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The amount of consolation compensation in road traffic accidents

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ABSTRACT

This study aimed to investigate the amount of consolation compensation that road accident perpetrators were willing to pay victims. It used 2010 statistics for general road accidents from Taiwan's National Police Agency (NPA) for further sampling and to mail questionnaires. In investigating consolation compensation, the framework of the contingent valuation method was used, and the data were collected through the design of different scenarios. In this study, five injury levels were designed to further analyse the consolation compensation price the perpetrators were willing to pay: minor injury, moderate injury, serious injury, disability, and death. The results revealed the price that many perpetrators were willing to pay was zero; however, we overcame this issue by using the Spike model. The estimated results showed that road accident perpetrators were willing to pay more consolation compensation with increased injury severity.

1. Introduction

<!–With an improved social environment in Taiwan, general public income has also increased. Currently, almost every Taiwanese household owns a motorcycle or automobile. Although greater ownership of private vehicles indicates increased income, it has also resulted in traffic congestion and violations, which have increased traffic accidents. In addition to causing property damage, accidents also cause physical injury and mental damage. The purpose of consolation compensation is to compensate victims' non-property damage caused by accidents, through claims filed against perpetrators, defined as those responsible for causing accidents. Other than court verdicts, Taiwan currently has no definitive judgment criteria for consolation compensation. In addition, research on this topic is limited; thus, the primary objective of this study is to estimate and investigate the factors that impact on the price a perpetrator is willing to pay for emotional damage (i.e., consolation compensation) to victims. Furthermore, we compare these prices with prices perpetrators are ordered to pay in current court verdicts. The results may serve as a reference for relevant institutions.

Most studies that use questionnaires to determine the price people are willing to pay for an outcome use the contingent valuation method as the research framework. For instance, Wang and Mullahy (2006) use the contingent valuation method to study the price residents in Chongqing, China are willing to pay to reduce air pollution. In Spain, Fernando et al. (2012) use the logit and probit models to explore the price people are willing to pay for the environmental impact of road transport in the Navarra region of the Pyrenees Mountains. Jou and Wang (2012) and Jou et al. (2012) use the contingent valuation method to investigate the price drivers are willing to pay price for highway electronic meter billing and the price motorcyclists are willing to pay for traffic violations.

In our investigation, we use questionnaires that asked respondents the price they are willing to pay for consolation compensation. Thus, data processing and analysis are difficult due to the use of the dictums model (e.g. the logit model) wherein the estimated willingness to pay (WTP) price would be lower if the proportion of subjects willing to pay zero is too high. Kriström (1997) proposes this issue is addressed by using the Spike model, whose advantage is in allowing a zero price. That is, in determining the compensation amount, responses with a zero WTP price are considered to address the complications from many zero WTP price responses. Many studies show that the Spike model is an appropriate approach to handling many zero responses for WTP survey data, and can incorporate additional WTP factors (Bengochea-Morancho et al., 2005; Hu, 2006; Jou et al., 2012; Jou and Wang, 2012; Saz-Salazar and Garcia-Menendez, 2001; Yoo and Kwak, 2002). Therefore, the Spike model provides a more realistic depiction than the aforementioned models.

There are a few alternatives to the approach of the Spike model. Anastasopoulos et al. (2008) identifies Tobit regression as an approach appropriate to deal with the censoring problem. There is a growing body of recent research that deals with

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possible heterogeneity across observations by allowing some or all parameters to vary randomly across observations (Anastasopoulos and Mannering, 2011; Gkritza and Mannering, 2008). Although the theoretical background between the Tobit and Spike models is similar, there are two differences as follows. First, in terms of the values of dependent variables, in the Tobit model, the dependent variable is the respondent's actual WTP. However, in the Spike model, the dependent variable is the bid offered in triple-bound dichotomous choice (TBDC) scenarios. For example, in our study, we specifically ask whether the respondent accepts or rejects the bid for compensation, rather than asking about their WTP. Second, the error terms are assumed to be normally distributed in the Tobit model while they are Gumbell distributed in the Spike model. The expected WTP in our study is estimated based on this logic. Since the intent of the current paper is to analyse the perpetrators' WTP consolation compensation prices in road traffic accidents by using TBDC, the widely used Spike model is selected for further investigations.

In this study, to analyse the perpetrators' WTP consolation compensation prices for different injury severities, we categorise victims' injury severity into minor injury, moderate injury, serious injury, disability, and death.[1] In our survey, 49.3% of respondents answered that their WTP is zero for minor injury, 36.1% for moderate injury, 32.5% for serious injury, 31.7% for disability, and 28.3% for death. Regardless of the injury type, zero WTP accounts for at least 30% of the responses, which justifies the use of the Spike model. In addition, this study uses a TBDC questionnaire with three layers of designed scenarios to determine the WTP for the subject.

This paper is organised as follows. The introduction describes the study's objectives and motives and includes a literature review; Section 2 discusses the model framework; Section 3 provides the investigation data and analyses; Section 4 includes the model estimation results; and Section 5 provides conclusions and recommendations.

2. Model framework

Many previous studies find that respondents are unwilling to pay anything (the WTP price is zero), and if the zero WTP price proportion is too high, then the estimated results using the traditional model may produce a negative WTP price and result in an estimate error. Therefore, Kriström (1997) suggests using the Spike model to address many zero WTP price responses. Further, even where the proportion of zero WTP prices is high, the Spike model yields consistent results (Saz-Salazar and Garcia-Menendez, 2001). Therefore, this study uses the Spike model to estimate respondents' WTP prices. Estimates from the model and a description of the perpetrators' WTP prices are provided below.

The WTP price is the maximum that respondents are willing to pay. Therefore, when respondents are provided with a scenario bid (A_1), if the $WTP \geq A_1$, then the respondents are willing to pay that amount. The probability function for the bid (A_1) that respondents are willing to pay is expressed as follows:

$$Pr(Yes) = Pr(WTP \geq A_1) = 1 - F_{wtp}(A_1) = F_{\varepsilon}(\Delta V(\bullet)) \tag{1}$$

where $\varepsilon = \varepsilon_0 - \varepsilon_1$; $\Delta V(\bullet) = V_1(Y - A_1, X, E) - V_0(Y, X, E)$; Y is personal income; X represents socio-economic characteristics; E represents characteristics of accident experience (1 is the current state; 0 is the original state).

The expected WTP price, *E(WTP)*, can be derived as follows,

$$E(WTP) = \int_0^{\infty} (1 - F_{wtp}(A_1))dA_1 = \int_0^{\infty} (F_{\varepsilon}(\Delta V(\bullet)))dA_1 \tag{2}$$

$F_{wtp}(A_1)$ is the cumulative probability function for the respondent's WTP, and its range is as follows:

$$F_{wtp}(A_1) = \begin{cases} F_{wtp}(A_1), & A_1 > 0 \\ P, & if\ A_1 = 0 \end{cases} \tag{3}$$

In Eq. (3), P is (0, 1). If $A_1 = 0$, then $F_{wtp}(A_1 = 0) = P$; if A_1 approaches ∞, then $F_{wtp}(A_1 = \infty) = 1$.

We assume that the differences of the utility functions are as follows,

$$\Delta V(\bullet) = V_1 - V_0 = (\alpha_1 - \alpha_0) - \beta A_1 + \delta X + \lambda E = \alpha - \beta A_1 + \delta X + \lambda E \tag{4}$$

wherein $\alpha = \alpha_1 - \alpha_0$.

Assuming $F_{wtp}(A_1)$ is the probability distribution for the logistic model (justified further in Section 4), the expected WTP price can be derived as follows:

$$E(WTP) = \int_0^{\infty} (1 - F_{wtp}(A_1))dA_1 = \int_0^{\infty} \left(\frac{e^{(\alpha - \beta A_1 + \delta X + \lambda E)}}{1 + e^{(\alpha - \beta A_1 + \delta X + \lambda E)}} \right) dA_1 = \frac{1}{\beta} \ln(1 + e^{\alpha + \delta X + \lambda E}) \tag{5}$$

The probability that the WTP price is zero is shown as

$$P = \frac{1}{1 + e^{\alpha + \delta X + \lambda E}} \tag{6}$$

Since this study uses a triple-bound questionnaire form, there are essentially $2 \times 2 \times 2 = 8$ types of answers. However, at the time of administering the questionnaire, if respondents are continuously reluctant to answer the final three questions, the respondents may actually have two possible WTP situations. First, the respondent is unwilling to pay any price, in which case the response for the WTP price is NT$ 0, as shown in the last line of Eq. (7). The other possibility is that the respondent has a certain WTP, but the WTP amount is lower than the amount on the questionnaire (i.e. 0 < WTP < A), as shown in the second to last line of Eq. (7). Therefore, taking into account these two situations, the total number of possible answers is 9, as shown in equation[2]

[1] Minor injury: includes general head, chest, abdominal, lumbar, upper limb, and lower limb injuries, as well as multiple traumas. Moderate injury: includes head fractures; thoracic, abdominal and lumbar fracture, and dislocation; upper limb fracture and dislocation; and lower limb fracture and dislocation. Serious injury: includes serious head injuries; major chest, abdominal and lumbar organ injuries; and injury to the central nervous system and spinal cord. Disability: includes serious injury but qualifies for disability certificate or disability. Death: loss of life.

[2] It shall be noted that we did further ask the maximum WTP and minimum WTP at I^{YYY} and I^{NNNY} cases, respectively. However, we did not use them in the estimation due to unattractiveness of mathematical derivation. One may apply Tobit (as mentioned in Section 1, when TBDC is not used) to directly use the WTP values, or develop the whole derivation (including expected WTP) by using probability density function for those exact WTP values. Nevertheless, either case is not the main intention of this study.