

Willingness to Pay for Better Safety on State Highways

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Abstract

India is experiencing ever rising crashes and fatalities in recent years. More than 1.4 lakh people are killed in about 5 lakh accidents in the country. Even though the Government of India has invested a significant amount of fund for road development, we are losing 3% of our GDP each year in road traffic crashes. Safety records of State Highways are alarming with very high fatal and sever injury crashes involving a disproportionate number of vulnerable road users. With increase in motorized traffic on roads the number of crashes is in the increasing trend in India. This increase has also been magnified by construction of new high speed National Highways. Majority of these state Highways are multilane facilities where crashes tend to be high compared to limited access expressways. However, cost of construction of these expressways is almost double than that of the multilane facilities. In this study, a stated preference experiment was designed to investigate how users value safety and how much they are willing to pay for better safety. To investigate willingness to pay (WTP) total of four parameters travel time, travel cost, expected number of accident and level of service are considered and survey was conducted to users of SH-BR-60 from Purnea to Forbisgang. For WTP estimation we collect socioeconomic survey data, road traffic crash data from 2007-2011, and SP survey data from Purnea to Forbisgang on State Highway-60(SH-60). In this paper we use fractional factorial design for SP survey data collection and analysis. From the road traffic crash data we find that about 50% fatal crashes involves vulnerable road users. Finally with discrete choice model analysis willingness to pay for safety estimated.

Keywords: Willingness to pay (WTP), stated preference, vulnerable road users, discrete choice modeling, Road accident.

1. Introduction

1.1 Road accidents happen mainly due to four reasons:

1. Defects in vehicle e.g. breakage of tie rod of running vehicle, tire bursting, wheel coming loose or failure of breaks. Due to such occurrence driver loses control on vehicle and accidents results.
2. Error of driving.
3. Environment around the road.
4. Defects in roads: a study of accidents registered with police shows that the number of accidents due to this reason is around 20% of the total accidents.

1.2 Willingness to pay (WTP)

Willingness to pay (WTP) is a dominant approach to derive the value of safety. In this method we can find tradeoff between risk and wealth. Countries adopted the concept of WTP in the early 1990s; Sweden 1990 (Persson, 2004), New Zealand 1991 (Guria et al., 2005), followed by the UK and the US in 1993 when the Department of Transport in each country decided to replace their previous policy value by preference based values (US DoT, 2004; UK DoT, 2007). environment) this is very useful tools in many area like water supply, environment, food security. Bhattacharya et al. (2006) find value of mortality risk reduction in Delhi. They used willingness to pay (WTP) method and find that WTP increases with size of risk reduction, income, and exposure to the road traffic risk. WTP decreases with the no of dependents for the primary breadwinner in the household they used stated preference method.

1.3 Stated preference (SP) method

Stated preference method refers to a family of techniques which individual respondent's statements about their performances in a set of transport option to estimate utility functions. Kroes et al. (1986) introduce the use of stated preference methods In transport research and to demonstrate their value in both complement in and supplementing revealed preference methods. They also explain difference between stated preference and revealed preference method. This paper also explains about how to write utility equation with various attribute. They also explain how to use fractional factorial design, survey methods techniques of analysis, application area of stated preference method.

2. Research Methodology

2.1. Selection and characteristics of study area

It is a 120 km stretch on SH-60 from Purnea to Forbisgang .This is a part of golden quadrilateral which connecting two major cities-Kolkata and Chennai. This road is currently a four lane divided facility with service lanes only at two suburban locations. A considerable part of this road goes through rural setup where there is no alternative roadway connecting the localities alongside of the SH-60. As a result the share of the non-motorized traffic is very high along those stretches of SH-60.

2.2. Type of data required and probable source

For this study data Socio-economic data, Accident data, Travel time, and travel cost are required. Accident data include no of fatal and non-fatal accident. It also include place of accident. For this data we contact various police station located in study area and they provide only us according to their FIR register. We collect accident data from year 2007-2011. from this data we find average no of fatal and non-fatal accident and that can be used in SP survey design.

2.3 Proposed method of data collection

In SP survey four attributes like travel time (TT), Travel cost (TC), no of accident (AC) and level of service (LOS) are incorporated. Each attributes have two variation levels. For ranking of attributes we take higher value as high or +1 and lower value as low or -1.

3. Analysis of Data and Discussion on Result

3.1 Primary analysis

From the primary analysis it is find that 70% respondent are male and 30% are female. It is also find that that 51% of respondent are of age group less than 35 year and 30% of respondent having age between 35 year to 55 years. It is also found that 34% of respondent having income between Rs (20000-30000) and 24 % have more than Rs 30000. When we asked respondent that, which factor like travel time, travel cost, safety and comfort are most important for him than 36% respondent told safety, 18% told travel cost, and 17% told comfort, 29% said travel time is important for them. This data indicates that maximum percentage of people have more influence towards safety. This is one of important finding of survey. Here we also find that most of the accident occurs at the intersection or crossing of the road. We also find that vulnerable road users are involved in about 50% of accident. From the data received from various police stations we find total no of accident (fatal and major) in this stretch is 475 per year. We include only that accident which is registered in various police station of the study area. Here we also observed that some area have more accident and some area have very less accident happened. It is also observed those areas which are near village having more accident compared to areas which are away from village area.

3.2 SP survey design analysis

For analysis for SP survey design Multinomial Logit (MNL) model is effective tools and for this project it is used. For analysis of Multinomial Logit (MNL) different software package are available in market. For this work we use NLOGIT software package of version 4.0.1. After analysis we find the coefficients of attributes and that can directly used for find the willingness to pay. In the all cases we expected signs of the coefficients of travel time (α) travel cost (β), no of accident (γ) and level of service (ρ) to be negative, since an increase in either travel time, travel cost, no of accident and level of service of the route should decrease utility. Here we find from above table that the values of coefficient of all attributes are negative and hence it is as per

expectations. After analysis we find that value of R-square (R²) is 0.179. Now come to another statistical test that is “t” test. Here t value for all coefficients is more than 1.96 and we know that for 95% confidence level value of “t” test more than 1.96. Hence “t” test is significant. As we know that the ratio of coefficient of no of accident to the travel cost gives willingness to pay for safety. Hence here we got that ratio which is equal to 2.58. It means that for every accident in one kilometer of stretch we have to pay Rs2.58 for one year. Hence we got willingness to pay for safety. Here value of travel time and level of service are also calculated and it is equal to 2.231 and 0.805 respectively.

| Variables | Coefficient | Ratio | Willingness to pay(WTP) |
|-------------------|----------------------|---------------------------|-------------------------|
| TT(Hrs) | $\alpha=-1.57016159$ | $\alpha/\beta=2.00473310$ | 2.231 |
| TC(Rs/km/persons) | $\beta=-0.70358139$ | - | - |
| NOA (per month) | $\gamma=-0.15151009$ | $\gamma/\beta=.081299878$ | 2.5840** |
| LOS | $\rho=0.56563236$ | $\rho/\beta=0.80491554$ | 0.805 |

4. Conclusion

In analysis of discrete choice modeling socio economic data is not incorporated. If socio economic data is incorporated then value of coefficient are changed and we may get sum superior result. If socio economic data include in analysis then we need to start analysis with mixed logit (ML) model and that required much more time. Now come to the main objective to find the willingness to pay for better safety. It is found that for every accident in one kilometer of stretch of state highways user want to pay Rs 2.58 in one year. As we know that the ratio of coefficient of no of accident to the travel cost gives willingness to pay for safety. Hence here we got that ratio which is equal to 2.58. It means that users are willing to pay about Rs 2.60/km for reduction of one accident in one year. Ratio of coefficient of travel time to travel cost is 2.00. It indicates that for per hour reduction on travel time users are willing to pay Rs 2 .00 /km of travel. People are willing to pay Rs 0.80 /km of travel for comfortable journey.

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