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Freeway drivers' willingness to pay for speeding fines.

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ABSTRACT:

Taiwanese drivers, like most drivers, often exceed the legal speed limit and expose themselves to the risk of a fine. Given the propensity to exceed the legal speed limit is common in many counties, it is of interest to understand the amount that drivers are willing to pay for driving faster than the law permits. This may provide useful guidance on the extent to which current fines are adequate as a deterrent to speeding. In this paper we use the contingent valuation method to measure drivers' preferences and to estimate econometric models to determine Taiwanese drivers' willingness to pay (WTP) for driving faster than the law allows. Given the high incidence of a zero willingness to pay, we use a spike model to capture this phenomenon. The study identifies some key influences on WTP such as personal income, the presence/absence of past violations, the risk tolerance of the driver, and the proportion of times spent on the roads where the driver was exceeding the speeding limit last year. On average, we find that freeway drivers in various locations in Taiwan were willing to pay between $US43 and $US51 for driving faster than the law allows.

KEY WORDS: ***Contingent valuation method, willingness to pay, speeding behaviour, spike model.***

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1. Introduction

In December 1, 2001, the Government Traffic Department of Taiwan increased the speed limit from 90 km/h to 100 km/h for the entire length of Freeway No. 1, and in 2008, increased the limit further of 110 km/h on the section between the Tainan rest area and the Nanzih intersection (detailed in Fig. 1). The speed limit on Freeway No. 5 was also raised from 70 km/h to 80 km/h on March 16, 2008. These higher speed limits were a consequence of freeway upgrading that enabled greater throughput of larger volumes of traffic. One consequence of these relaxed speed limits and greatly improved freeway performance was a noticeable increase is speeding. The Ministry of the Interior in Taiwan (2008) reported that speeding was the most common illegal driving behavior from 2001 to 2007, accounting for 63.8% to 77.3% of all such infringements. Speeding fines in Taiwan range from $US94 to $US1881, increasing as the speed increment increases. These figures are the equivalent, on average, of 6.7% to 13.3% of average monthly personal income.

Despite all the warnings, drivers continue to speed in ever increasing numbers, mindful of the increased risks of a crash and injury (including fatality), and the implications on loss of income to the driver and society in general (Carcary et al., 2001). The desire to speed for some drivers is linked to them gaining personal satisfaction through risky behavior, and therefore by implication has an association with a willingness to pay (WTP) speeding fines as well as to cover expenditure caused by accidents.

Becker (1968) in an early pioneering study, focused on the relationship between illegal behavior and the associated penalties, with the results demonstrating that the cost expectations of drivers who deliberately speed are consistent with expected penalties2, and are lower than the expectations of drivers who do not take risks. In that study, illegal behaviors were assumed to be rational choices. In other words, personal illegal behaviors occur when the expected benefits outweigh the expected costs; otherwise, drivers obey the law. If an administration wants to decrease illegal behavior, then there are a number of ways to achieve this. One approach is to have a larger police force which may also be accompanied by increasing speeding fines.

Becker's study, like those by Polinsky and Shavell (1979; 1991) and Chu and Jiang (1993), demonstrated that fines do not need to be raised to include all the risk-averse violator's property. Therefore, to increase the effectiveness of law enforcement, we should consider stipulating speeding fines which are rational and lower than the average overall monthly income level of society. Above all, reducing illegal behavior not only depends upon law enforcement, but also upon the stipulation of rational fines.

However, establishing the appropriate level of WTP speeding fines is a challenge given that it is a non-market good and there is no trading market in which to assess its actual value. In recent years, the contingent valuation method (CVM) has been widely applied to assess the value of non-market goods, with studies finding that CVM is one of the most efficient means of overcoming the difficulty of measuring risk and non-market goods. Several studies applied this method and developed discrete choice models of the logit form to investigate the WTP for goods and services such as improvements in environmental amenity and drink-driving behaviour, etc. (Liu, 1990; Fu and Jou, 1995; Lee, 1999; Bruce and John, 2000; Chen et al., 2003 Liu and Lee, 2007; Liu and Lee, 2007; Yeh and Fu, 2007; Saz-Salazar and Garcia-Menendez, 2001a).

Given the real possibility in a context such as WTP speeding fines that many respondent's in a CV setting may not be prepared to pay any money to obtain the preferred outcome, Kristrom (1997) proposed the 'Spike model' to deal with a large number of zero bids. The appeal of spike

1 $US1 is equivalent to $32 NT (Central Bank of the Republic of Taiwan, 2008).

2 Becker (1968) defines the expected penalty as the probability of being caught multiplied by the level of severity (for example, the fine).

models was confirmed by Yoo et al. (2002), who suggested that spike models can reduce statistical bias when using data with a high proportion of zero bids (Yoo et al. 2006; Bengochea-Morancho et al., 2005; Saz-Salazar and Garcia-Menendez, 2001b; Hu., 2006; Jou et al., 2011a, 2011b, 2012).

This paper develops a framework within which to obtain estimates of the WTP speeding fines. A spike model is estimated using data collected in a CVM survey.

2. Model framework

The framework proposed by Hanemann (1984), which introduces random utility theory in studies of contingent valuation, is used to investigate drivers' willingness to pay speeding fines on a freeway,. The Hanemann model which assumes that the utility function is linear, with observed and unobserved components, showed that we can obtain the mean and median of the WTP starting from a dichotomous valuation question. Formally, the utility function of a freeway driver can be expressed as equation (1):

$$U(Y, X, Q) = V(Y, X, Q) + \varepsilon \tag{1}$$

where Y is personal monthly income, X is a vector of socioeconomic characteristics, Q is a vector of awareness toward the effects of speeding, and the error component ε is randomly distributed with zero mean. Where a driver prefers to accept the cost of speeding (V_1) rather than obey the traffic laws and pay nothing (V_0), we have equation (2):

$$V_1(Y - A, X, Q_1) + \varepsilon_1 \geq V_0(Y, X, Q_0) + \varepsilon_0 \tag{2}$$

where A is the monetary cost that the driver is willing to pay for speeding, and ε0 and ε1 are random components with an independent and identical (iid) Gumbel distribution. The probability of the driver accepting a WTP amount under a new condition (that is, accepting the cost of speeding) is as follows:

$$\begin{aligned} &\Pr(Accept) = \Pr(\Delta V(*) \geq \varepsilon) = F_\varepsilon(\Delta V(*)) \\ &\Delta V = V_1(Y - A, X, Q_1) - V_0(Y, X, Q_0) \\ &\varepsilon = \varepsilon_0 - \varepsilon_1 \end{aligned} \tag{3}$$

The argument * of ΔV is Y, A, X, Q. In addition, the driver will accept the payment of driving faster than the law allows when their WTP value is greater than the bid (A) offered in the CV survey. This probability of driver acceptance is given in equation (4).

$$\begin{aligned} \Pr(Accept) &= \Pr(WTP \geq A) \\ &= 1 - G_{WTP}(A) \\ &= F_\varepsilon(\Delta V(*)) \end{aligned} \tag{4}$$

where GWTP(A) is the complementary cumulative distribution function (c.d.f.) of WTP. The expected WTP is given as equation (5).

$$E(WTP) = \int_0^{\infty} (1 - G_{WTP}(A))dA = \int_0^{\infty} (F_{\varepsilon}(\Delta V(*)))dA \tag{5}$$

The domain of $G_{WTP}(A)$ can be defined as equation (6).

$$G_{WTP}(A) = \begin{cases} 0, & A < 0 \\ P, & A = 0 \\ F_{WTP}(A), & A > 0 \end{cases} \tag{6}$$

where P belongs to the (0,1) interval and $F_{WTP}(A)$ is a continuous and increasing function such that $F_{WTP}(A=0)=P$ and $\lim A \to \infty$ $F_{WTP}(A)=1$. Maximum Likelihood Estimation (MLE) is used to estimate the binary dependent variable model, given its preferred properties over ordinary least squares (Bengochea-Morancho, et al., 2005). The maximum likelihood function is given in equation (7).

$$\begin{aligned} L = \sum_i [& M_i W_i \ln(1 - G_{WTP}(A)) \\ & + M_i (1 - W_i) \ln(G_{WTP}(A) - G_{WTP}(0)) \\ & + (1 - M_i) \ln(G_{WTP}(0))] \end{aligned} \tag{7}$$

where *M* and *W* are defined as equations (8) and (9) respectively.

$$M = \begin{cases} 1, \ WTP > 0 \\ 0, \ otherwise \end{cases} \tag{8}$$

$$W = \begin{cases} 1, \ WTP > A \\ 0, \ otherwise \end{cases} \tag{9}$$

Equation (3) can be further rewritten as Equation (10) given the assumption about the form of the functions V_1 and V_0.

$$\begin{aligned} \Delta V(*) &= \alpha_1 + \beta(Y - A) + \delta Q_1 - (\alpha_0 + \beta Y + \delta Q_0) + \gamma X \\ &= \alpha_1 - \alpha_0 - \beta A + \gamma X + \delta\left(Q_1 - Q_0\right) \\ &= \alpha - \beta A + \gamma X + \delta Q \end{aligned} \tag{10}$$

In the spike model estimation, assuming that $G_{WTP}(A)$ is takes a logistical functional form, $F_{\varepsilon}(\Delta V(*))$ is defined by equation (11):

$$F_{\varepsilon}(\Delta V(*)) = \frac{1}{1 + \exp[-\alpha + \beta A - \gamma X - \delta Q]} \tag{11}$$

Furthermore, equation (6) can be rewritten as equation (12).

$$G_{WTP}(A)=\begin{cases}0, & A<0\\ [1+\exp(-\alpha-\gamma X-\delta Q)]^{-1}, & A=0\\ [1+\exp(-\alpha+\beta A-\gamma X-\delta Q)]^{-1}, & A>0\end{cases} \tag{12}$$

Substituting equation (11) and equation (12) into equation (5), the expected WTP is expressed by equation (13):

$$\begin{aligned}E(WTP)&=\int_0^{\infty}(1-G_{WTP}(A))dA\\ &=\int_0^{\infty}\left(\frac{\exp(-\alpha+\beta A-\gamma X-\delta Q)}{1+\exp(-\alpha+\beta A-\gamma X-\delta Q)}\right)dA\\ &=\frac{1}{\beta}\{\lim_{A->\infty}(-\ln[1+\exp(-\alpha+\beta A-\gamma X-\delta Q)]\\ &\quad+\ln[1+\exp(-\alpha-\gamma X-\delta Q)])\}\end{aligned} \tag{13}$$

Kristroöm (1997) defined the spike value when A=0 (equations (14) and (15)) where equation (15) is a special case which does not take exogenous variables into account.

$$Spike=\frac{1}{1+\exp[-\alpha-\gamma X-\delta Q]} \tag{14}$$

$$Spike=\frac{1}{1+\exp(-\alpha)} \tag{15}$$

3. Survey instrument design and data analysis

The design of the survey instrument, the survey methodology and the analysis of the survey data are presented below in sections 3.1, 3.2 and 3.3, respectively.

3.1 Survey instrument design

There is no market or trade mechanism in existence to measure the WTP speeding fines for freeway drivers. Given this situation, we use a stated preference (SP) design of the contingent valuation form, to represent a hypothetical market in which to trade speeding fines.

A series of background questions were asked prior to the main CV questions in order to establish a context for the CV exercise. Details were obtained on gender, age, education level, marital status, car ownership and personal monthly income of the each sampled driver, followed by questions to obtain trip details. Trip data included freeway usage frequency, departure city (county), time spent on the freeway, and whether this trip involved speeding on the freeway.

Freeway drivers were questioned about their attitudes towards the law, which are used in identifying the WTP for speeding behavior. These questions are:

- What do you think is the probability of getting a speeding ticket when you are driving on the freeway?
- What do you think is the probability of an accident occurring due to speeding?
- If an accident were to occur due to speeding, what amount of compensation would you expect to have to pay?
- Have you received a speeding ticket in the last year?
- Do you usually speed on the freeway?
- Do you know that the more a driver exceeds the speed limit, the higher the fine he or she needs to pay?
- Have you ever turned right on red (this is not allowed in Taiwan)?
- Have you ever made a phone call while driving?
- Have you ever driven after drinking? and
- Do you use your turn signal every time you change lanes?

To investigate the effects of different speeding fine policies on drivers' WTP for speeding, seven scenarios defining a range of speeding fines were selected, including the current fine for speeding ($US94). These scenarios were described as follows: "Will you speed[3] on the freeway if the fine is ***X*** USD?" (yes or no). Fines for the ***X*** (in $US) were 47, 70, 94, 117, 141, 164 and 188, respectively, that is, -50%, -25%, 0%, 25%, 50%, 75% and 100% of the current fine. The respondent's WTPs for speeding are the fines that the respondent answers as a yes. Each respondent has to complete all seven scenarios, yielding for 505 drivers a total of 3,535 observations.

3.2 Survey methodology

The field survey was conducted as face-to-face interviews in the Sun Moon Lake national scenic area, an internationally-known sightseeing area, in the central region of Taiwan. This was an appropriate area for our survey since the majority of travelers (over 70%) driving to visit the area use freeways (Sun Moon Lake National Scenic Area Administration, 2007). The survey was conducted from 10 AM to 5 PM over three weekends (from June 21 to July 12) in 2008. The questions presented to respondents relate to freeway trips undertaken during the last 12 months as well as questions to capture attitude towards the law and WTP bidding scenario responses. A total of 505 valid surveys were returned with only five refusals at the point of requesting an interview. The interviewers were trained to be able to explain all related speeding regulations and consequences (including the fines drivers would have to pay) to respondents to ensure that they fully understood the implications of speeding beforehand.

3.3 Descriptive data profiles

1. Socioeconomic characteristics

Socioeconomic characteristics are summarized in Table 1. The majority of respondents were between 26 and 40 years old with 41.5% single. 82.6% of drivers only had one car. The distribution of monthly personal income lies between $US626 and $US1,875 (74.5%), with an average monthly personal income for the sample of $US1,764. Most respondents (86.4%) have held their driver's license for more than six years, indicating that the sample included mostly experienced drivers, that is, drivers with basic safe driving skills and an understanding of traffic laws. The car insurance fee paid per year was mostly below $US312 (53.9%).

[3] The current fine ($ US 94) is based on situations in which speeding does not exceed the posted speed limit by more than 20 km/h. More than 20km/h is not within our study scope.

2. Trip characteristics and attitude towards the law

On average, respondents used freeways 10.6 times per month. The proportion of drivers who reported speeding on freeways, 71.7%~76.9% of drivers, had a probability of speeding on freeways lower than 20%. Drivers who had not received a speeding ticket the previous year made up 81.4% of all drivers, 73.1% from the Taipei area, 86.6% from the Taichung area, and 82.1% from other areas in Taiwan.

A large number of sampled drivers (63.4%~66.7%) had made a phone call while driving; and the proportion of sample drivers who had turned right on red was also high (54.6%~66.2%). However, the experience of drink-driving was only 17.9%~22.2%. A high proportion of sampled drivers (75%~78.3%) perceived that the probability of getting a speeding ticket on the freeway was below 30% (including a high incidence of a zero probability). This suggests that the implementation of traffic laws on the Taiwanese freeways could be stricter. On the other hand, around 57%~94% of drivers perceived that there was only a 50% or lower probability that speeding on the freeway would be a main factor in a traffic accident. The reason for such answers may be the improvement in both the level of service on the freeway and car safety technologies (for example, ABS (Antilock brake system), TCS (traction control system) etc.; such equipment is widely used in cars in Taiwan). When an accident occurs due to speeding, 80%~85% of sampled drivers expect to outlay only 10% or less of their personal income for compensation (the amount of compensation is $US867.5 on average).

3. Hypothetical market scenarios

To measure a drivers WTP for driving faster than the law allows, seven different scenarios were designed. The statistical results are presented in Tables 2 and 3. The results show that the higher the fine for speeding, the less illegal behavior occurs.

Table 3 also reveals the changes in the percentage of drivers who would speed if the fine were changed (from the basic fine of $US94). The greatest impact is obtained by raising the fine for speeding to $US188 (associated with the number of speeding drivers decreasing by 49.2%~59.3% in comparison with the basic fine), with around 18.3%~28.7% of sampled drivers persisting in speeding on the freeway. This reaction on the part of drivers to increased speeding fines suggests that increasing speeding fines might be effective in curbing some amount of illegal driving.

Three market segments were analyzed to determine possible differences in WTP for speeding. These are personal income, the presence/absence of past violations, and driver characteristics.

This study investigates two personal monthly income groups: (1) above average and (2) below average (according to the DGBAS[4], the 2007 average personal GDP in Taiwan was $1,406 US). Table 4 presents the statistical results, showing that drivers with a higher WTP for driving faster than the law allowed had personal monthly incomes which were above average, although different area segmentations were not statistically significant.

Drivers were questioned about their previous freeway violations in this survey. We defined "past speeding violators" as drivers who had received speeding tickets on one or more previous occasions. The results of the analysis are presented in Table 5. The findings verify that past speeding violators have a higher WTP than those reporting no violations. This may indicate that past violators have become less sensitive to fines due to having received them in the past.

We divided driver characteristics into three categories based oin responses to two questions: "What do you think is the probability of getting a speeding ticket when you are driving on the freeway?" and "What do you think is the probability of an accident occurring due to speeding?" These questions showed that a driver belonged to one of the risk attitude categories - the "risk-seeking," "risk-averse," or "other".

[4] The Directorate General of Budget, Accounting and Statistics (DGBAS)

Risk-seeking drivers were defined as drivers who perceived a lower probability (below 40%) of receiving a speeding ticket and a lower probability (below 40%) of having an accident due to speeding. Risk-averse drivers were defined as those with conservative driving behaviors who perceived a higher probability of receiving a speeding ticket and a higher probability of an accident occurring due to speeding (both above 60%).

The driver characteristics under the different area segmentations are presented in Table 6. To summarise briefly, risk-averse drivers had the lowest WTP compared to other types of drivers across all scenarios. The average WTPs in the four area segmentations were $US25, $US27, $US35 and $US19, respectively. This result shows that risk-averse drivers are less willing to pay for their speeding fines. In contrast, risk-seeking drivers had the highest WTPs for all geographical areas ($US87, $US104, $US88 and $US80, respectively).

Model estimation results

The focus of model estimation is on the spike model given the incidence of a spike at the zero value response (i.e., 47% of participants had a zero WTP). The model is summarised in Table 7. Data for three market segments (the Taipei area, the Taichung area, and other areas (excluding the Taipei and Taichung samples)) and the combined sample are presented. All explanatory variables in Table 7 are statistically significant with the correct sign. The results indicate that drivers with higher personal monthly income are willing to pay higher speeding fines. The presence/absence of past violations, as a proxy variable indicating the total number of times the driver was punished for speeding last year, suggests that the greater the number of times someone is caught speeding, the higher the acceptance exhibited toward speeding fines; that is, the driver may not care at all about the amount of the speeding fine while he/she drives on the freeway. Risk-seeking drivers have higher WTP speeding fines. The reason is that these drivers are less sensitive to danger and the cost of speeding; and because they underestimate these factors, they are willing to pay more. Risk-averse drivers have lower WTP speeding fines, and their heightened awareness of cost and danger distinguishes them from risk-seeking drivers. Drivers with a higher percentage of time spent on the road where the driver was exceeding the speed limit last year, tended to accept higher speeding fines, indicating that the habit of speeding decreases a driver's aversion to paying fines.

The driver's average WTP for speeding fines was $US51 in all samples[5], $US43 in Taipei, $US51 in Taichung, and $US53 in other areas. The spike value ranges from 66%~75% for all models, indicating that a driver's WTP is not only determined by speeding fines, but also related variables. This study is consistent with evidence reported in Yoo *et al.* (2006).

The only other study we are aware of that has investigated the WTP for speeding fines is by Jou and Chen (2013). They used standard logit and probit models and obtained mean The WTP estimates of $US119 and $US116 respectively. The higher values of WTP can be attributed to the fact that zero WTPs were not taken into consideration. What this suggests is that the spike model is a preferred method to ensure that proper account is taken on the high incidence of zero values.

4. Conclusions and suggestions

In this paper we created a hypothetical market and used contingent valuation to investigate drivers' real WTP through a field survey. A spike model was estimated as a way of dealing with a high incidence of zero bids.

The main empirical results can be summarized as follows, together with some policy-related implications on how the evidence might be of value in revising current fine practices.

[5] Compared with another study by Jou and Wang (2012), the average WTP for speeding fines was $US23 for motorcyclists. Currently the actual fine for exceeding the speed limit by 20 k/h is $US40,

Drivers' reactions to increases in freeway speeding fines are systematically related to personal income. A driver who has a higher income also has a higher WTP. This indicates that not only enforcement of the law, but also the stipulation of rational fines is required to effectively reduce illegal speeding behavior. For example, Finland sets fines for moving violations according to two variables: "severity of the violation" and "progressive income." In the same way, income and past violation ratio variables can be further considered in policy making. Consistent with principles of social justice, fines for violating the laws increase as driver income increases.

We find that risk-seeking drivers have a higher WTP than drivers with risk-averse characteristics, showing that the relationship between drivers' characteristics and the amount of speeding fines is worth considering when drafting traffic legislation in the future.

The results of the study indicate that adopting the spike model to determine the real WTP that drivers have in mind is one way to determine the value of non-market goods in transportation related research.

The WTP values for speeding fines calculated by the spike model will be helpful in setting rational fines in the future.

Instead of defining Q as a vector of awareness, one might use another variable "the difference between the chosen and stipulated speeds" to derive the indirect utility such that the optimal speed chosen and optimal fine paid by the individual can be determined.

The spike model should be considered in future studies where there is high incidence of a specific value, which in our study is the zero response.

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Tables

Table 1: Description of respondent socioeconomic characteristics (percentages in parentheses)

Variable	Item	All	Taipei	Taichung	Other
Age	Below 25	44(8.7)	12(11.2)	14(10.4)	18(6.8)
	26~40	314(41.5)	60(55.5)	85(63.5)	169(64.3)
	Above 41	147(29.2)	36(33.3)	35(26.1)	76(28.9)
Marital status	Single	332(65.7)	38(35.1)	45(33.6)	90(34.2)
Car ownership	0	17(3.4)	4(3.7)	5(3.7)	8(3)
	1	417(82.6)	92(85)	114(85.1)	211(80.2)
	2 or above	71(14.1)	12(11.3)	15(11.2)	12(4.6)
Personal monthly income (USD)*	Below 625	21(4.2)	3(2.8)	6(4.5)	12(4.6)
	626～1875	376(74.5)	74(68.5)	108(80.6)	194(73.8)
	1876～3125	76(15)	21(19.4)	11(8.2)	44(16.7)
	Above 3126	32(6.3)	10(9.3)	9(6.7)	13(4.9)
Driving license (years held)	Below 2	15(3)	2(1.9)	3(2.2)	10(3.8)
	3～5	53(10.5)	10(9.3)	17(12.7)	26(9.9)
	Above 6	437(86.4)	96(88.9)	114(85.1)	227(86.3)
Insurance Fee per year (USD)*	Below 156	104(33.8)	66(66.1)	75(56.0)	160(60.8)
	157～313	62(20.1)	12(11.1)	21(15.7)	29(11.0)
	314～469	25(8.1)	5(4.6)	7(5.2)	13(4.9)
	470～625	45(14.6)	10(9.3)	11(8.2)	24(9.1)
	Above 626	72(23.4)	15(13.9)	20(14.9)	37(14.1)

*1 US$ = 32 NT$, Central Bank of the Republic of Taiwan, 2008

Table 2: Sample distribution under different speeding fine scenarios

Scenarios (USD)	47	70	94	117	141	164	188
All areas	233	31	46	41	34	19	101
Taipei	44	3	10	5	9	6	31
Taichung	59	13	9	13	10	8	22
Other areas	130	15	27	23	15	5	48

*Total samples are 505, Taipei samples are 108, Taichung samples are 134 and other area samples are 263.

Table 3: Drivers' speeding behaviour under various fines (percentages in parentheses)

Fine	All areas (%)	Percentage	Taipei	Percentage	Taichung	Percentage	Other areas	Percentage
47	272(53.9)	-12.9	64(59.3)	-5.0	75(56.0)	-21.0	133(50.6)	-12.7
70	272(53.9)	-12.9	64(59.3)	-5.0	75(56.0)	-21.0	133(50.6)	-12.7
94	241(47.7)	0	61(56.5)	0	62(46.3)	0	118(44.9)	0
117	195(38.6)	19.1	51(47.2)	16.4	53(39.6)	14.5	90(34.2)	23.7
141	154(30.5)	36.1	46(42.6)	24.6	40(29.9)	35.5	68(25.9)	42.4
164	120(23.8)	50.2	37(34.3)	39.3	30(22.4)	51.6	53(20.2)	55.1
188	101(20.0)	58.1	31(28.7)	49.2	22(16.4)	64.5	48(18.3)	59.3

Table 4: Two-sample t-test of WTP with respect to income

area	Above average income		Under average income		Two-sample t-test
	Samples	WTP	Samples	WTP	
All areas	164	84	341	71	1.76**
Taipei	49	101	59	82	1.19
Taichung	34	72	100	77	-0.34
Other areas	81	80	182	65	1.46

** Significant at 90% confidence level.

Table 5: Two-sample t-test of WTP with respect to past speeding violators

area	Past violator		Driver with no violations		t-value
	Samples	WTP	Samples	WTP	
All areas	94	115	411	66	5.60*
Taipei	29	154	79	67	6.58*
Taichung	18	109	116	70	2.19*
Other areas	47	93	216	64	2.24*

* Significant at 95% confidence level; **Significant at 90% confidence level.

Table 6: WTP according to driver characteristics under different areas (percentages in parentheses)

area	Risk-averse		Risk-seeking		Others	
	Samples	WTP	Samples	WTP	Samples	WTP
All areas	20(3.96)	25	333(65.94)	87	25(4.95)	57
Taipei	6(1.188)	27	76(15.049)	104	5(0.99)	33
Taichung	4(0.79)	35	87(17.22)	88	6(1.188)	63
Other areas	10(1.98)	19	170(33.66)	80	14(2.77)	64

Table 7: Spike model estimation results (t-value in parentheses)

Variables	All areas	Taipei	Taichung	Other areas
Constant	-0.841 (-10.41)	-1.109 (-5.07)	-0.686 (-4.27)	-0.832 (-7.49)
Bid (USD)	0.218 (24.08)	0.205 (10.09)	0.247 (13.92)	0.213 (17.64)
Personal monthly income (USD)	0.036 (4.84)	0.066 (3.65)	0.006 (1.45)	0.046 (3.35)
Past violations	0.347 (5.75)	0.678 (5.635)	0.223 (1.45)	0.236 (3.11)
Risk-seeking driver	0.469 (6.23)	0.394 (2.00)	0.730 (5.12)	0.340 (3.31)
Risk-averse driver	-0.961 (-4.46)	-0.693 (-1.82)	-0.662 (-1.57)	-1.333 (-3.82)
The proportion of times spent on the roads where the driver was exceeding the speeding limit (%)	0.023 (18.02)	0.034 (11.38)	0.024 (8.55)	0.019 (11.08)
Samples	3535	756	938	1841
Average WTP (USD)	51	43	51	53
Log-likelihood	-3034.944	-562.224	-829.143	-1608.715
Spike	0.698	0.751	0.665	0.696

Figures

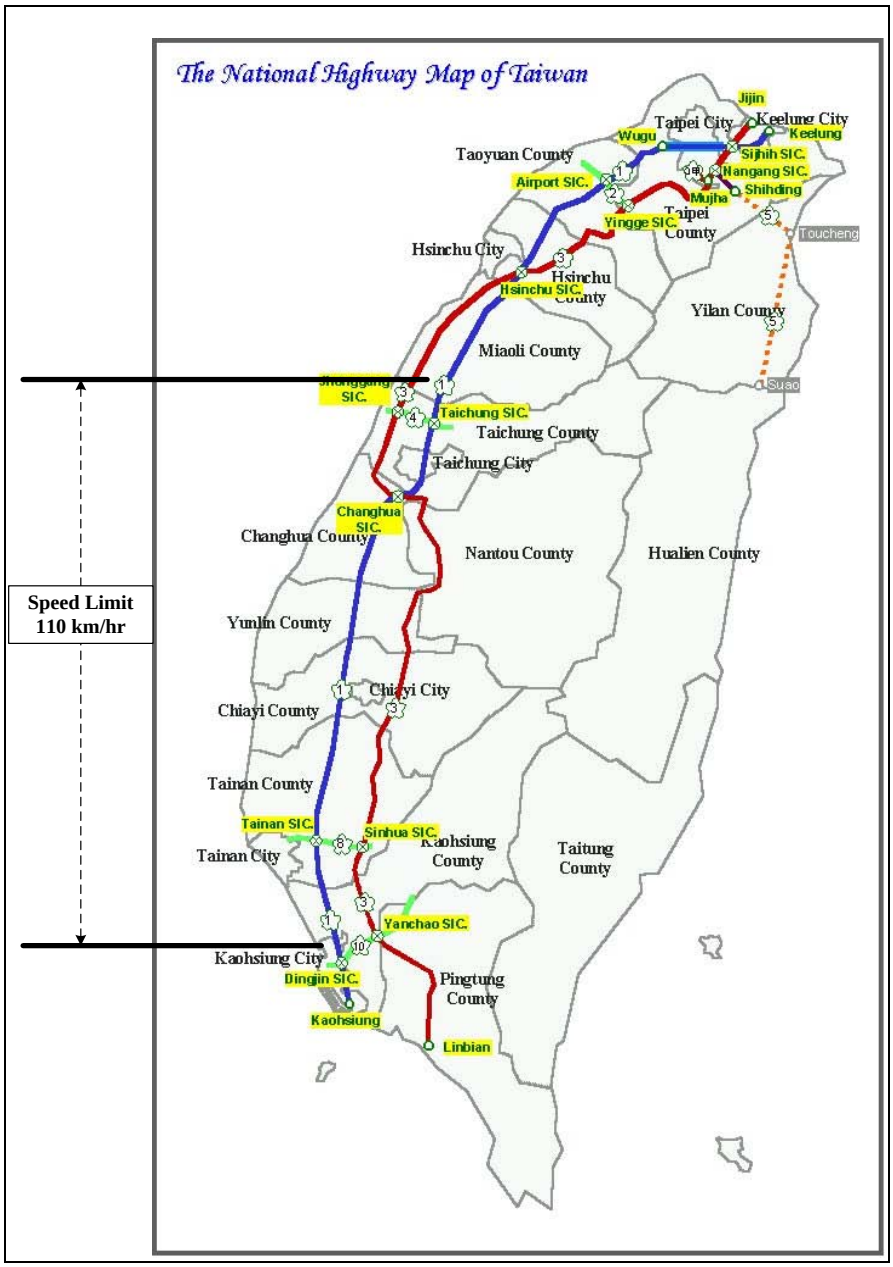

Figure 1: The Taiwan National Freeway system

Appendix

Attitudes toward the law (percentages in parentheses)

Variable	Item	All samples	Taipei	Taichung	Other areas
Have you received a speeding ticket in the last year?	0	411(81.4)	79(73.1)	116(86.6)	216(82.1)
	1	60(11.9)	18(16.7)	13(9.7)	29(11.0)
	2	24(4.8)	8(7.4)	3(2.2)	13(4.9)
	3	6(1.2)	2(1.9)	2(1.5)	2(0.8)
	Above 4	4(0.8)	1(0.9)	0	3(1.1)
Do you know that the more a driver exceeds the speed limit, the higher the fine he or she needs to pay?	Understand	219(43.4)	43(39.8)	64(47.8)	112(42.6)
	Normal	23(4.6)	4(3.7)	6(4.5)	13(4.9)
	Heard about that	22(4.4)	4(3.7)	4(3.0)	14(5.3)
	Never knew that	31(6.1)	13(12)	5(3.7)	13(4.9)
Do you usually speed on the freeway? (%)	100	41(8.1)	16(14.8)	8(6.0)	17(6.5)
	90	7(1.4)	0	3(2.2)	4(1.5)
	80	7(1.4)	1(0.9)	3(2.2)	3(1.1)
	70	5(1)	0	1(0.7)	4(1.5)
	60	4(0.8)	1(0.9)	1(0.7)	2(0.8)
	50	33(6.5)	5(4.6)	5(3.7)	23(8.8)
	40	11(2.2)	4(3.7)	2(1.5)	5(1.9)
	30	30(5.9)	4(3.7)	8(6.0)	18(6.8)
	20	62(12.3)	14(13.0)	19(14.2)	29(11.0)
	10	112(22.2)	25(23.5)	25(18.7)	62(23.6)
	0	193(38.2)	38(35.2)	59(44.0)	96(36.5)
What do you feel is the probability of getting a speeding ticket when you are driving on the freeway?	100	7(1.4)	2(1.9)	1(0.7)	4(1.5)
	90	7(1.4)	3(2.8)	0	4(1.5)
	80	12(2.4)	2(1.9)	3(2.2)	7(2.7)
	70	9(1.8)	3(2.8)	4(3.0)	2(0.8)
	60	8(1.6)	3(2.8)	0	5(1.9)
	50	60(11.9)	10(9.3)	18(13.4)	32(12.2)
	40	11(2.2)	4(3.7)	3(2.2)	4(1.5)
	30	71(14.1)	14(13.0)	24(17.9)	33(12.6)
	20	84(16.6)	19(17.6)	20(14.9)	45(17.1)
	10	179(35.4)	40(37.0)	47(35.1)	92(35.0)
	0	57(11.3)	8(7.41)	14(10.4)	35(13.3)

Attitudes toward the law (continued) (percentages in parentheses)

Variable	Item	All sample	Taipei	Taichung	Other areas
What do you feel is the probability of an accident occurring due to speeding?	100	8(1.6)	2(1.9)	2(1.5)	4(1.5)
	90	16(3.2)	4(3.7)	3(2.2)	9(3.4)
	80	21(4.2)	4(3.7)	7(5.2)	10(3.8)
	70	22(4.4)	4(3.7)	9(6.7)	9(3.4)
	60	15(3)	2(1.9)	5(3.7)	8(3.0)
	50	61(12.1)	9(8.3)	15(11.)	37(14.1)
	40	19(3.8)	2(1.9)	3(2.2)	14(5.3)
	30	39(7.7)	13(12.0)	7(5.2)	19(7.2)
	20	57(11.3)	17(15.7)	15(11.2)	25(9.5)
	10	134(26.5)	30(27.8)	39(29.1)	65(24.7)
	0	113(22.4)	21(19.4)	29(21.6)	63(24.0)
If an accident were to occur due to speeding, what amount of compensation do you think is fair?	300	18(3.6)	4(3.7)	4(3.0)	10(3.8)
	250	2(0.4)	1(0.9)	0(0.0)	1(0.4)
	200	15(3)	3(2.8)	4(3.0)	8(3.0)
	150	10(2)	1(0.9)	0(0.0)	9(3.4)
	100	22(4.4)	5(4.6)	6(4.5)	11(4.2)
	90	1(0.2)	0(0.0)	1(0.7)	0(0.0)
	80	7(1.4)	2(1.9)	3(2.2)	2(0.8)
	70	6(1.2)	1(0.9)	3(2.2)	2(0.8)
	60	12(2.4)	4(3.7)	3(2.2)	5(1.9)
	50	72(14.3)	15(13.9)	21(15.7)	36(13.7)
	40	29(5.7)	3(2.8)	6(4.5)	20(7.6)
	30	81(16)	18(16.7)	19(14.2)	44(16.7)
	20	80(15.8)	22(20.4)	18(13.4)	40(12.5)
	10	150(29.7)	29(26.9)	46(34.3)	75(28.5)