Stated Preference Discrete Choice Model to Investigate the Determinants of Public Willingness to Pay for Road Casualty Risk Reduction in Thailand

Dilum DISSANAYAKE
School of Civil Engineering & Geosciences, Newcastle University, Newcastle, NE1 7RU UK; E-mail: dilum.dissanayake@ncl.ac.uk

Abstract: This study intends to investigate how a society appreciates road safety and the factors that influence public willingness to pay (WTP) for a reduction in risk of road safety. For this purpose, the Discrete Choice modelling technique was employed to analyze WTP data collected through a Stated Preference Contingent Valuation experiment and to establish the WTP determinants of and the attitudes toward road safety. Accordingly, eight models were developed for car and motorcycle casualties by taking into account four severity classes of casualty: slight, serious but no permanent disability, serious with permanent disability, and fatal. The analysis shows that level of education and vehicle ownership have significant relationship with public WTP. It is also found that there exists a very strong correlation between past casualty experiences and WTP.

Keywords: Willingness to pay, Developing countries, Discrete choice analysis, Car and motorcycle casualty risk, Road safety policies.

1. INTRODUCTION

The increasing demand for travel experienced in Asia, along with the economic development of the 1980s, has resulted in a number of detrimental effects on urban systems. The economic development has certainly intensified per capita income, enhancing personal mobility. In Asia, private vehicle ownership and usage have continued to be recognized as an essential element of travel for many and affected road user behaviour. Motorization brings inexperienced drivers onto the roads, escalating deaths and injuries from road accidents. In a vehicle-dominant road network, pedestrians and cyclists are at particular risk, so improving their safety is an important issue that need to be addressed.

Many organizations including the World Health Organization (WHO) (1999), the Asian Development Bank (ADB) (1997), the Transport Research Laboratory (TRL) (2003) and the Global Road Safety Partnership (GRSP) (2005) have identified the importance of improving road safety, especially in Asian countries. As reported by GRSP (2005), 44% of the global road traffic fatalities in 1999 happened in Asia and the Pacific regions (Figure 1). According to GRSP (2005), major changes have happened in Asia within the past few years. Motorization has grown at an increasing rate, largely with the growth in motorcycles. The number of motor vehicles has been nearly trebled in China and more than doubled in the other large Asian countries in less than a decade. Highly motorized countries in Asia like Malaysia, Thailand and Korea are responsible for a significant share of the road fatalities (GRSP, 2005).

A recent study in Thailand reported that, at present, road accidents are regarded as one of the crucial problems there, in terms of country’s economy and public health (Luthep and Tanaboriboon, 2005). Due to the severity of the road accidents in Thailand, stakeholder groups, including the public and private sector organizations and non-profit organizations, are making significant contributions to road safety enhancements (ADB, 2005).

Delivering road safety policies along the lines of public demand is a challenging but important undertaking by all concerned stakeholders to maximize the societal benefits from
such policies. This subject has not been explicitly researched within the global transport community to date, even though it has been fundamental to decision making processes on road safety and related policy enforcements (Schwab Christe and Soguel, 1996). While recognizing the scale of the road safety problem in Asian countries, this study attempts to elicit public preferences for a safer road environment considering the city of Bangkok in Thailand as a case study. This research attempts to identify that public demand for and attitudes to road safety can be successfully investigated by analyzing (WTP) data for the reduction in risk of road casualties collected via Stated Preference (SP) experiments. Public demand for safety or social attitudes to road safety risk reduction cannot be revealed directly by other data sources, for example Revealed Preference (RP) data or secondary data sources. As such, it is imperative to come up with an approach and data source that can meet the objective of this study. A widely established SP technique is therefore considered appropriate to conduct a rational assessment of public behaviours and attitudes to road safety that can contribute in coming up with responsive road safety policies that will draw the programs and measures to alleviate the severity of accidents.

The prime objectives of this study are to investigate how the society in question appreciates road safety and to determine what factors influence public WTP for the reduction in risk of road casualties. The WTP method, whose application has been confined to developed countries thus far in assessing public or non-market goods, is incorporated in this study as an attempt to transfer the methodology to developing Asia. The state-of-the-art Discrete Choice modelling technique is identified as an analytically convenient means to model the WTP and to investigate the determinants of and attitudes to WTP for road safety risk reduction. Four severity classes (SC) were considered in the analysis: slight casualty (SC1), serious casualty but no permanent disability (SC2), serious casualty with permanent disability (SC3), and fatal casualty (SC4).

The study methodology basically involved the following steps:

- Review of available techniques on data collection and data analysis on road safety in both developed and developing countries to elaborate research gaps and formulate research questions.
- Design of and carrying out of a questionnaire survey to collect data on public WTP with respect to road casualty risk reduction in Thailand, and process the data for use in the analysis.
- Develop Discrete Choice Multinomial (MNL) models to analyze WTP data for car and motorcycle casualties taking into consideration each severity class.
- Investigate the factors that affect public decisions on WTP for road safety risk reduction.

Altogether, eight Discrete Choice Stated Preference models were estimated, and these were specified to explore the way that peoples’ socio-economic status and past casualty experiences related to their WTP decisions.
2. RESEARCH CONTEXT: STATED PREFERENCES AND WILLINGNESS TO PAY

Understanding consumer preferences are very useful in formulating social policies. This is notably true for coming up with transport policies and measures. Albeit this notion, evaluating preferences or measuring WTP for goods or services has often been a challenge for policy makers. Peoples’ preferences can be expressed as an indication of their needs and priorities. For private goods, end-user preference is generally revealed through available market observations, for instance RP data. In contrast, for public goods it is measured using SP methods. WTP techniques are devised to elicit peoples’ monetary valuations of costs and benefits for goods or services. Vloerbergh et al. (2007) described WTP as the amount of money that an individual is willing to pay to gain or avoid something.

According to Strand (2002), spending for traffic safety essentially has a public good aspect as safety improvements affect the statistical risk of each person. This confirms the suitability of SP techniques in assessing people’s WTP for road safety. WTP to lessen mortality risks may clearly indicate the individual's valuation of others' mortality risk reduction, both family members and society (Strand, 2002).

Eliciting WTP for road safety is usually achieved by making use of SP Contingent Valuation (CV) methods. The most popular methods of designing WTP questionnaires that belong to SP CV methods are open-ended, dichotomous choice, and payment card format (Reaves et. al., 1999). Each of these methods has its own advantages and disadvantages. In the open-ended method, respondents are required to state their maximum WTP. This is an iterative method. At the start of the interview, a certain amount is first offered to the respondents in this method. If they agree to pay, the initial amount will be gradually increased until the respondents refuse to pay for the benefit. The last bid accepted represents their willingness to pay (Islam, 2002). This method may be subject to interviewer bias. In the dichotomous choice set-up, a pre-determined price is chosen and respondents are asked if they are willing to buy the good at that given price. Since the format selected is a dichotomous choice, respondents provide a simple answer “yes” or “no”. If the price is lower than their WTP, they will agree; otherwise, they will refuse (Islam, 2002). With this method, many observations may be needed to estimate the willingness to pay distribution. In the payment card format, respondents are presented with a list of specific price options. Respondents choose the highest amount from the list that they are willing to pay. Reaves et al. (1999) stated that the payment card format has desirable properties relative to the other two methods; their results suggest that the payment card format may ease the valuation task faced by the survey respondents and lead to efficiencies in data collection. In recent years, the payment card method has been popular in road safety studies (Schwab Christie and Soguel, 1996; Islam, 2002; Jones-Lee, 1993; Jones-Lee, 1995; Kidholm, 1995). This study adopts the use of the payment card method for the data collection considering its benefits over other available methods.

Risk communication is regarded as a key issue in WTP survey design. According to Schwab Christie and Soguel (1995), biases may be generated if the survey is not carefully designed; in order to minimize the potential biases, testing of survey questions prior the main survey is recommended. Schwab Christie and Soguel (1995) also stated that some details about the initial risk and the change in risk have to be included in the questionnaires so that the respondents understand the situation clearly. The description of the risks provided to the respondents has a major influence on their degree of comprehension, and consequently, their responses to the questionnaires (Islam, 2002). As stated by Ball (2000), people do not necessarily possess clear-cut preferences toward changes in risk and therefore, survey responses might not be an accurate measure of true preferences. To minimize the potential biases, a sound survey design for the purpose of evaluating risk changes must ensure that
respondents be aware of the commodity they are being asked to value (Islam, 2002). In asking respondents to recall their prior experiences, knowledge of the good to be valued as well as attitudes and beliefs by including relevant questions in the questionnaire was considered as vital to receive accurate estimates of their WTP (Arrow et al., 1993; Hutchinson et al., 1996).

Integrating public preferences or WTP into social policy decisions has not been given attention in Asian countries until recently. Mohan (2002) highlighted the importance of employing WTP methods in safety policy decisions in India. A recent study by Fauzi et al. (2004) investigated the possibility of applying the WTP method to value road safety in Malaysia. Several studies identified the suitability of regression techniques in analyzing WTP data collected by means of SP CV techniques (Islam, 2002; Fauzi et al., 2004). In addition to regression techniques, the use of discrete-choice methods is popular in WTP studies. This method can provide proper understanding of travel behaviour given preferences or choices. Schwab Christie and Soguel (1996) analyzed WTP data collected through the payment card method using discrete choice models, especially logit models. The discrete choice method is regarded as very advantageous because it takes into account the trade-offs that people make between attributes (Mogas, 2006; Ben-Akiva and Lerman, 1985). This study therefore employs the discrete choice method to analyze the WTP data collected via the SP CV experiment.

3. CASE STUDY AREA

The empirical analysis is conducted using the data from the city of Bangkok, the capital of Thailand, serving as a development centre for the whole country. The population in Bangkok, as estimated in 2002, was 5.8 million, 10% of Thailand’s population (ADB, 2005).

The Thai economy was seriously affected by the financial crisis in Asia from 1997 to 2000. In 2002, the economy was growing at a rate of 5.4% (Luthep and Tanaboriboon, 2005). Vehicle ownership in Thailand has been growing continuously regardless of the economic downturn. The seriousness of road accidents in Thailand has been noted both before and after the recession periods (Luthep and Tanaboriboon, 2005; Patmasiriwat, 1996).

3.1 Road Casualty Trends

Increasing growth rates in GDP after the 1997 to 2000 recession period have a direct influence on vehicle ownership rates in Thailand. In order to show the relationship between GDP growth, the vehicle registration and traffic-related casualties, Figure 2 is presented using the data from ADB (2005) and IMF (2008).

According to Figure 2, the number of accidents and casualties fell between 1994 and 1999, but began to increase again starting in 1999, with a significantly higher rate from 2001. There was also a sudden increase of fatalities since 2000. The increase in accidents and other casualties after the recession period has been shown to have a direct relationship with increased motor vehicle registration in Thailand from 2000. These observations further provide justification for this study.

3.2 Types of Vehicle Involved in Road Accidents

Figure 3 illustrates the share of road accidents involving different vehicle types in 2002 in Thailand using the data from ADB (2005). It is observed that motorcycles are the most susceptible mode for road accidents in Thailand, followed by car and light trucks. This is a common phenomenon in many countries in Asia.
3.3 The Distribution of Fatalities by Age

Figure 4 shows the distribution of fatalities by age in Thailand (ADB, 2005). Accordingly, young people, those between 15-30 years of age, are overrepresented in fatalities and this is followed by working age adults aged 30-60.
4. THEORETICAL FOUNDATION: APPLICATION OF DISCRETE CHOICE METHODS IN ANALYZING WILLINGNESS TO PAY

As already mentioned earlier, Discrete Choice Analysis (DCA) is recognized in this study as a useful technique in modelling WTP data collected through SP CV experiments. The objectives of the study, to reveal how a society appreciates road safety in the context of an Asian country, and to investigate the factors that influence public willingness to pay for measures that reduce road casualty risk, are achieved by developing multinomial logit (MNL) models that come under DCA. Modelling WTP using DCA is conceptually appealing as it is not only a novel application in road safety policy but also its ability to provide welfare-consistent estimates on safety by taking into account the trade-offs that people make between attributes. However, to date it has been difficult to apply to developing countries due to the unavailability of data, as well as data biases and inaccuracies. Therefore, the data collection was carefully planned to achieve the objectives of the study.

4.1 Model Formulation: MNL Model

DCA allows the analyst to describe the utility of an alternative \( U \) using observed variables \( V \) and unobserved factors in the form of an error term \( \varepsilon \). According to Ben-Akiva and Lerman (1985), the utility can be expressed as follows:

\[
U^n_i = V^n_i + \varepsilon^n_i
\]

where,
- \( U^n_i \): the utility of alternative \( i \) for individual \( n \),
- \( V^n_i \): the systematic (deterministic) component of utility of \( i \) for individual \( n \),
- \( \varepsilon^n_i \): the random (disturbance or error) component of utility \( i \) for individual \( n \).

It is assumed that the decision maker selects the alternative with the highest utility. However, the utilities are not known to the analyst with certainty. The common practice of treating this uncertainty is by considering them as random variables.

\[
P^n_i = P(U^n_i \geq U^n_j, \ \forall j \in C^n, \ j \neq i) = P(V^n_i + \varepsilon^n_i \geq V^n_j + \varepsilon^n_j, \ \forall j \in C^n, \ j \neq i)
\]

where,
- \( P^n_i \): the probability that the individual \( n \) chooses alternative \( i \),
- \( C^n \): the choice set of the individual \( n \).

With the assumption that \( \varepsilon^n = (\varepsilon^n_i - \varepsilon^n_j) \) is logarithmically distributed, the probability that individual \( n \) chooses the alternative \( i \) \( (P^n_i) \) can be expressed as:

\[
P^n_i = \frac{e^{V^n_i}}{\sum_{j \in C^n} e^{V^n_j}}
\]
4.2 Application of Discrete Choice Methods in Modelling Willingness to Pay

Assuming the overall choice set \( C_n \) consists of several WTP choice options, the utility of selecting a specific WTP choice option \( i \) can be formulated as follows:

\[
U_{WTP(i)}^n = V_{WTP(i)}^n + \varepsilon_{WTP(i)}^n = \beta'X_{WTP(i)}^n + \varepsilon_{WTP(i)}^n
\]  

where,

- \( U_{WTP(i)}^n \): the utility of selecting WTP\((i)\) by individual \( n \),
- \( V_{WTP(i)}^n \): the systematic component of utility of selecting WTP\((i)\) by individual \( n \),
- \( \varepsilon_{WTP(i)}^n \): the random component of utility,
- \( X_{WTP(i)}^n \): the vector of attributes that explains the utility of selecting WTP\((i)\) by individual \( n \),
- \( \beta' \): the vector of unknown parameters.

The choice probability for selecting WTP\((i)\) by individual \( n \) can be written as follows:

\[
P_{WTP(i)}^n = \frac{e^{\beta'X_{WTP(i)}^n}}{\sum_{j \in C_n} e^{\beta'X_{WTP(j)}^n}}
\]  

where,

- \( P_{WTP(i)}^n \): the probability that individual \( n \) chooses WTP\((i)\).

5. STATED PREFERENCE CONTINGENT VALUATION (SPCV) EXPERIMENT

5.1 Questionnaire Design

The questionnaire was designed to collect information from the general public in the city of Bangkok regarding their WTP for car and motorcycle casualty risk reduction. The payment card method, one of the SPCV techniques for collecting data, was used in this study due to its suitability to exploring public WTP for road safety.

Since the WTP concept is unknown to the people in Bangkok city, it was decided that the main survey would be conducted via face-to-face interviews. The questionnaire was designed to take only about 15 minutes to complete as lengthy interviews would weaken the respondents’ interest. Since asking people directly regarding their WTP choices may generate problems, the questionnaire design considered the possible issues and pay attention to terminology, format, content, placement and organization to obtain accurate information (Vloerbergh, 2007).

The questionnaire covered data that belongs to three major categories of information: personal and household information, past experiences of road casualties and the WTP for reducing car/motorcycle casualty risk.

5.2 Personal and Household Information

Personal information includes respondent’s gender, age, education, occupation, personal income per month, monthly savings, transport mode for daily travel, and the number of cars
and motorcycles owned by the respondents. If the respondent is married and has a family, the respondent was further requested to provide further household information such as spouse’s occupation, spouse’s monthly income, household monthly savings and the number of children. The personal and household information complete the socioeconomic data needed in DCA and SP analyses.

5.3 Past Experiences of Road Casualties

To capture the relationship between respondents’ casualty experience and their WTP for casualty risk reduction in the analysis, the questionnaire referred to various kinds of casualty experiences that they had, for instance personal experience, household experience (spouse, children) and experiences related to their close community (parents, siblings, relatives, friends), were requested from the respondents.

5.4 WTP for Reducing Car and Motorcycle Casualties

Eight payment cards were designed to gather information from respondents regarding their WTP for the reduction of car casualty risk (CAR-SC1, CAR-SC2, CAR-SC3, and CAR-SC4) and motorcycle casualty risk (MC-SC1, MC-SC2, MC-SC3, and MC-SC4). Each payment card contains car or motorcycle casualty statistics in Thailand, as required, to give respondents information on the severity of the problem.

The payment cards were designed to include a statement, for example in CAR-SC1 card, “To reduce car-related slight casualties 25%, how much would you be willing to pay monthly for road safety improvement in your area?” The WTP values on the cards were set up to increase from 0B (Thai Baht) to 1000B in eight steps (0B, 5B, 10B, 25B, 50B, 100B, 250B, 500B, and 1000B respectively).

In order to receive reliable answers, the respondents were provided with an instruction to “Please remember that your WTP choice should reflect the value to you of avoiding pain, suffering and bereavement as well as lost time. Also consider your income and savings before making your choice”.

Once the questionnaire and the payment cards were completed, they were translated to the Thai language. The pilot survey was conducted in June 2006. Accordingly, the problems and concerns of the questionnaire design were identified and amended. Prior to the main survey, interviewers were selected and trained as required. These were some of the measures adopted to reduce bias in the conduct of the SP survey.

5.5 Data Collection and Preparation for the Analysis

The data collection was conducted between September and November 2006. Respondents were chosen using a random sampling technique in the Bangkok Metropolitan Area (BMA). The BMA has 50 administrative districts covering 1570 km². Altogether, 598 persons participated for the survey; there were 300 and 298 respondents for the Car and Motorcycle questionnaires respectively.

The collected data was systematically coded and arranged in two separate databases, one for WTP for car casualty risk reduction (car database) and the other for motorcycle casualty risk reduction (motorcycle database). Once the databases were completed, they were transformed into a software readable format.
6 DATABASE STATISTICS

6.1 Past Experiences on Road Casualties

Both car and motorcycle databases were used to explore the database composition of past casualty experiences considering personal experience, household experience and experiences related to their close community.

It was found that 47% of the respondents from the car database had personal experience of casualties. Only 20% reported that their household members had had casualty experience, while 43% of respondents stated that they were aware of casualty experiences involving people in their close community including their parents, siblings, relatives or friends. Similarly, for the motorcycle database, it was recognized that 39% had individual casualty experience and 17% had related casualty experience among household members, while 41% had community related casualty experiences.

6.2 Variation of Public WTP Values with respect to the Severity of the Casualties

The databases were analyzed to examine whether any significant trends existed between the public selection of WTP values and the severity of the casualty types SC1, SC2, SC3, and SC4 (Figure 5). Even though there were nine WTP options on the payment cards, the respondents selected seven options that excluded 500B and 1000B.

In Figure 5, WTP0, WTP5, WTP10, WTP25, WTP50, WTP100, and WTP250 indicate the respondents’ choice options of 0B, 5B, 10B, 25B, 50B, 100B and 250B respectively. For both Car and Motorcycle databases, WTP0 decreases when the severity of the casualty increases. Further, it was observed that public WTP increases when the severity of the casualty increases, especially for 25B and higher WTP values. For instance, only 20% of respondents pay 25B or more for reduction in risk of slight casualty (SC1) (see Figure 5(a)). This share increases up to 39% for serious casualty but no permanent disability (SC2), and increase further to 55% for serious casualty with permanent disability (SC3), and then up to 65% for fatal casualty (SC4). The variation of the WTP for reduction in risk of motorcycle casualty is similar to the case of reduction in risk of car casualty (see Figure 5(b)).

7. ANALYZING WILLINGNESS TO PAY USING DISCRETE CHOICE MODELS

7.1 Model Development

As already stated, the DCA was employed in this study and accordingly eight MNL models were developed. The first four models were based on public WTP for car casualty risk reduction considering the severity classes SC1, SC2, SC3, and SC4. Similarly, the other four models represent the motorcycle related casualty risk reduction over the four severity classes above. Each model consists of seven WTP choices: WTP0, WTP5, WTP10, WTP25, WTP50, WTP100 and WTP250. The details of the models developed in this study are summarized in Table 1.

The estimated MNL models have seven WTP choice options. The alternative specific constant (ASC) of the WTP250 choice option (value function) was initially set to zero in all Car and Motorcycle models (see Tables 2 and 3) as per the requirement of the model estimation; all other ASCs associated with the WTP0, WTP5, WTP10, WTP25, WTP50, and WTP100 value functions were estimated.
(a) Public WTP for car risk reduction

(b) Public WTP for motorcycle risk reduction

Figure 5. Variation of public WTP values with the severity of the casualties.

<table>
<thead>
<tr>
<th>Model ID.</th>
<th>Model Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR/SC1</td>
<td>WTP for reducing car-related slight casualties (SC1) by 25%</td>
</tr>
<tr>
<td>CAR/SC2</td>
<td>WTP for reducing car-related serious casualties with no permanent disability (SC2) by 25%</td>
</tr>
<tr>
<td>CAR/SC3</td>
<td>WTP for reducing car-related serious casualties with permanent disability (SC3) by 25%</td>
</tr>
<tr>
<td>CAR/SC4</td>
<td>WTP for reducing car-related fatal casualties (SC4) by 25%</td>
</tr>
<tr>
<td>MC/SC1</td>
<td>WTP for reducing motorcycle-related slight casualties (SC1) by 25%</td>
</tr>
<tr>
<td>MC/SC2</td>
<td>WTP for reducing motorcycle-related serious casualties with no permanent disability (SC2) by 25%</td>
</tr>
<tr>
<td>MC/SC3</td>
<td>WTP for reducing motorcycle-related serious casualties with permanent disability (SC3) by 25%</td>
</tr>
<tr>
<td>MC/SC4</td>
<td>WTP for reducing motorcycle-related fatal casualties (SC4) by 25%</td>
</tr>
</tbody>
</table>

In the CAR/SC1 and CAR/SC2 models, the ASCs of the WTP0, WTP5, WTP10, WTP50, and WTP100 value-functions are significant and positive, indicating the respondents’ preference for those choices over WTP250, which was considered as the base, for reducing
Table 2. Estimation results: Car models [CAR/SC1, CAR/SC2, CAR/SC3, CAR/SC4]

<table>
<thead>
<tr>
<th>Variable</th>
<th>CAR/SC1</th>
<th></th>
<th>CAR/SC2</th>
<th></th>
<th>CAR/SC3</th>
<th></th>
<th>CAR/SC4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative Specific Constants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alt. 1: WTP0</td>
<td>5.72</td>
<td>5.22</td>
<td>2.25</td>
<td>2.84</td>
<td>0.65</td>
<td>0.82</td>
<td>0.14</td>
<td>0.19</td>
</tr>
<tr>
<td>Alt. 2: WTP5</td>
<td>3.97</td>
<td>3.94</td>
<td>2.09</td>
<td>3.96</td>
<td>0.24</td>
<td>0.55</td>
<td>-1.07</td>
<td>-2.26</td>
</tr>
<tr>
<td>Alt. 3: WTP10</td>
<td>4.67</td>
<td>4.65</td>
<td>3.28</td>
<td>6.44</td>
<td>2.28</td>
<td>6.52</td>
<td>1.28</td>
<td>4.67</td>
</tr>
<tr>
<td>Alt. 4: WTP25</td>
<td>1.74</td>
<td>1.61</td>
<td>0.77</td>
<td>1.27</td>
<td>0.59</td>
<td>1.43</td>
<td>-0.67</td>
<td>-1.62</td>
</tr>
<tr>
<td>Alt. 5: WTP50</td>
<td>3.38</td>
<td>3.33</td>
<td>2.77</td>
<td>5.39</td>
<td>2.03</td>
<td>5.75</td>
<td>1.53</td>
<td>5.72</td>
</tr>
<tr>
<td>Alt. 6: WTP100</td>
<td>2.40</td>
<td>2.29</td>
<td>1.70</td>
<td>3.12</td>
<td>1.75</td>
<td>4.85</td>
<td>1.50</td>
<td>5.56</td>
</tr>
<tr>
<td>Alt. 7: WTP250</td>
<td>0.00</td>
<td>--</td>
<td>0.00</td>
<td>--</td>
<td>0.00</td>
<td>--</td>
<td>0.00</td>
<td>--</td>
</tr>
<tr>
<td><strong>Socio-economic Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income/10^5, Alts. 2, 3, 4, 5, 6, 7</td>
<td>0.38</td>
<td>0.67</td>
<td>-0.58</td>
<td>-0.95</td>
<td>-1.04</td>
<td>-1.65</td>
<td>-1.00</td>
<td>-1.52</td>
</tr>
<tr>
<td>Education, Alts. 2, 3, 4, 5, 6, 7</td>
<td>0.28</td>
<td>2.80</td>
<td>-0.01</td>
<td>-0.15</td>
<td>-0.09</td>
<td>-0.55</td>
<td>-0.11</td>
<td>-0.67</td>
</tr>
<tr>
<td>Car ownership, Alts. 2, 3, 4, 5, 6, 7</td>
<td>-0.30</td>
<td>-2.22</td>
<td>-0.17</td>
<td>-1.08</td>
<td>-0.08</td>
<td>-0.48</td>
<td>0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td><strong>Alternative Specific Dummies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1-4 experience [at a personal or household or community level], Alt. 1</td>
<td>-0.92</td>
<td>-3.06</td>
<td>-0.76</td>
<td>-2.07</td>
<td>-0.34</td>
<td>-0.84</td>
<td>-0.55</td>
<td>-1.35</td>
</tr>
<tr>
<td>SC1-4 happened 10 yrs ago [at a personal or household or community level], Alt. 1</td>
<td>0.37</td>
<td>0.83</td>
<td>0.11</td>
<td>0.19</td>
<td>0.16</td>
<td>0.27</td>
<td>0.26</td>
<td>0.43</td>
</tr>
<tr>
<td>SC2 [at a personal or household level], Alt. 6</td>
<td>2.14</td>
<td>3.53</td>
<td>2.35</td>
<td>4.59</td>
<td>1.38</td>
<td>2.85</td>
<td>0.92</td>
<td>1.91</td>
</tr>
<tr>
<td>SC3 or SC4 [at a personal or household or community level], Alt. 7</td>
<td>3.57</td>
<td>2.85</td>
<td>3.06</td>
<td>4.01</td>
<td>2.24</td>
<td>3.37</td>
<td>2.63</td>
<td>4.80</td>
</tr>
</tbody>
</table>

**Summary statistics**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>L(\hat{\beta})</th>
<th>L(0)</th>
<th>\rho^2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>300</td>
<td>-443.18</td>
<td>-583.77</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>-476.36</td>
<td>-583.77</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>-498.67</td>
<td>-583.77</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>-485.54</td>
<td>-583.77</td>
<td>0.17</td>
</tr>
</tbody>
</table>

0 in Coef. column indicates a constant term set to zero.
-- in t-stat. column indicates t-stat. not available.
0 in t-stat. column indicates t-stat. not available.
SC1- slight casualty
SC2- serious casualty but no permanent disability
SC3- serious casualty with permanent disability
SC4- fatal casualty
Bold figures are significant at 95%.
Table 3. Estimation Results: Motorcycle models [MC/SC1, MC/SC2, MC/SC3, MC/SC4]

<table>
<thead>
<tr>
<th>Variable</th>
<th>MC/SC1</th>
<th>MC/SC2</th>
<th>MC/SC3</th>
<th>MC/SC4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative Specific Constants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alt. 1: WTP0</td>
<td>5.59</td>
<td>7.49</td>
<td>4.06</td>
<td>6.26</td>
</tr>
<tr>
<td>Alt. 2: WTP5</td>
<td>2.54</td>
<td>4.02</td>
<td>1.10</td>
<td>2.07</td>
</tr>
<tr>
<td>Alt. 3: WTP10</td>
<td>3.02</td>
<td>4.84</td>
<td>2.63</td>
<td>5.45</td>
</tr>
<tr>
<td>Alt. 4: WTP25</td>
<td>2.64</td>
<td>4.20</td>
<td>2.18</td>
<td>4.44</td>
</tr>
<tr>
<td>Alt. 5: WTP50</td>
<td>1.85</td>
<td>2.83</td>
<td>1.89</td>
<td>3.79</td>
</tr>
<tr>
<td>Alt. 6: WTP100</td>
<td>2.64</td>
<td>4.18</td>
<td>2.40</td>
<td>4.92</td>
</tr>
<tr>
<td>Alt. 7: WTP250</td>
<td>0.00</td>
<td>--</td>
<td>0.00</td>
<td>--</td>
</tr>
<tr>
<td><strong>Socio-economic Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income/10^5, Alts. 2, 3, 4, 5, 6, 7</td>
<td>1.47</td>
<td>2.12</td>
<td>5.74</td>
<td>1.26</td>
</tr>
<tr>
<td>Education, Alts. 2, 3, 4, 5, 6, 7</td>
<td>0.33</td>
<td>3.71</td>
<td>0.25</td>
<td>2.57</td>
</tr>
<tr>
<td>Motorcycle ownership, Alts. 2, 3, 4, 5, 6, 7</td>
<td>0.34</td>
<td>2.00</td>
<td>0.34</td>
<td>1.64</td>
</tr>
<tr>
<td><strong>Alternative Specific Dummies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1-4 experience [at a personal or household or community level], Alt. 1</td>
<td>-0.51</td>
<td>-1.63</td>
<td>-0.48</td>
<td>-1.41</td>
</tr>
<tr>
<td>SC1-4 happened 10 yrs ago [at a personal or household or community level], Alt. 1</td>
<td>0.65</td>
<td>1.47</td>
<td>0.50</td>
<td>1.07</td>
</tr>
<tr>
<td>SC2 [at a personal or household level], Alt. 6</td>
<td>0.29</td>
<td>0.55</td>
<td>1.09</td>
<td>2.65</td>
</tr>
<tr>
<td>SC1-4 [at both a personal and household level], Alt. 7</td>
<td>2.00</td>
<td>2.10</td>
<td>1.50</td>
<td>1.72</td>
</tr>
<tr>
<td>SC3 or SC4 [at a personal or household or community level], Alt. 7</td>
<td>2.51</td>
<td>2.60</td>
<td>2.03</td>
<td>2.30</td>
</tr>
</tbody>
</table>

**Summary statistics**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>298</th>
<th>298</th>
<th>298</th>
<th>298</th>
</tr>
</thead>
<tbody>
<tr>
<td>L(\hat{\beta})</td>
<td>-496.30</td>
<td>-514.32</td>
<td>-509.75</td>
<td>-487.13</td>
<td></td>
</tr>
<tr>
<td>L(0)</td>
<td>-579.88</td>
<td>-579.88</td>
<td>-579.88</td>
<td>-579.88</td>
<td></td>
</tr>
<tr>
<td>\rho^2</td>
<td>0.15</td>
<td>0.11</td>
<td>0.12</td>
<td>0.16</td>
<td></td>
</tr>
</tbody>
</table>

0 in Coef. column indicates a constant term set to zero.
-- in t-stat. column indicates t-stat. not available.
SC1- slight casualty
SC2- serious casualty but no permanent disability
SC3- serious casualty with permanent disability
SC4- fatal casualty
Bold figures are significant at 95%.
the risk of SC1 and SC2. For the model CAR/SC3, the ASCs for the WTP10, WTP50 and WTP100 value-functions are significant and positive showing the respondents’ propensity to pay 10B, 50B, and 100B for reducing SC3. The parameters of the CAR/SC4 model reveal the respondents’ attitudes to reducing fatal casualties (SC4). The negative and significant ASC of the WTP5 value function in the CAR/SC4 model indicates that the respondents are less likely to pay as little as 5B for the reduction of fatal casualties. Instead, they prefer paying 10B, 50B, or 100B as the ASCs of the WTP10, WTP50, and WTP100 value-functions are positive and significant. The explanation above for Car models is also applicable for Motorcycle models.

The results further revealed that when the level of severity of the casualty increases, the choice of 0B (WTP0) decreases. This is clearly shown by the ASCs for WTP0 in all Car Models (5.72, 2.25, 0.65 and 0.14) and Motorcycle Models (5.59, 4.06, 3.57 and 2.64). When the WTP is at lower levels, especially 5B and 10B, the ASCs decrease as the level of severity of the casualty increases (see Tables 2 and 3). For fatal casualties (see CAR/SC4 and MC/CS4), the constant term gradually increases from WTP10 to WTP100 indicating the social attitude on the payment selection.

In all models, the attributes of age, gender, income, savings, education, number of children, and vehicle ownership were tested to examine their association with the WTP for the reduction in risk of casualty. Among those variables, only income, education and vehicle ownership were found to be suitable. However, the income attribute did not lead to significant estimates for all models except for the MC/SC1 model. This is comparable with the recent research in Malaysia conducted by Fauzi et al. (2004), in which they were unable to comment on any relationship between peoples’ income and WTP. It is reasonable to assume that the income has considerable correlation with education in all car and motorcycle models developed in this study, and this could be the reason for not having both income and education parameters significant in the same model.

The education variable shows a positive and significant relationship with the WTP in the CAR/SC1 and all Motorcycle models. This implies that as people’s level of education increases, their WTP increases. On the other hand, car ownership has a negative and significant relation to WTP, as shown in the CAR/SC1 model which explains that when household car ownership increases, the WTP for reduction in risk of slight casualty risk reduction decreases. This seems logical, considering that car owners are less exposed to becoming slight casualties compared to pedestrians, motorcyclists and cyclists. This is further confirmed by the positive sign and significance of the parameter for motorcycle ownership in the MC/SC1 model as opposed to the negative sign and significance of the same parameter for car ownership in the CAR/SC1 model.

Several dummy variables related to the casualty experiences of individuals, their households, and their close community were also tested to investigate any relationships that may exist between the past casualty experiences and the WTP choices. When an individual has any kind of casualty experience [SC1-4] at a personal, household or community level, the chances of selecting WTP0, in other words paying 0B, for the reduction in car and motorcycle risk are unlikely; the negative sign of this parameter for all car and motorcycle models confirm this. This view is further reinforced by the negative sign and significance of parameters related to the CAR/SC1 and CAR/SC2 models (-0.92 and -0.76) and the MC/SC3 and MC/SC4 models (-0.68 and -0.73). Where the casualty had happened a long time ago, for instance a decade ago, at a personal or household or community level was tested as a dummy variable in all car and motorcycle models. The parameter estimates were found to be positive but insignificant and therefore do not support the drawing of any firm conclusions. However, the positive sign of the respective parameters indicates that casualties that even happened
more than a decade ago may have a positive influence on peoples’ WTP for the reduction in casualty risk.

An individual, who has had an experience of SC2 at either a personal or household level, will choose to pay a significant amount such as 100B (WTP100) for reducing the risk of slight (SC1) as well as serious casualties (SC2 and SC3). This is shown by the positive and significant parameters for the related dummy variable in the CAR/SC1, CAR/SC2, and CAR/SC3 models and the MC/SC2 and MC/SC3 models. An individual who suffered from either SC2 or SC3 at a personal or household or community level, has a strong willingness to pay at a higher level (WTP250) for all car and motorcycle casualties (SC1, SC2, SC3, and SC4). The positive and highly significant parameters, in the Car models (3.57, 3.06, 2.24, and 2.63) and the Motorcycle models (2.51, 2.03, 2.06, and 3.38), demonstrate the relationship that exists between people’s prior casualty experience and their WTP for the reduction in risk of road casualties. This result is consistent with the findings of earlier research (Schwab Christe and Soguel, 1996; Fauzi et al., 2004).

8. CONCLUDING REMARKS

One of the major challenges faced by the authorities proposing policies on road safety in Asia is how to deliver them consistent with and responsive to public demand. Achieving this target requires a clear idea of public attitudes toward road safety and their willingness to pay for the reduction in risk of road casualties. This case study conducted in the city of Bangkok looked into exploring the factors in relation to the reduction in risk of road casualties employing DCA in analyzing and modelling SP data. Data was generated using a WTP questionnaire that was designed using the payment card method with emphasis on both car and motorcycle casualties over four severity classes. The MNL models were estimated to analyze the data collected from Bangkok City.

The analysis results show that there exists a significant relationship between the level of education and the WTP. In addition, it was found that the level of vehicle ownership and the WTP are evidently correlated. The analysis of past casualty experiences at a personal, household and community level were showed that a very strong correlation with WTP. Having experienced either a serious casualty at a personal, household and community level or a fatal casualty at household or community level makes the individuals more willing to pay to reduce the likelihood of casualty occurrences compared to others with no casualty experience. This high level of WTP, 100B or more for the case study, suggests people’s perceptions of both the physical and mental distress from being either a casualty or a relative of a casualty. Even though the identification of human factors was recognized as important by previous studies, they were often neglected when making decisions on road safety policies (Schwab Christe and Soguel, 1996). Furthermore, this study attempted to elicit public preferences for road safety in general and their WTP for the reduction of casualty risks in particular, using a sound methodology, targeted at the delivery of useful information for decision makers in the developing world.

REFERENCES


