insurance premiums that people are willing to pay is very necessary as an alternative form of post-disaster risk mitigation effort. The aim of this research is to determine the willingness to pay disaster mitigation insurance premiums and the influence of the independent variables. An EWTP of IDR 62,700 (USD 4,04) was obtained using the dichotomous choice method for 20 community samples. This research was conducted on 274 respondents using the contingent valuation method. This research uses logistic regression analysis. The research results show that the variables age, number of dependent family members, educational attainment, income, length of residence, and risk aversion have a significant influence on willingness to pay disaster mitigation insurance premiums.

Keywords: Willingness to Pay; Insurance Premium; Contingent Valuation Method; Disaster Mitigation
JEL Classification: Q54, Q51,

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THIS ARTICLE IS AVAILABLE IN:
http://journal.umy.ac.id/index.php/jerss

DOI: 10.18196/jerss.v8i1.21423

CITATION:
Permadi, W. Y. N., & Saptutyningsih, E. (2024). Assessing Public Willingness to Pay for Earthquake Disaster Insurance in Yogyakarta, Indonesia: An Economic Valuation Using Contingent Valuation Method. *Journal of Economics Research and Social Sciences*, *8*(1), 13-23

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Introduction

Disasters, whether natural or man-made, pose significant threats to both lives and property, with devastating consequences. These losses and victims can be in the form of material or human lives. There are several countries in the Asia Pacific and Latin America regions that also frequently experience disasters. The difference only lies in the type of disaster and the losses suffered. For example, Japan is known as a country that frequently experiences earthquakes. This is because Japan is located in the Pacific Ring of Fire, which forms a basin surrounding the Pacific Ocean (Anneahira, 2014).

The earthquake disaster that hit Turkey on August 17, 1999, claimed the lives of 17,127 people, with a damage and loss value of 8,500 million US dollars. Furthermore, the disasters that hit Indonesia were the tsunami in the northern part of Indonesia (Aceh) and the earthquake in the southern part of Java Island (DIY and Central Java) on December 26, 2004, and May 27, 2006, respectively, claiming the death toll of 165,708 people and 5,716

people, respectively, with damage and loss values of 4,450 million US dollars and 3,134 million US dollars (PAPPENAS, 2006). Indonesia is situated at the meeting point of the Pacific and Mediterranean Circum mountain ranges. Indonesia has a large number of active volcanoes as a result (Kusumadinata, 1979; Katili & Siswowidjojo, 1994; Kelfoun et al., 2000).

Katili and Siswowidjojo (1994) stated that volcanoes (vulcans) are formed on the face of the earth in the form of giant cones, domes, or hills resulting from magma breaking through to the earth's surface. Volcanoes occur due to an active subducting collision process (Sudrajat, 1995). In most earthquake-prone areas, many people are still willing to have a place to live in areas that are actually earthquake-prone. This may be due to the low purchase price of land and property, even though it is full of risks when small and large earthquake disasters strike. On May 27, 2006, an earthquake rocked near the historical city of Yogyakarta.

The epicenter of the earthquake was around 33 km south of Bantul Regency, in the Indian Ocean. This earthquake lasted for 52 seconds and had a Richter scale value of 5.9. There was extensive devastation, particularly in Bantul Regency, the Special Region of Yogyakarta, and Klaten in Central Java Province, as a result of the earthquake's relatively shallow depth of 33 kilometers underground, which caused stronger shaking at the surface than an earthquake of the same strength occurring in a deeper layer (Wuryanto & Hadi, 2006).

This study was carried out in Bantul for three primary reasons: First, the May 2006 earthquake was one of the worst of the twenty-first century, although it was only 5.9 SR and occurred 33 KM below the surface. The damage to houses that occurred during the 2006 earthquake was the most severe in Bantul Regency/Kodya, with the number of houses slightly damaged being 73,669 houses, while the houses that experienced heavy or moderate damage were 71,372 houses. Which sub-district in Bantul Regency experienced the worst damage to houses, with each Each of the 11,356 houses damaged was in the Jetis sub-district, so this was the reason for conducting research in the Jetis sub-district.

Second, the majority of Bantul Regency's territories (those inside the ring of fire lines) are susceptible to earthquakes. The worst damage was in the Bantul area, even though Yogyakarta was the nearest location of the earthquakes and the two powerful aftershocks. Third, while it is generally easy to anticipate when and where an earthquake will occur, it is a disaster type that is repeatable. The destruction resulting from earthquake events serves as a reminder of how crucial preparation is. The financial toll that these occurrences take frequently demonstrates the value of catastrophe insurance as a crucial instrument for risk reduction.

Because there are so many factors influencing people's willingness to pay for disaster insurance, this is a difficult topic of study. The individual's assessment of the hazards connected to prospective disasters, particularly in earthquake-prone areas, is a significant determining factor. According to Kunreuther (2004), it is critical for people to have a

precise awareness of risk in order to recognize the necessity of purchasing catastrophe insurance. Furthermore, Botzen et al. (2016) and Browne et al. (2016) emphasize the significance of risk communication and information dissemination in influencing risk perceptions and, in turn, willingness to pay.

These societal-level elements enable a more thorough understanding of the social aspects of disaster insurance and the willingness to pay. The complex and ever-changing relationship between willingness to pay and disaster insurance calls for a multimodal approach. Numerous significant aspects, including risk perception, economic factors, and economic valuation techniques, have an impact on the intricate subject of catastrophic risk reduction. Particularly in areas that are prone to earthquakes, the contingent valuation method proves to be an invaluable instrument for estimating the financial worth that people place on catastrophe insurance.

The contingent valuation approach is a well-liked way of figuring out how much consumers are willing to pay for catastrophe insurance. A basic explanation of this approach is given by Carson and Groves (2007), who also highlight how it may be used to value non-market commodities like insurance. Studies by Hanemann (1994) and Mitchell and Carson (1989) underline the necessity of carefully constructing surveys to get accurate willingness-to-pay responses. Botzen and van den Bergh (2008) and Bin et al. (2008) demonstrate the flexibility of contingent valuation in capturing values and preferences pertaining to seismic hazard insurance by looking at scenarios particular to earthquakes.

Behavioral economics is also becoming more and more popular to include in research on consumers' willingness to pay for catastrophe insurance. While Kunreuther & Pauly (2004) investigate the impact of cognitive biases, Sunstein and Thaler (2003) argue for the importance of nudges and choice architecture. These behavioral insights help us comprehend disaster insurance decision-making processes in a more sophisticated way. The works of Gigerenzer and Gaissmaier (2011) and Loewenstein et al. (2001) emphasize the significance of framing and communication methods in changing perceptions and choices about disaster insurance as research in this field progresses.

In order to close this knowledge gap, this research looks into one of the best ways to reduce earthquake damage before it happens, namely through community involvement and a willingness to pay insurance premiums for natural disasters, particularly earthquakes, which can happen at any time. and hit the Jetis area, Bantul, and Yogyakarta.

Table 1 References

Independent Variables	Relationship	Reference
Gender	-	Sunarjito & Wibowo, (2014)
Age	-	Sunarjito & Wibowo, (2014); Rusminah & Gravitiani, (2012)
Family Size	+	Sunarjito & Wibowo, (2014)
Income	+	Sunarjito & Wibowo, (2014); Rusminah & Gravitiani (2012); Suryanto & Kuncoro, (2012); Siswanto, (2015)
Education	+	Sunarjito & Wibowo (2014); Rusminah & Gravitiani (2012)
Long Stay	+	Sunarjito & Wibowo (2014), Richardson, (2008)
House Tenure	+	Sunarjito & Wibowo (2014)
Risk Awareness	+	Wang, et al. (2012); Surminski & Eldridge, (2015)
Risk Averse	+	Suryanto & Kuncoro, (2012)
Perception	+	Suryanto & Kuncoro, (2012); Rusminah dan Gravitiani (2012); Wiarti, (2012); Daniell et al., (2015); Kawawaki, (2012)

Research Method

Study site

The research was carried out in Jetis District, which is located in Bantul Regency, Yogyakarta Special Region. The study site was specifically selected based on data regarding the extent of damage and number of casualties following the 2006 DIY earthquake in Jetis District. This research is aimed at the community in Jetis District, Bantul Regency, which is the target population for this research.

Survey design and administration

In order to find out who was involved in the earthquake catastrophe mitigation procedure in Jetis District, Bantul Regency, we surveyed the local population in the research area. Their willingness to pay insurance premiums for catastrophe mitigation serves as a proxy for their participation. To choose benchmarks, we convened a focus group discussion with twenty prominent individuals. People in Bantul Regency were interviewed using the contingent valuation method to ascertain their willingness to pay for the premiums associated with earthquake disaster mitigation insurance (Daniell et al., 2015; Kawawaki, 2012; Wang et al., 2012). To analyze the potential economic benefits to society of funding seismic disaster mitigation, the contingency assessment results are employed as a stand-in. Contingent valuation surveys are developed using payment systems. Our respondents were asked, "Do you agree or disagree with charging a group fee of x for disaster mitigation insurance premiums?" The community's readiness to pay for seismic hazard mitigation reached IDR 62,700 (USD 4.04), but the double-bound study began with the lowest offer of IDR 50,000 (USD 3.22). The willingness to pay of the entire research population is not reflected in these numbers. Rather, these findings point to the possible financial advantages of disaster mitigation from the standpoint of an informed public.

Figure 1 Geography of Bantul Regency
Source: Regional Secretary of Bantul Regency

The communities that are able and willing to carry out mitigation are then identified using this. We did this by asking participants if they would be prepared to contribute IDR 62,700 (USD 4.04) each month to hazard mitigation related to earthquakes. There were four sections on the final survey form, as follows:

Table 2 Final Survey Part of Questions

Section	Characteristics	Variable
Part A	Sociodemographic	Gender, age, number of dependents, educational attainment, and income
Part B	Population	Length of stay and residence status
Part C	Community awareness to disaster risk	Risk awareness, Risk averse
Part D	Community Perception	earthquake and drought dummy
Part E	Public WTP	Willingness to pay (a monthly payment of IDR 67,200 (USD 4.04) for disaster mitigation insurance premiums)

Data Analysis

To determine people's willingness to take part in disaster mitigation insurance premiums, we used logistic regression (Wang & Elhag, 2007). The dependent variable in the model is community willingness, with 1 denoting agreement and 0 denoting disagreement. The model's independent variables include sociodemographic traits, population status, society's ability to minimize disaster risks (Risk Averse and Risk Awareness), and perceptions (Table 2). The underlying model of logit estimation is as follows:

$$Log_e = \left[\frac{\{p(y=1)|x_1 \dots x_p\}}{\{1-p(y=1|x_1 \dots x_p\}}\right] = Log_e\left[\frac{\pi}{1-\pi}\right] = \alpha + \beta_1 x_1 + \cdots + \beta_p x_{p^1}$$

$$= \alpha + \sum_{j=1}^{p} \beta_j x_j$$

where P (Y = 1| X1... Xp) is a conditional probability of that type. Another name for the analytical method discussed here is logit analysis. The above log-odd is also known as the logit transformation. The logistic function was as follows:

$$\langle P\big(Y = 1|X_1 \dots X_p\big)\rangle = \frac{exp\Big(\alpha + \sum_{j=1}^{p} \beta_j x_j\Big)}{1 + exp\left(\alpha + \sum_{j=1}^{p} \beta_j x_j\right)}$$

Table 3 The definitions of explanatory variables

Categories	Variables
Willingness to pay for disaster mitigation	Support for monthly payment for disaster mitigation insurance premiums (1 : yes ; 0 :no)
Sociodemographic characteristics	Gender (1: male ; 0 : female)
	Age of head of household (years)
	Number of family members (no.)
	Income (Rupiah)
	Educational attainment (years)
Population characteristic	Length of stay (years)
	Population status (1: native resident; 0: not native resident)
Risk Awareness	Attitude in increasing awareness of disaster risks (no.)
Risk Averse	Community efforts to avoid disaster risks (no.)
Perceptual characteristic	Earthquake dummy (1 : yes; 0: no)
	Drought dummy(1: yes ; 0: no)

This might instead become:

$$\langle P\big(Y = 1|X_1 \dots X_p\big)\rangle = \frac{1}{1 + exp\left(-\alpha - \sum_{j=1}^{p} \beta_j x_j\right)}$$

The likelihood of a non-response is:

$$P = \big(Y = 0|X_1 \dots X_p\big) = 1 - p\big(Y = 1|X_1 \dots X_p\big) = \frac{1}{1 + exp\left(-\alpha - \sum_{j=1}^{p} \beta_j x_j\right)}$$

where Y = 1 (yes) indicates that the respondents are willing to pay IDR 67.200 (USD 4,04) and Y = 0 indicates that they are not. The logistic regression equation for the log odds supporting drilled well irrigation is calculated using the list of predictors as follows:

$$log\left[\frac{p}{1-p}\right] = b_0 + b_i x_j + \varepsilon_t$$

Together with the logarithm of the odds that farmers will decide to support drilled well irrigation, the log equation shows a log-odd ratio. The statistical significance and recommendations of the parameter indicate the direction of the farmers' response (Gujarati, 2009).

Result and Discussion

The study's findings indicated that while 23.4% of participants (n = 68) were unwilling to pay a certain sum for disaster mitigation insurance premiums, 76.6% of participants (n = 182) were. Six of the independent factors have an influence on people's willingness to pay for disaster mitigation insurance premiums, according to the results of the partial significance test in Table 4. These variables are age, number of dependent family members, educational attainment, income, length of residence, and risk aversion.

Table 4 Regression results

Variable	Odd ratio
Constant	0,063
Gender	1,539
Age	0,932***
Dependent Family Members	1,717***
Educational Achievement	1,126*
Income	1,000**
Length of Stay	1,030**
Residence Status	1,191
Risk Awareness	1,013
Risk Averse	1,385***
Earthquake Dummy	0,000
Drought Dummy	0,000

Dependent Variable: Willingness to Pay; (..) is Standard Error; ***Significance at level α = 1%; **Significance; there is a level α = 5%; *Significance at level α = 10%

Age is a sociodemographic characteristic that has negative and significant characteristics; the variables number of dependent family members, educational attainment, and income are sociodemographic characteristics that have positive characteristics and a big influence, but the gender variable does not have a big influence. Age has a significant impact on the propensity to pay premiums for catastrophe mitigation insurance. For the age variable, the odd ratio value of 0.932 means that the older the age, the probability of willingness to pay for disaster mitigation insurance premiums is 0.932 times lower than the younger, assuming that other factors are considered constant (ceteris paribus). This means that increasing age will reduce the willingness to pay compared to before regarding disaster mitigation insurance premiums, assuming that other factors are considered constant (ceteris paribus). This is in line with Aryani's (2015) research.

The number of dependent family members greatly influences a family's willingness to pay catastrophe mitigation insurance premiums. The willingness of people to pay the premiums for disaster mitigation insurance is positively and significantly influenced by the number of dependent family members. The odd ratio value for the variable number of dependent family members is 1.717, meaning that the greater the number of dependent family members, the probability of willingness to pay is 1.717 times higher than the fewer number of dependent family members regarding the willingness to pay for insurance premiums for disaster mitigation, assuming that other factors are held constant (ceteris paribus). The willingness to pay premiums for catastrophe mitigation insurance will rise

as the number of dependent family members rises. This is in line with research by Sunarjito and Wibowo (2014), who used the CVM survey to discover that the number of family members has a significant impact on the WTP of microearthquake insurance premiums.

The variable of educational attainment has a considerable influence on the willingness to pay insurance premiums related to disaster mitigation. The variable is positively correlated and significantly affects people's willingness to pay premiums for insurance that mitigates disasters. The educational attainment variable has an odd ratio value of 1.126. This indicates that, assuming all other variables remain constant, the probability of willingness to pay for disaster mitigation insurance premiums will be 1.126 times greater for higher education than for lower education. According to research by Sari and Setiartiti (2015), education has a positive and significant influence on WTP. People with higher education typically have a better level of knowledge and information regarding disaster risks, and the coverage is wider, so people with higher education will increase their willingness to pay.

The income variable has an impact on the willingness to pay premiums for catastrophe mitigation insurance. The variable, which has a positive relationship with it, significantly influences people's willingness to pay for disaster mitigation insurance premiums. The odds ratio value of income is 1,000, which means that the probability of willingness to pay for disaster mitigation insurance premiums will be 1 times greater for higher income than for lower income, assuming that other factors are considered constant (ceteris paribus). The higher a person's income, the more available a portion or percentage of that community's income will be set aside and used to pay disaster mitigation insurance premiums. This is in line with studies done by Sunarjito and Wibowo (2014) and Siswanto (2015).

The length-of-stay variable strongly determines the willingness to pay catastrophe mitigation insurance rates. The variable significantly and favorably affects people's willingness to pay insurance premiums for disaster mitigation. The length of stay variable has an odd ratio value of 1.030, which indicates that, assuming all other variables remain constant (ceteris paribus), respondents who have lived in the area longer have a probability of being willing to pay 1.030 times more than respondents who have recently moved there in terms of insurance premiums and disaster mitigation. Similar to studies by Richardson (2008), the varied length of stay has a positive and significant influence on the parameters of population status. This shows that people who have lived in the area for a long time are increasingly willing to pay disaster mitigation insurance premiums because they have identified and understood that the building or house they occupy is located in the area. who have experienced a disaster (an earthquake) or are categorized as disaster-prone areas, while the population status variable is not significant on the willingness to pay disaster mitigation insurance premiums.

The risk-aversion characteristic has a significant impact on the willingness to pay catastrophe mitigation insurance premiums. The variable is positively correlated and significantly influences people's willingness to pay premiums for insurance that mitigates

disasters. The risk-averse variable's odd ratio value is 1.385, which indicates that, assuming all other variables remain constant, the greater the community's efforts to reduce the risk of disaster, the probability of willingness to pay for disaster mitigation is 1.385 times larger than the lower community's efforts to reduce the risk of disaster. When people learn more about the hazards associated with past disasters like earthquakes and other calamities, their willingness to pay for disaster mitigation insurance premiums is positively and significantly influenced by their risk aversion. So, there is significance if the community's efforts to try to avoid disaster risks increase by making sustainable efforts, and then the willingness to pay related to the willingness to pay disaster mitigation insurance premiums will also increase. Suryanto and Kuncoro's (2012) research is in support of these findings.

This study is to determine the willingness to pay disaster mitigation insurance premiums in Jetis sub-district, Bantul Regency, which, with this research, can increase public awareness about mitigating disasters that will occur at any time. The financial impact of these events often underlines the importance of disaster insurance as an important risk mitigation tool. Conclusion The value of willingness to pay disaster mitigation insurance premiums is IDR 62,700. Based on this value, as many as 66%, or the equivalent of 182 respondents, stated that they were willing to pay disaster mitigation insurance premiums from a total sample of 274 respondents. Looking at the results of the influence between the variables gender, age, number of dependent family members, years of education, income, length of residence, residence status, risk awareness, risk averseness, and perception on willingness to pay (WTP) for disaster mitigation insurance premiums, we received a good result. If a disaster mitigation insurance program is implemented in Indonesia, it will be able to reduce the burden on the government budget in terms of disaster mitigation. This research can be used as a reference for other regions in Indonesia regarding the public's willingness to pay disaster mitigation insurance premiums.

Conclusion

The value of willingness to pay disaster mitigation insurance premiums is IDR 62,700. Based on this value, as many as 66%, or the equivalent of 182 respondents, stated that they were willing to pay disaster mitigation insurance premiums from a total sample of 274 respondents. Looking at the results of the influence between the variables gender, age, number of dependent family members, years of education, income, length of residence, residence status, risk awareness, risk averseness, and perception on willingness to pay (WTP) for disaster mitigation insurance premiums, we received a good result. If a disaster mitigation insurance program is implemented in Indonesia, it will be able to reduce the burden on the government budget in terms of disaster mitigation. This research can be used as a reference for other regions in Indonesia regarding the public's willingness to pay disaster mitigation insurance premiums.

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