Drunk Drivers’ Willingness to Use and to Pay for Designated Drivers

Rong-Chang Jou * and Li-Wun Syu

Department of Civil Engineering, National Chi Nan University, Nantou 54561, Taiwan; s106322511@mail1.ncnu.edu.tw
* Correspondence: rcjou@ncnu.edu.tw

Abstract: While drunk driving accidents, which are a serious problem in Taiwan, have decreased in recent years, cases of drunk driving continue to emerge endlessly, and are a source of traffic risks even when the accidents cause no injuries. In order to prevent drunk driving and reduce car accidents, the government has made laws stricter, and has vigorously promoted “designated drivers”. As the concept of designated drivers is not common in Taiwan, this study mainly explores drunk drivers’ understanding of designated drivers in Nantou County and Taichung City, and investigates the willingness of drunk drivers to use and to pay for designated driving services. This study conducted a questionnaire survey on the drunk drivers of the drunk driving and traffic safety training course held at the Motor Vehicles Office. Double-hurdle and tobit models were applied to investigate the issues mentioned above. According to the test results, the tobit model was superior to the double-hurdle model. The estimation results indicated that distance, age, income, family conditions, and drinking habits influence the willingness to use and to pay for designated drivers. Gender, age, family background, and experience in designated driving cause differences in the willingness to use designated drivers in the two regions. It is expected that the conclusion of this study could provide a direction and reference for the future improvement of designated driving services.

Keywords: drunk driving; designated driving; choice behavior; willingness-to-pay

1. Introduction

Alcohol can cause the brain to lose control, meaning that drinking alcohol influences people’s thinking, judgment, and attention, which leads to a decline or even a loss of driving ability. Hence, drunk drivers have a higher risk of being involved in traffic accidents than those with no alcohol in their blood, and the risk sharply increases with increasing blood alcohol concentrations. The number of annual road traffic deaths increased to 1.35 million in 2018. The number is the eighth leading cause of death worldwide [1]. There are more than 0.12 million drink driving violation incidents per year, and one person dies per day on average due to drunk driving; that is, approximately one sixth of deaths are due to drink driving traffic crashes in Taiwan [2]. The numbers show that drink driving accidents seriously endanger traffic safety, and this problem not only causes huge social costs but also leads to many broken families; therefore, it has drawn the attention of society and has become the focus in road traffic safety and drunk driving issues. One way to prevent drivers from drunk driving is to designate drivers who are alcohol-free.

Designated driving is popular in South Korea, and its main task is to drive drunk owners home in their cars, in order that the owners are free from the trouble of spending money and time to return to the original places to pick up their cars. This service is expensive, and is charged according to the distance, with the starting fare of KRW20,000–30,000 (equivalent to NT$ 600–700; 1 US$ = 30 NT$). After parking the cars in the owners’ garages and returning the keys, in addition to the designated driving service charge, the designated drivers will charge taxi fares to return to their taxi companies or home.
At present, Japan has the most perfect designated driving management system and standard in the world. Taiwan offers designated driving with taxis, while Japan considers it to be an industry and formulates the laws regarding the designated driving industry.

The vehicles of designated driving companies are specially painted for easy identification, and the service mode is as follows: the company dispatches two designated drivers in one car to the passenger’s location, with one driving the passenger in his or her car and the other following and videotaping the entire process; after arrival at the location designated by the passenger, the two drivers drive the company’s car to return to the office. The videos can be used to monitor driving and provide evidence in case of any accident.

In the United States, special drivers are often designated. One person or a group of people are designated not to drink during an event, and to drive everyone home after the event.

At present, Taiwan has no special laws or regulations concerning the designated driving system. The Ministry of Transport has only stipulated that designated drivers must hold professional licenses, while the government has integrated vehicle fleets, unified the charge standards, and promoted designated driving to the public. However, there have been no specific and uniform standards set for other driving conditions, certification, or service quality evaluations. While the designated driving service has been implemented by taxi companies in Taiwan for many years, it has not been as popular as expected, and the public is not very familiar with the designated driving system.

Taiwan’s taxi companies began to offer “designated driving” services in 2007, and its service mode is as follows: the taxi fleet receives a reservation and dispatches a taxi driver to the location designated by the passenger. Then, the taxi driver parks their taxi where the passenger parked, drives the passenger’s car to take him or her to their destination, and then calls another taxi to return to the original place to pick up the first taxi.

The Department of Transportation of Taipei City Government integrated 20 taxi fleets in 2013 to offer “designated driving” services, and taxi drivers help to bring drunk people home safely. Designated driving can be booked by telephone, on-site scheduling, and in the Ibon system of convenience stores. After accepting a reservation, the taxi fleet will first confirm the starting and ending points with the clients, and make a quotation. With the clients’ consent, a driver will go to the starting point to drive the owners in their vehicles to the designated ending point. The service is charged according to distance, and the starting fare is no more than NT$1000 if the distance is within 10 km, and no more than NT$100 per 2 km is additionally charged if the distance is more than 10 km.

The Bureau of Transportation of Taichung City Government launched designated driving services in 2014, which integrated taxi companies and assumed the same charge mode as in Taipei City, which is based on the distance of 11km. Clients can dial the special line for designated driving services and the system transfers them to the participating companies. There are two service modes, as follows: first, two designated drivers offer the service together, with one driving the taxi to follow the other, who drives the client’s car, and after arrival they take the taxi and return. Second, a taxi driver offers the service, and finds a way to return to the place where the taxi is parked after the service. However, no government or organization has launched designated driving services in Nantou County. The reason is that, while they are geographically close, they vary in development levels.

This study conducted a survey with the members of a drunk driving and traffic safety training course at the supervision stations in Taichung and Nantou, in order to understand drunk drivers’ willingness to use designated driving services, and their willingness-to-pay (WTP) in Taiwan. This study estimated the actual WTP for designated drivers by the double-hurdle model, and compared the results with the tobit model.

The remainder of the paper is structured as follows. Section 2 describes the background and literature related to designated drivers and willingness to pay. Section 3 illustrates the models applied in this study. The questionnaire design and data analyses are depicted in Section 4, followed by model estimation results. The final section concludes with the findings and suggests appropriate policies.
2. Background and Literature Reviews

2.1. Current Alcohol-Related Regulations and Penalties in Taiwan

The alcohol-related regulations and penalties have been revised to be more rigorous and stricter over the years (as shown in Table 1) [3].

2.2. Literature Related to Designated Drivers

Boots and Midfo [4] and Watson and Watson [5] attempted to solve the risks of drunk driving in Australia through the Pick-a-skipper program, which mainly ensures sober driving by encouraging drinkers to return home in vehicles driven by non-drinkers, and by offering free soft drinks to the designated drivers. The program was implemented in two regions with similar geographical features for a period of 16 weeks: Mackay was the intervention area where the program was implemented, and Rockhampton was the comparison area, meaning that it was not influenced by the program. According to the results, the awareness of the skipper program in the intervention area increased from 6% to 68%, which was significantly higher than that in the comparison area, and such advocacy had positive effects on the intervention area. More people worked as designated drivers, and the number of passengers adopting designated driving tended to increase. Finally, the drinkers using designated driving consumed significantly more alcohol than those not using designated driving, which is a phenomenon that is worthy of attention.

Ditter et al. [6] examined whether a designated driving program could effectively reduce drunk driving and alcohol-related accidents, and evaluated the implementation method from two aspects: advocating the use of designated driving and using a designated driving incentive mechanism. The designated driving program originated in the United States, and was advocated by the media to influence and change social norms. According to the promotional results, people aged between 18 and 35 were mainly influenced, and the designated driving usage rate increased by 13%. The incentive mechanism of the program provided free soft drinks to designated drivers, which increased the understanding of designated driving and reduced alcohol consumption in the United States, and in Australia, the number of drunk drivers and their passengers was decreased by 6.5%. Many papers show that the designated driving program causes passengers to consume more alcohol Martineau et al. [7]. Moreover, notably, there was no significant increase in the alcohol consumption of the people aged between 18 and 23 who hired or did not hire designated drivers.

In the United States, young people aged between 21 and 34 cause the majority of alcohol-related injuries. By random dialing, the interviews with people in this age group verified that the injury rate was high due to excessive alcohol consumption. The results showed that two thirds of them had been chosen as designated drivers, but were often chosen casually, and only after drinking [8]. As alcoholic drinks influence mental state and driving performance, designated drivers should avoid drinking alcohol or only consume less than the amount that affects their mental state [9].

Rowland et al. [10] investigated the effects of the designated driving program on drinking behaviors in Australia; they took sports club members as the subjects, and divided them into two groups: with and without designated drivers. According to that study, nearly half of the members in the group with designated drivers chose to use the service, while the members in the group without designated drivers chose to take taxis, and age and gender influenced alcohol consumption. Finally, they proposed that the designated driving program was a strategy to address drunk driving, but it also encouraged greater alcohol consumption. In order to ensure that drinkers do not drive after drinking, Bryant and Williams [11] and Ker and Chinnock [12] proposed that the staff in places where alcohol is served should be trained. Moreover, sanctions against drunk drivers, especially recidivists, such as the suspension or withdrawal of their licenses, can reduce recidivism in the short-term [13]. In addition, according to some studies, while the drivers know how drunk they are, nearly half of them still choose to drive; thus, drunken driving behavior is more likely to occur, especially when driving alone within short distances [14].
Table 1. Legal standards and penalties for drunk driving in Taiwan.

| Sources of Law | Drivers | Situations | Categories | Penalties |
|---------------|---------|------------|------------|-----------|
| **Administrative law** | | First offence | Motorcycle | NT$ 15,000–90,000 |
| | | | Passenger car | NT$ 30,000–120,000 |
| | | Blood alcohol concentration standard 0.03% | | |
| | | Breath alcohol concentration standard 0.15 mg/L | | |
| | | Recidivist (within 5 years) | Motorcycle | NT$ 90,000 |
| | | | Passenger car | NT$ 120,000 |
| | | Punitive damages | Professional drivers engaging in automobile transportation | |
| | | First offence | Motorcycle or car | NT$ 180,000 |
| | | | Professional drivers engaging in automobile transportation | |
| | | | Motorcycle or car | NT$ 600–3000 |
| | | Failure to use the automatic locking device for vehicle ignition as required | Alcoguard | NT$ 6000–12,000 |
| | | Criminal law | Powered vehicles | |
| | | | | |
| | | Blood alcohol concentration standard 0.05% | | |
| | | Breath alcohol concentration standard 0.25 mg/L | | |
| | | Recidivist (within 5 years) | Powered vehicles | |

The motorcycle or automobile shall be detained for safekeeping, and the driver’s license shall be withdrawn for 1 to 2 years; for anyone who carries children under 12 or injures others as a result of accidents, the driver’s license shall be withdrawn for 2 to 4 years.

Anyone who offends against the law for more than 3 times shall be fined NT$ 90,000, in addition to the fines imposed for previous violations of this provision, the motorcycle or automobile shall be detained for safekeeping, the driver’s license shall be withdrawn, and a traffic safety training course shall be completed. For anyone who causes serious injuries or deaths, the driver’s license shall be withdrawn, and the offender shall not be allowed to take another driving test.

Anyone liable for any injury may, at the request of the victim, impose a punitive damage of less than 3 times that of the damage, depending on the circumstances of the injury.

Anyone who offends against the law more than 3 times shall be fined NT$ 180,000, in addition to the fines imposed for previous violations of this provision, the motorcycle or automobile shall be detained for safekeeping, the driver’s license shall be withdrawn, and a traffic safety training course shall be offered. For anyone who causes serious injuries or deaths, the driver’s license shall be withdrawn and the offender shall not be allowed to take another driving test.

Any passenger aged 18 or above shall be fined more than NT$ 600 and less than NT$ 3,000, excluding those who are aged 70 or above, mentally impaired, or take public transportation.

The offender shall be sentenced to a fixed-term of imprisonment of less than 2 years and fined less than NT$ 200,000.

Anyone who causes serious injuries shall be sentenced to a fixed-term of imprisonment of more than 1 year, but less than 7 years.

Anyone who causes deaths shall be sentenced to a fixed-term of imprisonment of more than 3 years, but less than 10 years.

Anyone who causes serious injuries shall be sentenced to a fixed-term of imprisonment of more than 3 years, but less than 10 years.

Anyone who causes deaths shall be sentenced to life imprisonment or a fixed-term of imprisonment of more than 5 years.
2.3. Literature Related to Willingness-to-Pay

This section mainly reviews literature that discusses the willingness-to-pay according to the double-hurdle model and the tobit model. Guo and McDonnell [15] evaluated whether New Yorkers agreed to a charge for residential parking and their willingness-to-pay, and pointed out that because roadside parking spots were often free, non-local residents abused or occupied them for a long time, resulting in traffic jams or congestion. In order to solve this problem, the decision makers initiated the Residential Permit Program (RPP), which was intended to make roadside parking spots available only to local residents in all regions; however, the effects could not be achieved in most cases due to the low or lack of charge. Hence, their studies estimated the respondents' willingness-to-pay by payment cards, as was based on the double-hurdle model. The main factors influencing the willingness-to-pay are the number of vehicles owned by residents and the types of parking available; for example, residents who own no vehicle are more willing to pay for parking than those owning vehicles. Thus, more vehicles owned by residents lead to a higher percentage of zero payment. Income is another factor; high-income residents are more willing to pay for parking. Residents who live far away from parking lots or have difficulty in finding parking spots are also willing to pay high prices to improve their parking problems. Thus, policies can be improved according to the double-hurdle results, such as charging more for residents that own vehicles, reducing the abuse of parking spots and solving traffic congestion.

Eakins [16] studied household expenditures on gasoline and diesel in Ireland, as well as the factors that influence such expenditures, and compared the situations in May 2004 and October 2009 according to the literature. The study mentioned that, because the license tax of diesel cars was less than that of gasoline cars, as based on the policies in Ireland and the economic decline, they found that many families intended to buy gasoline cars, but gradually changed to buying diesel cars, which resulted in higher expenditures for diesel than gasoline. According to the study results, the main factors influencing residents’ expenditures on fuel oil (diesel and gasoline) were the number of household vehicles, place of residence, number of workers in a family, and public transport expenses. In other words, as people without cars have to take public transport, they spend less on fuel. In addition, because public transport systems in urban areas are more developed than those in rural or suburban areas, urban residents are less likely to spend money on fuel. In terms of years, the money spent on fuel in 2009 was less than that in 2004, indicating that public transport was improving. As a result, the residents gradually choose to take public transport, thus reducing their expenditures on fuel.

Saz-Salazar and Rausell-Köster [17] applied the double-hurdle model to investigate whether residents in Spain were willing to pay for urban public green spaces and facilities. In their investigation of residents’ use of non-market benefits, some people thought that enquiring about the willingness-to-pay for them indicated that they are a commodity or commercial service, and most responses were zero expenditures, as respondents thought they already earned too little and paid too much in taxes. However, income is often the explanatory factor or key influence of willingness-to-pay. The author argued that people will be reluctant to visit free recreation locations if they are charged for the recreational facilities (such as museums). According to the results, the tobit model can only process one type of zero expenditure, while the double-hurdle model can identify two influencing factors: willingness-to-participate and willingness-to-pay. Comparing the two models, the willingness-to-participate and willingness-to-pay are subject to different processes. As the tobit model is unable to explain why the respondents proposed zero expenditure, the double-hurdle model is superior to the tobit model.

Jang and Ham [18] collated leisure and tourism expenditure data through a household income and expenditure survey, and found that the ordinary least-square regression model (OLS), the tobit model, and the double-hurdle model were used in most of the research literature for estimation. Generally, the sample of zero expenditures is very common in household consumption expenditures. If the observations of zero expenditures are
included in the samples, it implies that the tourism expenditure is not normally distributed, and errors and inconsistencies will be caused in these cases if OLS is used for estimation, but can be solved by the tobit model. However, as zero expenditure arises from the economic conditions of the respondents, it can be considered as no consumption. Tourism participation decisions are influenced by economic characteristics and other factors, and are set as the consumption decisions by the double-hurdle model, as developed from the tobit model, including two stages—namely, participation and consumption—in order to solve the problem that the factors influencing participation decisions cannot be estimated by tobit. Hence, the double-hurdle model is often used in recent studies to estimate the willingness-to-pay and willingness-to-participate.

This study adopted open-ended bidding, and asked drunk drivers to answer the highest price they were willing to pay. However, in discussing willingness-to-pay according to this method, the respondents might give answers of zero expenditure. Halstead and Cornelia [19] and Maddala [20] mentioned that zero observations are often ignored if standard ordinary least-square regression is used, which may cause estimate errors and inconsistencies. Tobin [21] proposed the use of the tobit model for estimation, in order to solve the problem that the zero willingness-to-pay cannot be identified. However, Martínez-Espiñeira [22] explained that, in the tobit model, if all of the respondents are willing to participate in the expenditure, the expenditure will be directly analyzed, the respondents’ decision-making processes will be ignored, and the observations of all zero expenditure will be interpreted as corner solutions. Cragg [23] and Goodwin et al. [24] proposed that the double-hurdle model could make up this weakness, and measured the factors influencing respondents’ decisions regarding participation and expenditure according to various variables.

2.4. Summary

According to the literature review on drunk driving and designated driving, the factors influencing respondents’ decisions are cognitive behaviors and socioeconomic characteristics, and the designated driving services promoted in foreign countries and Taiwan are implemented by hiring others to drive, but have slightly different operational modes. There are few studies on third persons as designated drivers.

According to the literature regarding willingness-to-pay, the tobit model and double-hurdle model can be used to estimate the willingness-to-pay, and the tobit model can even be used for performance evaluation. There are two reasons for willingness-to-pay zero expenditure: respondents answer zero willingness-to-pay because they are unwilling to participate in the expenditure; respondents are willing to participate in the expenditure, but consider that they can use it without paying, and thus the payment choice is zero. Hence, after conducting a literature review regarding willingness-to-pay, the tobit model and double-hurdle model were adopted for estimation and comparison to explore the reasons why respondents are willing to participate in such expenditures, and their willingness-to-pay.

The situations in the questionnaire are mainly designed based on the concept of user payment, in order to explore the designated driving price trend according to the driving distance and the payment, to study the choice and preference for the two driving models, and to understand the drinking habits of drunk drivers.

3. Models

Two models, tobit and double-hurdle, are used in this study. Because the tobit model has been commonly used in the academic society, interested readers can refer to the study of Tobin [21]. The following is focused on the double-hurdle model. Cragg [23] proposed the double-hurdle model based on a two-stage approach (deciding whether to participate and how much to pay) that represents the decision-making of the research subject, and that its calibration process can be affected by different variables. In this study, the first and second stages of the decision-making equation are summarized in Formulae (1) and
(2): \( D_i^p \) is an unobserved variable, indicating whether respondent \( i \) will participate in the decision-making process (being willing or unwilling to pay the fee for an additional service); \( Y_i^* \) is a potential variable, indicating what price the individual is willing to pay.

\[
D_i^p = \chi_{1i} \alpha_i + u_i, \quad u_i \sim N(0, \sigma^2) \quad \text{The participation decision - making process.} \quad (1)
\]

\[
Y_i^* = \chi_{2i} \beta_i + v_i, \quad v_i \sim N(0, \sigma^2) \quad \text{The expenditure decision - making process.} \quad (2)
\]

In the formula, \((u_i, v_i) \sim \text{BVN}(0, \Sigma)\), \( \Sigma = \begin{pmatrix} 1 & \rho \sigma_p / \sigma_v^2 \\ \rho \sigma_p / \sigma_v^2 & \sigma_v^2 \end{pmatrix} \).

\( \chi_i \) is an explanatory variable vector that explains the personal characteristics of the two-stage decision. This study assumes that participation and expenditure decisions have the same single explanatory variable, i.e., \( \chi_{1i} = \chi_{2i} = \chi_i \), while \( \alpha \) and \( \beta \) are the parameters for the first and second stages. The potential variables \( D_i^p \) and \( Y_i^* \) are expressed as follows:

\[
Y_i = Y_i^*, \quad \text{if } Y_i^* > 0 \text{ and } D_i^p > 0
\]

\[
= 0, \quad \text{if } Y_i^* \leq 0 \text{ and } D_i^p > 0
\]

\[
\quad \text{or } Y_i^* > 0 \text{ and } D_i^p \leq 0
\]

\[
\quad \text{or } Y_i^* \leq 0 \text{ and } D_i^p \leq 0 \quad (4)
\]

In Formula (3), when \( Y_i^* \) and \( D_i^p \) are greater than zero, the WTP price \( Y_i \) of respondent \( i \) will be equal to the actual amount \( Y_i^* \) that the respondent is willing to pay; in contrast, if \( Y_i^* \) is negative or zero, all will be represented by a zero value. Therefore, the zero observation value here represents two meanings. One is that the actual WTP is zero; the other is that the actual WTP is a negative value.

The following is a sample likelihood value of the model:

\[
L = \prod_i \{1 - F(u_i > -x_1 \alpha_i, v_i > -x_2 \beta_i)\}
\]

\[
\times \prod_i \{F(u_i > -x_1 \alpha_i, -x_2 \beta_i) f(v_i | u_i > -x_1 \alpha_i, v_i > -x_2 \beta_i)\}
\]

\[
(5)
\]

In the formula, 0 represents a zero observation and + represents a positive observation. According to the study conducted by Gao, Wailes and Cramer (1995), Formula (4) can be simplified as:

\[
L = \prod_i \{1 - \Phi(-x_1 \alpha_i, -x_2 \beta_i / \sigma_p)\}
\]

\[
\times \prod_i \{\Phi(-x_1 \alpha_i + \frac{\sigma_p}{\sigma_v} (Y_i^* - x_2 \beta_i) / \sqrt{1 - \rho^2}) \phi(Y_i^* - x_2 \beta_i) / \sigma_v\}
\]

\[
(6)
\]

4. Questionnaire Design and Data Analysis

Because we targeted drivers who violated alcohol-related regulations, it was appropriate to conduct a survey on the class of a drunk driving and safety training course held at the Motor Vehicles Office. The sampling method was so-called “choice-based sampling”. In the questionnaire survey, the drunk drivers’ basic data and drinking behaviors were collected, and situations were designed to collect the actual willingness-to-pay according to the driving charges within different distances. This section consists of four sub-sections: Section 4.1 is the questionnaire design, Section 4.2 is the questionnaire survey method, Section 4.3 is the collation and analysis of the surveyed data, and Section 4.4 is the verification of the sample data.

4.1. Questionnaire Design

This questionnaire mainly consists of four parts: Part 1 explains respondents’ basic data, Part 2 explains drunk driving-related items, Part 3 explains drinking experience, and Part 4 explains the actual willingness-to-pay under the driving charges according to different distances. All of the parts are explained in detail, as follows.
4.1.1. Basic Data

The basic data are: (1) gender; (2) age; (3) educational level at five levels, namely, primary school, junior high school, general senior and vocational high school, university (college) and graduate school or above; (4) monthly income per person at five levels, from less than NT$ 20,000 to more than NT$ 80,000, with every 20,000 as a new level; (5) occupation in 13 categories, namely students, agricultural workers, forestry workers, fishery workers, animal husbandry workers, soldiers, civil servants, and teachers; and (6) family members, i.e., living with family members and living alone.

4.1.2. Drunk Driving-Related Items

A description of drunk driving was given to the respondents, and they were requested to answer according to their understanding. The answers are graded on a 6-point Likert scale, and there are a total of 17 questions.

4.1.3. Drinking Experience

This part investigates present drunk driving behaviors and drinking habits. The respondents should answer the behaviors of drinking and drunk driving according to their places, times, reasons, transportation, and types of drinking.

4.1.4. Driving Models

Driving Model 1 and Driving Model 2 are offered according to five hypothetical distances, namely, the driving distances of 1.5 km, 3 km, 5 km, 11 km, and 13 km, and the regular taxi fees and Taichung City’s current designated driving service charges are provided for reference. The driving models are described as follows.

- Driving Model 1: a driver goes to pick up the client alone, drives the client’s car to the client’s home, and then returns to place where his or her car is parked.
- Driving Model 2: two drivers go to pick up the client together; one drives the taxi and the other drives the client’s car. They arrive at the destination at the same time and return together.

The respondents were asked whether they would be willing to pay for a designated driver within different distances, and for the highest price they were actually willing to pay in the different driving models with driving charges. Furthermore, the respondents were asked whether they preferred Driving Model 1 or Driving Model 2 within the different distances. Finally, the question was “If you have been drinking, you should choose a way to get home from the following options: Driving Model 1, Driving Model 2, taking a regular taxi, asking relatives and friends for help, taking public transport, drunk driving, and other ways”.

4.2. Questionnaire Survey Description

This study mainly explored the usage willingness and willingness-to-pay for designated drivers, as currently provided in Taiwan, and the subjects were the drivers who violated the alcohol-related regulations. It is appropriate to conduct a survey of the class of a drunk driving and safety training course held at Motor Vehicles Office. The sampling method was so called “choice-based sampling”. The survey duration was 93 days, from 16 October 2017 to 17 January 2018 at the Motor Vehicle Offices in Taichung City and Nantou County. The survey method was as follows: questionnaires were issued during the training course, with each drunk driving offender taking one questionnaire; then, an interviewer explained the questionnaire, guided them to answer the questions on the platform, and collected questionnaires after checking whether there were any omissions.

This study collected 607 questionnaires, and after screening, there were a total of 515 valid questionnaires, including 286 from Taichung and 229 from Nantou. The sample size was calculated according to the following formula: sample Size = (Z-score) × StdDev × (1 − StdDev)/(margin of error)². Assuming that we choose a 95% confidence level,
0.5 standard deviation, and a margin of error (confidence interval) of $+/- 5\%$, then the sample size is 385. Therefore, the sample size of 515 in our study is sufficient statistically. The standard to determine invalid questionnaires was that respondents did not drink in Taichung City or Nantou County.

4.3. Data Analysis

4.3.1. Socioeconomic Characteristics

According to the collation of the respondents’ personal data in Part 1, in the two regions (Nantou, Taichung), most of the drunk drivers were men, accounting for 92.1% and 85.7%, respectively. In terms of age, most drunk drivers were aged between 41 and 60 (56.7%) in Nantou and between 31 and 50 (53.5%) in Taichung, and were aged between 41 and 60 (52.6%) overall. In terms of educational level, most of the respondents in the two regions had completed general senior and vocational high school; however, the drunk drivers in Nantou were less educated, while those in Taichung were more educated. In terms of occupation, most of the drunk drivers worked in services (accounting for 20.6% and 29.1%, respectively), followed by industry (accounting for 16.8% and 24.3%, respectively). Their income was between NT$ 20,001 and NT$ 40,000 (accounting for 45.0% and 44.1%, respectively). In terms of family background, most of the respondents lived with family members (accounting for 76.9% and 67.8%, respectively).

4.3.2. Drunk Driving-Related Items

The knowledge influencing drunk driving, as mentioned in Section 2, was used to observe the differences between the two regions. The knowledge of drunk driving was similar in Nantou and Taichung, with only slight differences in the item “I am confident that I will not be stopped and banned by the police when I am drunk”. The drivers in Nantou were more confident of drunk driving than those in Taichung.

4.3.3. Drinking Experience

According to the data collation regarding the present drinking experience cases, more than half of the reasons for drunk driving were parties with friends (accounting for 56.8% and 53.1%, respectively). In terms of place, drinking at home (49.3%) was more common in Nantou, while drinking at home and restaurants (accounting for 36.4% and 30.8%, respectively) was more common in Taichung. In terms of time, the peak was 18:00–22:00 (accounting for 50.2% and 46.4%, respectively), followed by 22:00–02:00, indicating that the peak period for drinking and drunk driving was from evening to midnight. In terms of vehicles, in the two regions, motorcycles were most commonly used (accounting for 62.9% and 62.6%, respectively), followed by passenger cars (accounting for 28.8% and 32.5%, respectively), indicating that the Taiwanese prefer motorcycles as a means of transport. In terms of the type of alcohol, beer was the most consumed, followed by whisky and sorghum wine. The most important factor for drunk driving was the self-identified high ability to drive after drinking (accounting for 22.6% and 24.6%, respectively), followed by the place being close to home (accounting for 22.6% and 23.8%, respectively), showing overconfidence and the fluke of drunk drivers not being caught. The breath-alcohol concentration was mainly between 0.56 mg/L and 0.80mg/L (accounting for 37.3% and 32.5%, respectively), which shows that the breath-alcohol concentration was higher in Nantou than in Taichung.

4.3.4. Drinking Habits

According to the data collation regarding respondents’ drinking habits, in terms of experience in hiring designated drivers, nearly 90% (89.1) of the respondents in Nantou had never hired designated drivers, while a quarter (23.8) of the respondents in Taichung had hired designated drivers, indicating that designated driving was not very widespread, especially in Nantou. Drinking frequency referred to the number of times that participants drank within a month (55.9 and 51.4, respectively). In terms of the frequencies of drunk
driving and receiving a ban, most people did not drive after drinking and had not been banned. The reasons, places, times, vehicles, and types of drinking, as well as the proportions of all drunk driving factors, were similar to those of the present drunk driving cases, indicating that, due to their habits, the drunk drivers were accustomed to such cases and neglected the dangers and injuries of drunk driving.

4.4. Analysis of Scenario Data

Regarding the situations, this study included two driving models and five different driving distances. In each situation, the respondents were asked whether they were willing to pay for the designated driving service, and those who were willing to use the driving models of the five driving distances were counted. In the two regions, whether it was Driving Model 1 or Driving Model 2, the willingness to hire designated drivers increased with the increase of distance, and Driving Model 1 rose faster than Driving Model 2; in other words, the willingness-to-pay for Driving Model 1 was slightly higher than that for Driving Model 2.

Regarding the driving models preferred at different driving distances in Nantou and Taichung, within short distances, people preferred Driving Model 1, which offers a single driver; when the distance increased, people preferred Driving Model 2, which offers two drivers. In addition, when choosing driving models, Driving Model 1 was preferred in Taichung, while the two driving models were equally chosen by the respondents in Nantou.

Regarding the influence of distance on how respondents chose to get home, regardless of the distance, the respondents in the two regions preferred to take taxis to get home, followed by asking relatives and friends for help. Based on the respondents’ selections, Driving Model 1 was more popular than Driving Model 2. However, as the distance increased, fewer people chose Driving Model 1 and more people chose Driving Model 2, indicating that the choice of driving models might be slightly influenced by the distance, and such influence was significant in Nantou. In addition, in Nantou, regardless of the distance, no one chose to take public transport, indicating that the public transport in the area was underdeveloped, and people had no convenient transport selection.

In the scenario design of this study, the drunk drivers were asked not only about their willingness to pay for designated driving, but also about the highest price they were actually willing to pay, and the data of Nantou and Taichung were integrated, respectively. The highest price that people were actually willing to pay for Driving Models 1 and 2 in Nantou was higher than those in Taichung. Moreover, in the two regions, the price people were willing to pay increased with the distance, no matter whether NT$0 was included, but the amount in Taichung increased more than in Nantou.

4.4.1. Regional Chi-Square Test

The data of Nantou and Taichung were compared in order to determine whether there was any regional difference, including the chi-square testing of the influence of gender, age, educational level, income, occupation, living with family members, and the user experience of designated driving on the willingness to choose situations.

In terms of gender, the items varying by region were the “ways to get home within short distances (1.5 km, 3 km)”, “willingness to pay the charge of Driving Models 1 and 2 within long distances (11 km, 13 km)”, and “choice of designated driving within long distances (11 km, 13 km)”. In Nantou, those who preferred Driving Models 1 and 2 within the distances of 11km and 13km were men. In Taichung, those who answered “taking a regular taxi” for the question of the “ways to get home within short distances (1.5 km, 3 km)” and “prefer Driving Model 1” for the question of the “choice of designated driving within long distances (11 km, 13 km)” were men.

By comparing the data of the two regions, men’s willingness to use designated driving increased within long driving distances; thus, because most of the respondents were men, designated driving services might be advocated for men.
In terms of age, the items varying by region were “willingness to pay the charge of Driving Model 1 within short distances (1.5 km, 3 km)” and “ways to get home within different distances”. In Nantou, those aged between 40 and 60 answered that they were willing to pay the charge of Driving Model 1, and answered “taking a regular taxi” for the question of the “ways to get home within different distances”.

According to the comparison of the influence on the willingness to use the situations in the two regions, as conducted by chi-square testing, educational level and income had no significant influence on the willingness to use designated driving, the model choice, or the ways to get home within different distances.

In terms of occupation, the items varying by region were “ways to get home within distances of 1.5 km, 11 km, and 13 km”, “willingness to pay the charge of Driving Model 2 within distances of 3 km and 11 km”, and “choice of designated driving within a distance of 13 km”.

In Nantou, the people in service occupations chose regular taxis as the way to get home within distances of 11 km and 13 km. With a distance of 13 km and more, people in services chose to use Driving Model 2. In Taichung, the people in services chose regular taxis as the way to get home within a distance of 1.5 km, and people in both service and industry occupations were willing to pay for Driving Model 2 within distances of 3 km and 11 km.

In terms of living with family members, the “ways to get home” differed significantly within different distances only in Nantou. Regardless of the distance, the respondents living with their family members mainly chose to take regular taxis and ask relatives and friends for help, indicating that, in Nantou, people living with their family members would hardly ever choose designated driving services.

In terms of the user experience of designated driving, the items varying by region were “ways to get home within a distance of 1.5 km” and “willingness to pay the charge of Driving Models 1 and 2 within distances of 5 km, 11 km, and 13 km”.

In Taichung, regarding the “ways to get home within a distance of 1.5 km”, people inexperienced in designated driving chose to take regular taxis, while people experienced in designated driving chose Driving Model 1 and to take regular taxis. Within distances of 5 km, 11 km, and 13 km, respondents inexperienced in designated driving chose Driving Models 1 and 2, and were willing to pay, and those experienced in designated driving were also willing to pay.

However, the “ways to get home within distances of 1.5 km, 11 km, and 13 km” differed significantly in the two regions, which was mainly because both inexperienced and experienced people in designated driving chose to take regular taxis.

4.4.2. Regional Independent T-Testing

In order to understand whether the respondents’ actual willingness-to-pay for the different situations of all of the items differed significantly due to the socioeconomic characteristics and user experience of designated driving, and in addition to the above chi-square testing, as carried out to verify the influence of socioeconomic characteristics and user experience of designated driving on the willingness-to-pay under various situations, choices, and ways to get home, independent T-testing was conducted on the various variables. The T-test consisted of 3 parts: exploring the influence of the three variables—namely, gender, living with family members, and experience in designated driving services—on willingness-to-pay under the various situations in different regions.

Regarding the influence of gender on willingness-to-pay in the various situations in different regions, in terms of gender, in Nantou, men and women differed significantly in their willingness-to-pay for Driving Model 1 within distances of 1.5 km, 3 km, and 5 km, and the average willingness-to-pay of men was higher than that of women. Hence, men in Nantou were willing to pay more for designated drivers. In Taichung, men and women differed significantly in their willingness-to-pay for Driving Model 2 within distances of
5 km and 13 km, and the average willingness-to-pay of women was higher than that of men. Hence, women in Taichung were willing to pay more for designated driving services.

Regarding the influence of living with family members on willingness-to-pay under the various situations in different regions, according to the comparison of the people living with and without family members, those in Nantou differed significantly in their willingness-to-pay for Driving Model 1 and Driving Model 2 within distances of 11 km and 13 km, and the average willingness-to-pay of those living with family members was higher than that of those living without family members. Hence, in Nantou, people living with family members were willing to pay more for designated driving services. In Taichung, people differed significantly in their willingness-to-pay for Driving Model 1 within distances of 1.5 km, 3 km, 5 km, and 13 km, and those living without family members were, on average, willing to pay more than those living with family members. Hence, in Taichung, people living without family members were willing to pay more for designated driving services.

Regarding the influence of experience in designated driving on willingness-to-pay under the various situations in different regions, according to the comparison of experienced and inexperienced people in designated driving services, in Nantou, with the exception of Driving Model 1 and Driving Model 2 within distances of 11 km and 13 km, the t values of all of the situations were less than one, and insignificant. In Taichung, people with and without experience differed significantly in their willingness-to-pay for Driving Model 2 within a distance of 11 km, as well as Driving Model 1 and Driving Model 2 within a distance of 13 km, and those experienced in designated driving services were, on average, willing to pay more than those inexperienced in designated driving. Hence, in Taichung, people experienced in designated driving were willing to pay more for designated driving services.

5. Model Estimations

Taking the tobit model and the double-hurdle model as its theoretical foundation, this study mainly explored drunk drivers’ choices and willingness-to-pay within different distances in Nantou County and Taichung City. As described in Section 2, a large amount of the literature has proposed that estimation errors and inconsistencies are likely to occur for the tobit model, which only considers respondents’ willingness-to-pay, but not whether they are willing to pay for this service; thus, the double-hurdle model and the tobit model are used for comparison.

5.1. Model Estimations

The estimations of the tobit and double-hurdle models are interpreted according to five distances (1.5 km, 3 km, 5 km, 11 km, and 13 km), and whether the respondents are located in Nantou County or Taichung City for each distance. However, because only slight differences exist in the variables between the model estimations within different distances, the shortest (1.5 km) and the longest (13 km) driving distances are taken as representatives for interpretation.

5.1.1. 1.5 km
Nantou County

Table 2 shows the estimations of Driving Model 1 within the driving distance of 1.5 km in Nantou. According to the table, in the tobit model, being “aged over 60 years old”, having a “monthly income more than NT$ 60,000”, “taking a regular taxi to go home”, and “asking relatives and friends for help to go home” all have significant influence on the respondents’ willingness-to-pay. They also have a significant influence on the analysis of the willingness-to-pay according to the truncated model of the double-hurdle model.
Due to diversified and convenient ways to get home, the respondents aged over 60 years old may be unwilling to pay or may pay lower prices within the short distance of 1.5 km. Moreover, people earning more than NT$ 60,000 a month are defined as those with a high income in this study, and thus are more insensitive to prices; the influence of cost is insignificant in the probit model, but with a positive sign, indicating that they are willing to pay more for the service.

In addition, in terms of the ways to get home, the respondents choosing to take regular taxis and to ask relatives and friends for help are unwilling to pay for Driving Model 1, especially those who choose to ask relatives and friends for help. Compared with those taking regular taxis, maybe those choosing to seek help from others do not have to pay for the trips home; thus, they are less willing to pay the price, which negatively influences respondents’ willingness-to-pay.

Table 3 shows the estimations of Driving Model 2 within the driving distance of 1.5 km in Nantou. According to the table, in the tobit model and the truncate model, being “aged below 30 years old”, having a “monthly income more than NT$ 60,000”, “taking a regular taxi to go home”, and “asking relatives and friends for help to go home” all have significant influence. Table 3 is very similar to Table 2, and the difference lies in age. The respondents under 30 years old or over 60 years old are unwilling to pay or pay lower prices when the distance is less than 1.5 km. Perhaps, for younger respondents, there is little difference between one driver and two drivers when they use the designated driving service, as their main task is to drive the car home and it is unnecessary to waste manpower.
Table 3. Nantou: estimations of the driving distance of 1.5 km (Driving Model 2).

| Variables                                           | Tobit   | Double Hurdle | Tobit   | Double Hurdle | Tobit   | Double Hurdle |
|-----------------------------------------------------|---------|---------------|---------|---------------|---------|---------------|
|                                                    | ß       | t             | ß       | t             | ß       | t             |
| Constant term                                      | 7.08    | 11.45 ***     | 0.74    | 3.61 ***      | 6.51    | 7.60 ***      |
| Aged below 30 years old                            | −1.87   | −2.44 **      | −0.59   | −2.51 **      | −2.33   | −1.66 *       |
| Monthly income more than NT$ 60,000                 | 3.15    | 2.44 **       | 0.20    | 0.49          | 3.31    | 2.00 **       |
| Taking a regular taxi to go home                    | −3.13   | −4.28 ***     | −0.42   | −1.78 *       | −3.45   | −3.21 ***     |
| Asking relatives and friends for help to go home    | −3.57   | −4.56 ***     | −0.82   | −3.27 ***     | −3.42   | −2.85 ***     |
| Log likelihood function                             | −566.92 | −143.14       | −479.66 |               |         |               |
| LM test [df] for tobit                              | 3.100 [5]| -             | -       |               |         |               |
| Pseudo R-squared                                    | -       | 0.06          | -       |               |         |               |
| Observation                                         | 222     |               |         |               |         |               |

* Indicates a significance level of 10%, with a t-value greater than 1.65; ** indicates a significance level of 5%, with a t-value greater than 1.96; *** indicates a significance level of 1%, with a t-value greater than 2.58.

Taichung City

Table 4 shows the estimations of Driving Model 1 within the driving distance of 1.5 km in Taichung. According to the table, in the Truncate model, being “aged over 60 years old”, having a “monthly income more than NT$ 60,000”, “drinking alcohol every day”, and “asking relatives and friends for help to go home” all have significant influence on the respondents’ willingness-to-pay. In the tobit model, all of the items have significant influences on willingness-to-pay, except for “monthly income more than NT$ 60,000”.

Table 4. Taichung: estimations of the driving distance of 1.5 km (Driving Model 1).

| Variables                                           | Tobit   | Double Hurdle | Tobit   | Double Hurdle | Tobit   | Double Hurdle |
|-----------------------------------------------------|---------|---------------|---------|---------------|---------|---------------|
|                                                    | ß       | t             | ß       | t             | ß       | t             |
| Constant term                                      | 6.28    | 11.01 ***     | 0.70    | 3.43 ***      | 5.86    | 6.11 ***      |
| Aged over 60 years old                              | −2.57   | −3.63 ***     | −0.82   | −3.38 ***     | −5.86   | −3.05 ***     |
| Monthly income more than NT$ 60,000                 | 2.92    | 2.46 **       | 0.49    | 1.08          | 3.05    | 1.82 *        |
| Drinking every day                                  | −2.81   | −4.16 ***     | −0.33   | −1.41         | −3.06   | −2.73 ***     |
| Asking relatives and friends for help to go home    | −3.04   | −4.20 ***     | −0.82   | −3.27 ***     | −3.35   | −2.65 ***     |
| Log likelihood function                             | −547.02 | −138.03       | −452.23 |               |         |               |
| LM test [df] for tobit                              | 7.533 [5]| -             | -       |               |         |               |
| Pseudo R-squared                                    | -       | 0.02          | -       |               |         |               |
| Observation                                         | 222     |               |         |               |         |               |

* Indicates a significance level of 10%, with a t-value greater than 1.65; ** indicates a significance level of 5%, with a t-value greater than 1.96; *** indicates a significance level of 1%, with a t-value greater than 2.58.

Within short distances, respondents over 60 years old are unwilling to pay for the service, but are willing to pay high prices, which may be due to the prosperous development,
high land use, and high roadside parking fees in Taichung. In addition, the respondents that drink every day are unwilling to pay for designated driving or are willing to pay lower prices, which is presumably because alcohol costs are high, and they would rather save money to buy more alcoholic drinks.

The income and ways to get home in Taichung are similar to those of Nantou, meaning that people with high income may pay high prices, and those asking relatives and friends for help can save on designated driving charges.

Table 5 shows the estimations of Driving Model 2 within the driving distance of 1.5 km in Taichung. According to the table, in the truncate model, being “aged below 30 years old”, “having university (college) degree”, having a “monthly income more than NT$ 60,000”, being “inexperienced in designated driving and unwilling to let strangers drive their own cars”, and “asking relatives and friends for help to go home” all have significant influence on the respondents’ willingness-to-pay. In the tobit model, only “asking relatives and friends for help to go home” has significant influence on willingness-to-pay.

Table 5. Nantou: estimations of the driving distance of 1.5 km (Driving Model 2).

| Variables                                                      | Tobit       | Double Hurdle                      |                           |                           |                           |
|---------------------------------------------------------------|-------------|-----------------------------------|---------------------------|---------------------------|---------------------------|
|                                                               | β           | t    | β                         | t    | β                         | t    |
| Constant term                                                 | 7.08        | 11.45*** | 0.74                      | 3.61*** | 6.51                      | 7.60*** |
| Aged below 30 years old                                        | −1.87       | −2.44** | −0.59                     | −2.51** | −2.33                     | −1.66*  |
| Having university (college) degrees and monthly income more   | 3.15        | 2.44** | 0.20                      | 0.49  | 3.31                      | 2.00**  |
| than NT$ 60,000                                                |             |       |                           |       |                           |       |
| Inexperienced in designated driving and unwilling to let       | −3.13       | −4.28*** | −0.42                     | −1.78* | −3.45                     | −3.21*** |
| strangers drive their own cars                                 |             |       |                           |       |                           |       |
| Asking relatives and friends for help to go home               | −3.57       | −4.56*** | −0.82                     | −3.27*** | −3.42                     | −2.85*** |
| Log likelihood function                                        | −566.92     | −143.14 | −479.66                   |       |                           |       |
| LM test [df] for tobit                                         | 3.100 [5]   |       |                           |       |                           |       |
| Pseudo R-squared                                              |              | 0.06  |                           |       |                           |       |
| Observation                                                    | 222         |       |                           |       |                           |       |

* Indicates a significance level of 10%, with a t-value greater than 1.65; ** indicates a significance level of 5%, with a t-value greater than 1.96; *** indicates a significance level of 1%, with a t-value greater than 2.58.

People with university (college) degrees are defined as being highly educated in this study. Highly educated respondents may be willing to pay high prices because they have wider knowledge and higher incomes, and are bound by social, moral and ethical norms. People who are inexperienced in designated driving have no reference to measure the designated driving service and its quality, and due to the fear of new things and love for their vehicles, as is based on human nature, they are unwilling to pay or pay low prices.

5.1.2. 13 km

Nantou County

Table 6 shows the estimations of Driving Model 1 within the driving distance of 13 km in Nantou. According to the table, in the tobit model and truncate model, having a “monthly income more than NT$ 60,000”, “drinking and driving every time”, “taking a regular taxi to go home”, and “asking relatives and friends for help to go home” all have
significant influence. The respondents who drink and drive every time are unwilling to pay or are only willing to pay low prices, indicating that drunk drivers have negative attitudes towards hiring designated drivers, and are unwilling to pay for the designated driving service.

Table 6. Nantou: estimations of the driving distance of 13 km (Driving Model 1).

| Variables                                      | Tobit     | Double Hurdle |                    |                    |                    |
|------------------------------------------------|-----------|---------------|--------------------|--------------------|--------------------|
|                                                | β | t     | β | t     | β | t     |
| Constant term                                  | 8.40 | 12.53 *** | 0.90 | 4.15 *** | 8.37 | 12.78 *** |
| Monthly income more than NT$ 60,000            | 4.52 | 3.16 *** | 0.87 | 1.59 | 3.88 | 2.88 *** |
| Drinking and driving every time                | −3.75 | −2.85 *** | −0.41 | −1.18 | −4.01 | −2.19 ** |
| Taking a regular taxi to go home               | −2.93 | −3.63 *** | −0.46 | −1.83 * | −1.98 | −2.41 ** |
| Asking relatives and friends for help to go home| −3.38 | −3.95 *** | −0.98 | −3.80 *** | −2.58 | −2.87 *** |
| Log likelihood function                        | −597.79 |                | −134.55 |                | −514.60 |                |
| LM test [df] for tobit                         | 4.331 [5] |                |                |                |                |                |
| Pseudo R-squared                               | - | 0.08 | - | - | - | - |
| Observation                                    | 222 |                |                |                |                |                |

* Indicates a significance level of 10%, with a t-value greater than 1.65; ** indicates a significance level of 5%, with a t-value greater than 1.96; *** indicates a significance level of 1%, with a t-value greater than 2.58.

Table 7 shows the estimations of Driving Model 2 within the driving distance of 13 km in Nantou. According to the table, in the tobit model and truncate model, having a “monthly income less than NT$ 20,000”, having a “monthly income more than NT$ 60,000”, “drinking and driving every time”, “going home by Driving Model 1”, and “going home by Driving Model 2” all have significant influence. People earning less than NT$ 20,000 a month are defined as having a low income in this study, and they are highly sensitive to prices; thus, the influence of price is insignificant in the probit model, but with a negative sign, indicating that they are unwilling to pay or are only willing to pay low prices.

The difference between Tables 6 and 7 is going home by different driving models, and choosing to go home by Driving Model 1 and Driving Model 2, which indicates that respondents accept the two different designated driving methods to bring themselves and their cars safely to their doors. Hence, they are willing to pay high prices.

Taichung City

Table 8 shows the estimations of Driving Model 1 within the driving distance of 13 km in Taichung. According to the table, in the tobit model and truncate model, only being “inexperienced in designated driving and unwilling to let strangers drive their cars” and “drinking and driving every time” have significant influence, indicating that they are less confident of the affairs they do not understand, and of leaving their vehicles to be driven by others. Hence, they are unwilling to pay or are only willing to pay low prices. Other variables, such as having a “monthly income more than NT$ 60,000” and “going home by Driving Model 1” only have significant influence in the tobit model and truncate model, respectively.
Table 7. Nantou: estimations of the driving distance of 13 km (Driving Model 2).

| Variables                                  | Tobit                      | Double Hurdle                     |
|--------------------------------------------|----------------------------|-----------------------------------|
|                                            | $\beta$ | $t$ | $\beta$ | $t$ | $\beta$ | $t$ | $\beta$ | $t$ |
| Constant term                              | 6.16    | 13.61 *** | 0.30    | 2.47 ** | 7.31    | 14.65 ***|
| Monthly income less than NT$ 20,000        | $-1.25$ | $-1.77$ * | $-0.21$ | $-1.13$ | $-1.94$ | $-2.49$ **|
| Monthly income more than NT$ 60,000        | 4.29    | 2.82 *** | 0.08    | 0.19    | 3.45    | 2.43 ** |
| Drinking and driving every time            | $-4.33$ | $-3.15$ *** | $-0.73$ | $-2.07$ ** | $-5.10$ | $-2.61$ ***|
| Going home by Driving Model 1              | 3.31    | 3.00 *** | 0.55    | 1.71 *  | 2.17    | 2.00 ** |
| Going home by Driving Model 2              | 3.73    | 3.52 *** | 0.94    | 2.66 *** | 2.73    | 2.68 ***|
| Log likelihood function                    | $-607.62$ |       | $-138.73$ |       | $-525.05$ |       |
| LM test [df] for tobit                     | $9.173$ [6] |       | -       |       | -       |       |
| Pseudo R-squared                           | -       | 0.06 | -       | -       | -       | -       |
| Observation                                | 222 |       |       |       |       |       |

* Indicates a significance level of 10%, with a $t$-value greater than 1.65; ** indicates a significance level of 5%, with a $t$-value greater than 1.96; *** indicates a significance level of 1%, with a $t$-value greater than 2.58.

Table 8. Taichung: estimations of the driving distance of 13 km (Driving Model 1).

| Variables                                  | Tobit                      | Double Hurdle                     |
|--------------------------------------------|----------------------------|-----------------------------------|
|                                            | $\beta$ | $t$ | $\beta$ | $t$ | $\beta$ | $t$ | $\beta$ | $t$ |
| Constant term                              | 7.15    | 19.21 *** | 0.62    | 5.47 *** | 8.22    | 25.68 ***|
| Monthly income more than NT$ 60,000        | 1.31    | 1.44 | 0.26    | 0.85    | 1.57    | 2.03 ** |
| Inexperienced in designated driving and unwilling to let strangers drive their own cars | $-2.10$ | $-2.46$ ** | $-0.53$ | $-2.14$ ** | $-1.64$ | $-2.11$ **|
| Drinking and driving every time            | $-4.19$ | $-3.45$ *** | $-0.66$ | $-1.93$ *  | $-3.55$ | $-2.86$ ***|
| Going home by Driving Model 1              | 1.50    | $-3.45$ ** | 0.57    | 2.10 ** | 0.14    | 0.22   |
| Log likelihood function                    | $-600.85$ |       | $-124.00$ |       | $-513.72$ |       |
| LM test [df] for tobit                     | $22.407$ [5] |       | -       |       | -       |       |
| Pseudo R-squared                           | -       | 0.05 | -       | -       | -       | -       |
| Observation                                | 222 |       |       |       |       |       |

* Indicates a significance level of 10%, with a $t$-value greater than 1.65; ** indicates a significance level of 5%, with a $t$-value greater than 1.96; *** indicates a significance level of 1%, with a $t$-value greater than 2.58.

Table 9 shows the estimations of Driving Model 2 within the driving distance of 13 km in Taichung. According to the table, in the tobit model and truncate model, only “going home by Driving Model 2” has significant influence. Compared with Table 8, in the different driving models, people are willing to use the existing service to return home. Moreover, the other variables, namely, “having university (college) degree” and
having a “monthly income more than NT$ 60,000”, have significant influence only in the truncate model.

Table 9. Taichung: estimations of the driving distance of 13KM (Driving Model 2).

| Variables | Tobit | Double Hurdle |
|-----------|-------|---------------|
|           | £ t   | £ t          |
| Constant term | 7.51 19.82 *** | 0.46 4.90 *** |
| Having university (college) degrees and monthly income more than NT$ 60,000 | 0.11 0.09 | 0.23 0.66 | 3.20 1.70 * |
| Going home by Driving Model 2 | 3.33 2.48 ** | 0.68 1.64 | 1.71 1.81 * |

Log likelihood function | -624.82 | -134.24 | -513.23 |
LM test [df] for tobit | 27.256 [3] |
Log likelihood function | - | - |
AIC/BIC | 5.67/5.73 | 1.24/1.28 | 4.66/4.72 |
Observation | 222 |

* Indicates a significance level of 10%, with a t-value greater than 1.65; ** indicates a significance level of 5%, with a t-value greater than 1.96; *** indicates a significance level of 1%, with a t-value greater than 2.58.

This study compared the results of the log-likelihood function and chi-square testing of the tobit and double-hurdle models. Table 10 shows the comparison of the log-likelihood function. As tobit is only applicable to the estimate models of willingness-to-pay, the situations are organized and the log-likelihood function of the double-hurdle model is similar; thus, it is selected for comparison.

In order to verify whether the model was appropriate, or to compare their advantages and disadvantages, a log-likelihood comparison was conducted first. A large log-likelihood value indicates the high fitness of a model. According to this table, in this study, the log-likelihood values of the tobit are greater than those of the double-hurdle model; thus, the tobit is superior to the double-hurdle model in this study. Finally, Table 11 shows the chi-square test results of the tobit and double-hurdle models. As mentioned in the model architecture verification of Section 3, if the tobit, probit and truncate are estimated by the same explanatory variables, λ will be regarded as having X2 distribution. Table 11 shows that the λ values are less than the chi-square values in all situations, which indicates that the tobit model is supported, while the double-hurdle model is rejected.

Table 12 compares the willingness-to-pay in the different situations of the tobit and truncate models. From the perspective of distance, with the exclusion of 0, there is a trend to be willing to pay more for designated driving with the increase of distance, which is significant in Taichung. From the perspective of the driving model, with the exclusion of 0, the willingness-to-pay for Driving Model 2 is higher than that for Driving Model 1 in the two regions.

The double-hurdle model is mainly used to solve the influence of a zero sample value. However, in this study, the ratio of zero expenditures in the data is low; therefore, the tobit model is applicable rather than the double-hurdle model.

5.2. Summary

The questionnaire of this study used open-ended bidding to ask the respondents about their actual willingness-to-pay, which might result in a large number of zero offers. In order to solve this problem, the double-hurdle model and tobit model, which support a large number of zero prices, were adopted in this study to compare the willingness-to-pay, as
estimated by the two models in all situations. The tobit model was used in most previous studies. As described in literature, the double-hurdle model is superior to the tobit model. Hence, the two methods of the log-likelihood function and chi-square test were used to determine the model fitness, and the results show that the tobit model is superior to the double-hurdle model, which is possibly due to the small ratio answers of zero expenditure.

Based on the above test results, the influences of all variables in different situations can be sorted, as follows.

5.2.1. Age

Respondents under 30 years old are less willing to pay or pay lower prices in the two regions; those over 60 years old are less willing to pay or pay lower prices within short distances (1.5 km, 3 km) in Nantou, but are more willing to pay according to the increase of distance in Taichung.

5.2.2. Income

Respondents with a monthly income of less than NT$ 20,000 are unwilling to pay or are only willing to pay lower prices within the different distances in the two regions, while those with a monthly income of more than NT$ 60,000 are willing to pay high prices within different distances in the two regions.

**Table 10. Comparison of the log-likelihood functions of the models.**

| Situations | Models                  | Tobit     | Double-Hurdle |
|------------|-------------------------|-----------|---------------|
| 1.5 km     | Nantou (Driving Model 1) | −547.02   | −590.26       |
|            | Nantou (Driving Model 2) | −566.75   | −622.19       |
|            | Taichung (Driving Model 1)| −553.32  | −599.89       |
|            | Taichung (Driving Model 2)| −586.20  | −630.03       |
| 3 km       | Nantou (Driving Model 1) | −552.26   | −598.49       |
|            | Nantou (Driving Model 2) | −565.45   | −622.43       |
|            | Taichung (Driving Model 1)| −554.95  | −606.76       |
|            | Taichung (Driving Model 2)| −587.91  | −629.69       |
| 5 km       | Nantou (Driving Model 1) | −559.77   | −614.19       |
|            | Nantou (Driving Model 2) | −571.56   | −627.63       |
|            | Taichung (Driving Model 1)| −560.13  | −620.49       |
|            | Taichung (Driving Model 2)| −592.62  | −630.36       |
| 11 km      | Nantou (Driving Model 1) | −571.68   | −621.49       |
|            | Nantou (Driving Model 2) | −589.23   | −641.43       |
|            | Taichung (Driving Model 1)| −575.48  | −615.50       |
|            | Taichung (Driving Model 2)| −600.46  | −624.65       |
| 13 km      | Nantou (Driving Model 1) | −597.80   | −649.15       |
|            | Nantou (Driving Model 2) | −607.62   | −663.78       |
|            | Taichung (Driving Model 1)| −600.85  | −637.72       |
|            | Taichung (Driving Model 2)| −624.82  | −647.47       |
Table 11. Chi-square test results by the tobit and double-hurdle models.

| Situations | Results | \( \lambda \) | \( \chi^2(\text{df}) \) |
|------------|---------|-------------|----------------|
| 1.5 km     |         |             |                 |
| Nantou (Driving Model 1) | &lt; 86.49 | &lt; 15.09 | |
| Nantou (Driving Model 2) | &lt; 110.88 | &lt; 15.09 | |
| Taichung (Driving Model 1) | &lt; 92.74 | &lt; 15.09 | |
| Taichung (Driving Model 2) | &lt; 87.66 | &lt; 15.09 | |
| 3 km       |         |             |                 |
| Nantou (Driving Model 1) | &lt; 92.46 | &lt; 15.09 | |
| Nantou (Driving Model 2) | &lt; 113.96 | &lt; 15.09 | |
| Taichung (Driving Model 1) | &lt; 103.63 | &lt; 15.09 | |
| Taichung (Driving Model 2) | &lt; 83.57 | &lt; 15.09 | |
| 5 km       |         |             |                 |
| Nantou (Driving Model 1) | &lt; 108.84 | &lt; 15.09 | |
| Nantou (Driving Model 2) | &lt; 112.13 | &lt; 15.09 | |
| Taichung (Driving Model 1) | &lt; 120.71 | &lt; 15.09 | |
| Taichung (Driving Model 2) | &lt; 75.49 | &lt; 15.09 | |
| 11 km      |         |             |                 |
| Nantou (Driving Model 1) | &lt; 99.63 | &lt; 15.09 | |
| Nantou (Driving Model 2) | &lt; 104.39 | &lt; 15.09 | |
| Taichung (Driving Model 1) | &lt; 80.04 | &lt; 15.09 | |
| Taichung (Driving Model 2) | &lt; 48.38 | &lt; 15.09 | |
| 13 km      |         |             |                 |
| Nantou (Driving Model 1) | &lt; 102.70 | &lt; 15.09 | |
| Nantou (Driving Model 2) | &lt; 112.31 | &lt; 16.81 | |
| Taichung (Driving Model 1) | &lt; 73.74 | &lt; 15.09 | |
| Taichung (Driving Model 2) | &lt; 45.30 | &lt; 11.34 | |

Note: Indicates the estimate is under the significance level of \( \alpha = 0.01 \).

5.2.3. Taking Regular Taxis to Go Home

Within different distances in the two regions, respondents choosing to take regular taxis are unwilling to pay, or are only willing to pay lower prices.

5.2.4. Asking Relatives and Friends for Help to Go Home

Within different distances in the two regions, respondents choosing to ask relatives and friends for help in order to save extra costs are unwilling to pay, or are only willing to pay lower prices.

5.2.5. Drinking Habits

Within different distances in the two regions, the respondents who drink and drive every day are unwilling to pay or are only willing to pay lower prices due to their dependence on alcohol and understanding of drunk driving.
Table 12. Comparison of willingness-to-pay in the tobit and double-hurdle models (unit: NT$).

| Distance (km) | Taxi Fare | Reference Price for Questionnaire | Tobit WTP | Tobit WTP (Excluding 0) | Double-Hurdle Truncate WTP | Double-Hurdle Truncate WTP (Excluding 0) |
|--------------|-----------|-----------------------------------|-----------|------------------------|----------------------------|----------------------------------------|
| 1.5 km       | Nantou (Driving Model 1) | 85 | 1000 | 403 | 483 | 186 | 463 |
|              | Nantou (Driving Model 2) | 62 | 249 | 22 | 278 |
|              | Taichung (Driving Model 1) | 132 | 294 | 120 | 348 |
|              | Taichung (Driving Model 2) | 156 | 342 | 59 | 306 |
| 3 km         | Nantou (Driving Model 1) | 125 | 1000 | 45 | 211 | 12 | 218 |
|              | Nantou (Driving Model 2) | 57 | 238 | 21 | 243 |
|              | Taichung (Driving Model 1) | 169 | 308 | 97 | 339 |
|              | Taichung (Driving Model 2) | 156 | 342 | 53 | 272 |
| 5 km         | Nantou (Driving Model 1) | 175 | 1000 | 174 | 325 | 83 | 311 |
|              | Nantou (Driving Model 2) | 203 | 358 | 107 | 335 |
|              | Taichung (Driving Model 1) | 125 | 276 | 58 | 258 |
|              | Taichung (Driving Model 2) | 156 | 342 | 48 | 248 |
| 11 km        | Nantou (Driving Model 1) | 325 | 1000 | 68 | 249 | 54 | 229 |
|              | Nantou (Driving Model 2) | 89 | 282 | 30 | 251 |
|              | Taichung (Driving Model 1) | 154 | 307 | 67 | 254 |
|              | Taichung (Driving Model 2) | 173 | 357 | 60 | 254 |
| 13 km        | Nantou (Driving Model 1) | 425 | 1200 | 86 | 288 | 29 | 277 |
|              | Nantou (Driving Model 2) | 204 | 392 | 85 | 339 |
|              | Taichung (Driving Model 1) | 167 | 343 | 65 | 269 |
|              | Taichung (Driving Model 2) | 218 | 420 | 86 | 300 |

6. Conclusions and Policy Implications

This study explored whether the willingness to use designated driving services and willingness-to-pay are different in Nantou County and Taichung City in Taiwan. A questionnaire survey was conducted on the drunk drivers of the supervision stations in order to collect the sample data of the two regions, and this study analyzed the factors influencing the use of designated driving and the willingness-to-pay. Based on data integration, model analysis, and estimations in the previous chapters, this chapter draws the conclusions and offers suggestions for future studies.

6.1. Conclusions

The subjects in this study were the members of the drunk driving and traffic safety training course at supervision stations in Nantou County and Taichung City in Taiwan. The questionnaires were issued in class, and all of the questions were interpreted and answered one by one in order to understand the willingness to use designated driving and willingness-to-pay, and a total of 515 valid questionnaires were collected. The analysis results are shown, as follows.

During the survey of drunk drivers’ understanding of and user experience with designated driving, while 90% of respondents knew about it, 90% of the respondents in Nantou and 75% of respondents in Taichung had never used it, and nearly no designated driving services were offered in Nantou. The difference between the willingness-to-pay and the reference price, as previously integrated by the government, was NT$ 300–400, indicating that the current willingness-to-pay was high.

According to the study results, the variables—namely, age, gender, income, family background, and experience in designated driving—influenced the drunk drivers’ partici-
pation willingness and willingness-to-pay in the same region, and economic structure and user experience caused regional differences.

The relationship between driving distance and willingness-to-pay showed that the willingness-to-pay increases with the increase of distance, which is consistent with the concept of user-pays. However, there was no way to know whether the current fixed designated driving charge is in line with the market price, only that people’s willingness-to-pay differs greatly from the currently promoted price.

According to the estimations, the younger the drunk drivers, the less willing they were to pay for designated drivers, which is consistent with the argument presented in the literature, meaning that young people are more likely to drive after drinking. Moreover, higher incomes led to higher willingness to use designated driving services and higher willingness-to-pay.

6.2. Policy Implications

Suggestions on the procedures and results of this study are offered in order to facilitate future studies of policy revision.

The scope of this study was Nantou and Taichung, and the large differences in the population composition and different frequencies of training courses led to long survey times and a poor efficiency of questionnaire collection. It is suggested that regions with similar geographical characteristics can be surveyed in the future, which will help to improve the efficiency of the questionnaire collection.

At present, the implementation and system of designated driving in Taiwan is developing slowly. While there have been adjustments and amendments to the drunk driving laws, no regulations or measures have been introduced for designated driving. It is suggested that laws and regulations should be developed by referring to the designated driving services of other countries.

With the base fare of NT$ 1000, the current designated driving charge is unreasonable, as it discourages passengers within short distances; thus, it is suggested that the relative distance equation should be adjusted flexibly in order to reduce the chances of drunk drivers being on the road.

In addition to promoting designated driving, the effective measures to prevent drunk driving include: increasing the frequency of bans by police to realize the effect of threat and supervision; enacting and amending laws to enforce fines, penalties, driver’s license suspension, vehicle registration cancellation, and prevention, in order to increase the drunk driving restrictions for young people and repeat offenders; and enhancing the understanding of drunk driving and the risks of drunk driving, as well as the practicality and convenience of designated driving services.

Driving Model 1 and Driving Model 2 have their own advantages and disadvantages. Motorcycles are the main means of transport in Taiwan, and it is obvious that the designated driving service designed for vehicles cannot completely solve the problem of drunk driving. In addition, Taiwan could refer to the designated driving methods adopted by foreign countries when designing a new designated driving method to solve this phenomenon; for example, when two drivers offer the designated driving service, the drinker returns home in the designated driver’s car, followed by another driver on the drinker’s motorcycle.

**Author Contributions:** R.-C.J. participated in revising the manuscript critically for important intellectual content, and gave final approval of the version to be submitted. L.-W.S. made substantial contributions to the conception and design, the acquisition of the data analysis and the interpretation of the data, and participated in writing the article. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** Provided by the authors upon request.

**Conflicts of Interest:** The authors declare no conflict of interest.
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