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Which Pricing Policy Road Users' Accept? A Case Study

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Abstract

Road pricing remains one of the questionable concerns for transportation planners and researchers. However, the prerequisite for the implementation of road pricing is still user acceptability. The present study provides users' preferences for different road pricing schemes, which helps the researchers to determine the optimum pricing schemes for adoption. The present study conducts a user acceptability survey to analyse their perceptions and acceptability of different road pricing schemes. Based on a questionnaire survey, a large-scale survey was conducted. However, with the varying toll charges and travel time savings from the alternatives, this study reviews the stated preference survey. The results from the developed Multinomial Logit model show that there are significant differences in the choice of pricing scheme. The probability of supporting distance-based pricing is more and it is affecting significantly. High Occupancy Toll (HOT) emerged as the most acceptable by users with a perception of less travel time savings from using toll roads. However, the acceptance rate of Dynamic Toll Pricing (DTP) increases for the users who oppose the current pricing scheme. Additionally; socio-economic variables possess a huge impact on the pricing schemes. The estimated parameter signs are logical and statistically significant. Further, the price elasticities are calculated for each pricing scheme and these vary from -0.45 to -4.80. The elasticities for DTP are more when compared with other pricing schemes. The research outputs generated from this study will assist the practitioners working in a similar domain in developing various schemes and estimating the acceptance after the implementation.

Keywords: Road Pricing Scheme, Acceptability, Multinomial Logit Model

Introduction

Road pricing is known as any kind of fee or charge imposed on the user for the usage of certain roads or areas. The policy of road pricing schemes is predominantly for the generation of revenue, road maintenance, financing, or as a management tool to reduce bottleneck conditions, heavy traffic jams and environmental impacts.

Keeping this aspect into consideration various toll pricing schemes exists for the smooth operation and collection of toll fees like Dynamic Toll Pricing (DTP), High Occupancy Toll (HOT), Distance-based pricing etc[1]. HOT lanes permits small occupancy vehicles to ply by paying toll[2]. Dynamic pricing refers to variable tolls based on the time or level of set aim to minimize the traffic created during the peak time in an optimum way[3]. These technologies are well developed and are in use in different developed countries. However, the implementation of pricing scheme required user perception and ability to pay for it especially in developing countries.

In India, due to manual operation, the processing time was high causing traffic congestion and delays to the users[4] hence, the Government of India (GOI) has recently implemented the electronic toll collection (ETC) (called FASTag in India[5]) for compulsory payment of tolls on National Highways (NHs). Further, the toll collection system in India will switch to Open Road Tolling in upcoming years[6]. Hence, the present research work aims to understand the user's perceptions and acceptability of various pricing schemes in India and also evaluate their willingness for toll fee payment across different pricing schemes.

Previous Research

As per the literature insights, various existing studies have worked on understanding the user perceptions and acceptability of pricing schemes. The summary of literature is given in Table 1.

Table 1 Summary of the literature review

Reference	Study Area	Modelling Framework	Number of Samples	Respondents
Schade and Schlag[7]	European cities	Stepwise Multiple Regression	954	Motorists
Jaensirisak et al.[8]	Leeds and London	Logit Model	830	Car, Bus and other mode users
Jou and Yeh[9]	Taiwan	Mixed Logit Model	2339	Passenger Car users
Sugiarto et al.[10]	Jakarta	Bivariate Response Model	1998	Car users
Janwari et al.[11]	India	Elasticity analysis, the Cost equation	Not applicable	Car, Bus, Light Commercial Vehicles, Heavy Commercial Vehicles.
Glavić et al.[12]	European countries	Structural Equation Modelling (SEM)	284	Passenger Car

Davidson et al.[13] conducted a stated and revealed preference survey to know the importance of toll route choice of the users when new pricing schemes are implemented. Some contributions considered variables such as perception about toll amount and travel time savings for the user's willingness to pay the toll [14,15]. Nikitas et al.[16] concluded that the older people's attitudes are distinctly different from the younger people's attitudes toward road pricing. Swami et al.[3] evaluated the dynamic toll pricing viability for the developing economy context and considered the Indian case through the same survey approach. The authors further captured through literature that the maximum shift for dynamic toll pricing by the small car users for a 25 per cent discount rate.

Literature has majorly revealed that the pricing schemes such as HOV/HOT, and the distance-based pricing and DTP doesn't applied across the Indian context. The present work aims to know the user's acceptability of different toll pricing schemes for Indian conditions and also to know the factors which affect the acceptability.

Research Methodology

The research work focuses on users' perceptions of various road pricing schemes by developing a structured questionnaire. The response survey was developed to project various preference data. According to the user responses and their choice preference across different categories as received from the questionnaire survey the present work proposes a multinomial choice model.

Questionnaire survey

Revealed Data Survey

There are variables like gender, age, monthly income was initially included under the socio-economic category in the survey. The variation in the user's paying willingness and attitude was the major reason behind its consideration[17]. Similarly, several travel-related observations were included in the next part which comprises vehicle type and trip purpose etc., and in the later section, various attitudinal variables e.g., respondent's choice and perception of the user were considered in the scenario of a new type of pricing scheme. An in-depth literature review helped for the same.

Stated Preference Survey

In this regard, travel cost and time are the most critical attributes taken into consideration. In this study, the toll charge is referred to as the travel cost that a user pays as a toll fee. The distance-based tolling depends on the distance traveled. In order to explain the said issue, hypothetical scenarios are made considering the base price of 50INR (as 0.65INR/km is considered by NHAI in order to decide the toll rates, PART II-Section 3.-Subsection (i)[18]) for the travel distance of 60km (considering its length of a minimum of 60km and some bridges and tunnels in between [18]. Thus, the price is the multiplication of the per kilometer price with the 60km.

All the respondents were given four alternatives across the choice experiment design, which includes DTP, Single Occupancy Vehicle (SOV), HOT, and distance-based pricing. A user can select an alternative based on the values of attributes. Each attribute will have different levels. The basis for this information is taken from Jou and Yeh[9] (**Table 2**).

Table 2 Attribute levels for each alternative

Pricing scheme	Travel cost (INR)	Travel time savings
Single Occupancy Vehicle (SOV)	65,70,80	5%, 10%
High Occupancy Toll (HOT)	60,65	5%,10%
Dynamic Toll Pricing	50, 55, 60	2.5%, 5%
Distance based tolling	70, 80, 90	10%, 15%

All the selected attributes are evaluated based on the 5-point Likert scale where the perception varies from strongly disagree (-2) to strongly agree (+2). The observed values are corrected for leniency and central tendency errors. The calculated scores (Avg- Average value; SD- Standard deviation) are shown in (**Figure 1**). The selection of attribute levels is performed in context to revealed data. Each combination will have one particular level of the attribute. For the present study, to ensure the mutually exclusive situation across the considered attributes, the orthogonal design was utilised[9]. The outcomes (relation among attribute and alternative-within the similar alternative) reveal variance (70-90%) across the explanation of response data. This study utilizes a Fractional Factorial Design (FFD) to minimize and remove the choice sets given to the users[19]. Accordingly, such choices were eliminated from the questionnaire. Hence, eight specific scenarios including the user's peak and off-peak travel are taken up in this study.

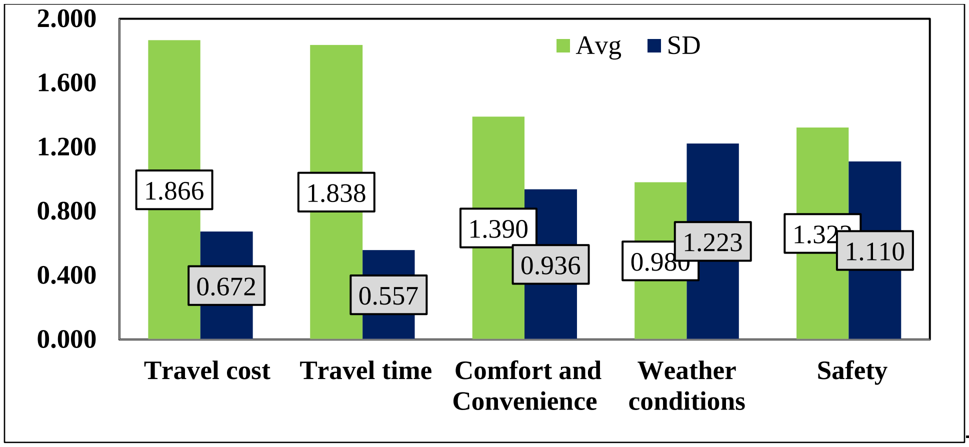


Figure 1 Evaluation of attributes scale of -2 to 2

The present work utilizes the Multinomial Logit Model (MNL) to understand the factors affecting users' acceptability of preferred pricing schemes. The MNL is considered as an upgraded version of the Binary Logit Model that emerges as a preferred choice of the researchers across the discrete choice model [11,20,21] where all log odd of outcomes is formulated as linear-combination for the predictor variables.

The general equation for the MNL for choosing an alternative *'i' (i=1, 2,…j)* from a set of j alternatives is given by **Equation 1**

$$Prob(y_i = j) = \frac{\exp(\beta' X_{ij})}{\sum_{m-1}^{J_i} \exp(\beta' X_{im})} \qquad (1)$$

Where 'y_i' is the index of the choice made

$\beta' x_{ij}$ is the deterministic component of the utility function.

Data Collection

The data was collected in online mode by sending more than 1200 google forms to the users. The online platform is preferred for car users due to the COVID-19 pandemic situation. Out of 1200 forms sent 35% forms were received back. The study region was selected near the zone Eethakota (Andhra Pradesh-India). During the physical interaction interview conducted with the bus-truck drivers specifically, the required responses were collected at the lorry office, fuel pumps, and hotels close to the toll plazas following proper COVID-19 guidelines in December. Some of the responses were taken from the passenger car drivers in the field, and it was found that there was no significant difference between the dataset; hence it was combined.

The whole data from the bus and commercial vehicle drivers were purposefully collected with the help of face-to-face interviews as most of the drivers had less education, and the questionnaire was asked in the regional language rather than in English to get the actual responses from them. The respondent has to select one alternative from the available alternatives in the case of the stated preference survey. Respondents were toll road users who were already being charged for using toll roads. The data collection process includes several vehicles which include all different types of commercial and non-commercial vehicles consisting of buses, cars, Light Commercial Vehicles (LCVs), Heavy Commercial Vehicles (HCV) and Multi Axle Vehicles (MAV). The sampling technique that was used in the present study was a simple random sampling technique for the representative sample from the population for a face-to-face interview and a snowball technique for Google forms. Israel[22] provides a simplified table to estimate the required sample to be considered. Considering a sample population greater than 1,00,000[23] and a level of precision of 0.05, the approximate number of required responses is around 400. For the present study, a total of 750 responses were included in this research work.

Data Analysis

A total of 750 response data was collected through the questionnaire survey. There is no missing data found in the collected responses. To evaluate the outliers appropriately, the authors utilised the Mahalanobis D^2 equation for generating desired results[21] accordingly a total of six outliers were captured for the further evaluation process. The adequacy, variable relationship and normality were inspected properly for the collected responses. The results depicted through the Kaiser-Mayer-Olkin (KMO) and Bartlett's test of sphericity are 0.860 and 0.000 respectively.

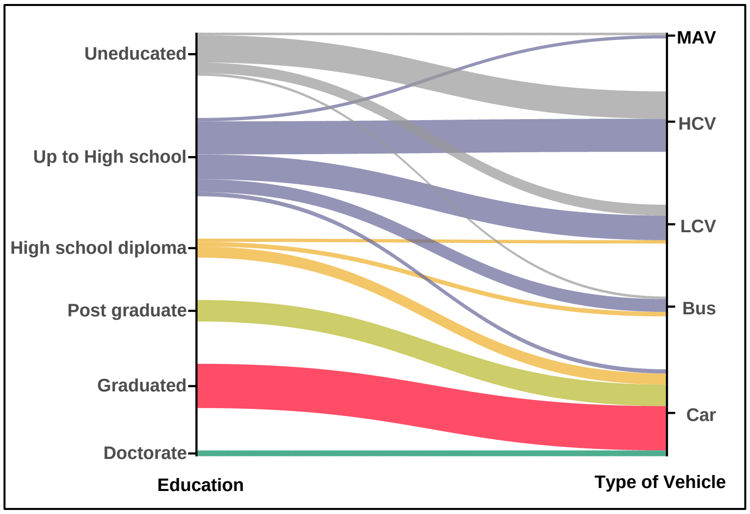
The primary evaluation of responses resulted that only six per cent of respondents were female whereas others were male. The age group classification of the analysis reveals that the 30-39 years group respondent was 41.5% followed by the 21-29 years group at 27.3%. However, it was further interesting to observe that majority of the respondents belong to the income group less than 20,000 INR (54.60%). Whereas the highest education of respondents up to high school was 37 %. The majority of the respondents were car users (32.54%) and HCV users (28.68%). It was further observed that most of the respondents pursued their travel for work purposes i.e., 35.10% and similarly, the commercial users were around 33.60%. The majority of the respondents travelling across data collection had travelled the trip more than 180km 49.9%. Whereas around 64.15% of the respondents had awareness regarding usage. Around 54.40% of respondents reverted that the toll fares are quite high, however, they mutually got agreed that it results in travel time saving.

Further, the chi-square analysis is carried out to check the significant association between two categories of variables. The null and alternate hypothesis is taken as follows.

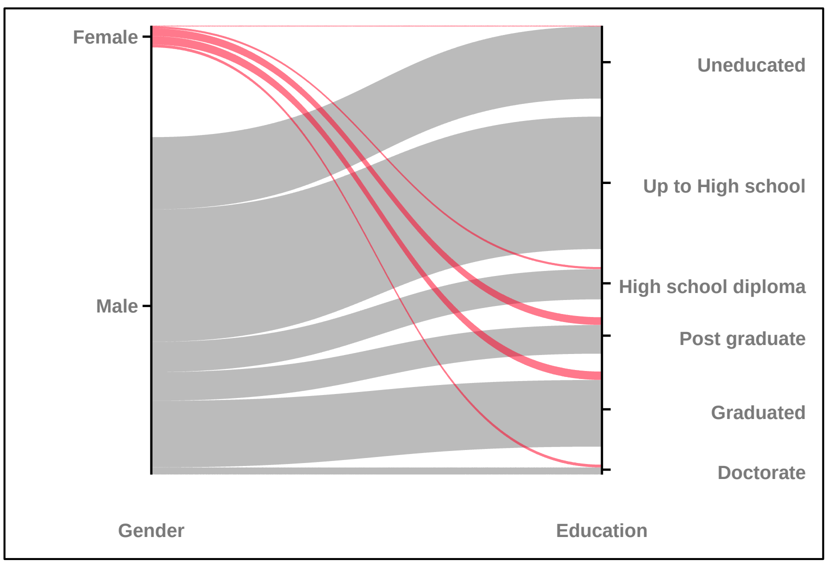
H_0 = The education and vehicle type (age/trip purpose) are not having any association (correlation).

H_1 = The education and vehicle type (age/trip purpose) have any association (correlation).

The level of significance is taken as 0.05. The results showed that the p-value for all the cases is lower than 0.05, and hence it can be said that education is strongly associated with vehicle type/age/trip purpose. The alluvial plots are plotted to strengthen the results, as shown in **Figure 2**. It can be seen that the heavy vehicle drivers were mostly having lower education or no education.


Uneducated
Up to High school
High school diploma
Post graduate
Graduated
Doctorate
Education
MAV
HCV
LCV
Bus
Car
Type of Vehicle

(a)


Female
Male
Uneducated
Up to High school
High school diploma
Post graduate
Graduated
Doctorate
Gender
Education

(b)

(c)

Figure 2 Alluvial Plots (a) Education and vehicle type (b) Gender and Education and (c) Education and Trip Purpose

Figure 3 shows the acceptability levels of different pricing schemes from the preliminary observation of response data, under which users leaned more towards the acceptability of implementation of distance-based pricing (85%) followed by DTP (70%).

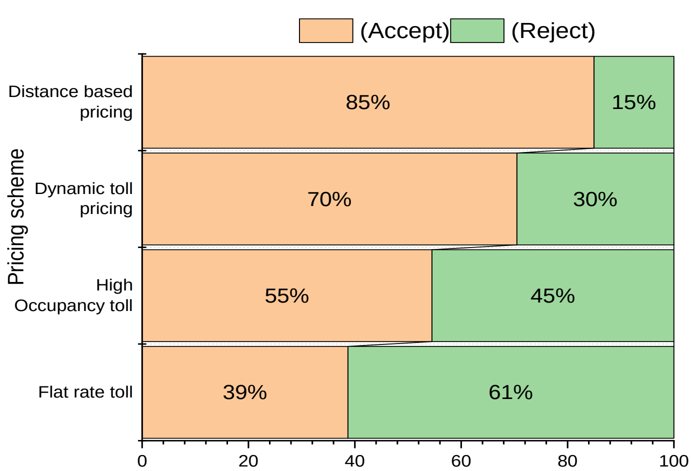


Figure 3 Summary of acceptability of pricing schemes

MODEL DEVELOPMENT

The MNL models are utilized to compute the effect of variables on users' perceptions and individual choices of the particular pricing schemes. The choice of an existing one is considered a reference choice to measure the acceptability of other pricing schemes. Since the variables which were considered are categorical, the last category is considered the base case in the present study. For instance, the base case for the gender variable is taken as the female category.. Parameter estimates of the MNL model are shown in **Table 3**, which contains coefficients of variables across 95% confidence levels appearing to be statistically significant. The related variables are analysed according to the logical significance of the coefficients and their p-value.

The generic variables considered here are travel-cost and travel-time-savings which shows a significant influence on user's acceptability. The results across the analysis reveal that the respondents do not prefer to pay whenever the travel cost enhances concerning the pricing scheme type. The results of the model for the SOV show that the acceptability towards implementation increases even with the increase in travel cost this may be due to if the user wants to make a trip with single occupancy and has to pay the high toll. The higher travel time savings does not lead to more acceptability of SOV as it affects negatively. As can be seen that the younger age group people are more willing to adopt SOV (Coefficient=3.375). SOV appears to be adaptable across highly educated respondents. It can be understood by the fact that highly educated respondents diverge towards the aligned lanes and hence they gave preference to SOVs. The model shows that the car users accepted the SOVs for short distances. Attitudinal factors also affect significantly the acceptability of SOV, as the acceptability is more for the user's who perceive the current pricing system provides more delay and for the user's who feel toll rates are economic.

The positive signs of coefficients of higher income level categories show that as income increases, the users tend to shift to the HOT lane. The acceptability of HOT also alters significantly over travel-related characteristics. The coefficient for vehicle type affects negatively commercial vehicle users because car users accept HOT more (44.39%). These findings acquaint that those users who are using toll roads with the car as a vehicle type lean more towards the managed lanes. Consequently, the acceptability of HOT is notably low for the respondents who observed that the existing one is useful for saving more travel time. However, the choice of HOT increases with a decrease in travel cost because it affects negatively.

Table 3 Estimates of Multinomial Logit Model

	Single Occupancy Vehicle (SOV)		**High Occupancy Toll (HOT)**		**Dynamic Toll pricing**		**Distance-Based pricing**	
	Coefficient	**Sig.**	**Coefficient**	**Sig.**	**Coefficient**	**Sig.**	**Coefficient**	**Sig.**
Constant	0.806	0.000	0.683	0.000	0.238	0.213	0.598	0.000
Gender								
Male	-1.069	0.000	-0.055	0.849	-1.132	0.000	-1.547	0.000
Female (Base Case)								
Age group								
21-29	3.375	0.000	1.251	0.08	0.856	0.064	1.824	0.000
30-39	2.519	0.000	0.313	0.051	0.163	0.684	-0.827	0.033
40-49	1.429	0.000	-0.257	0.429	0.326	0.423	0.326	0.040
50-59	1.342	0.002	-0.360	0.320	0.439	0.350	0.436	0.270
Over 60 (Base Case)								
Income level (in INR)								
Below 20,000	-1.850	0.001	-1.970	0.000	-0.727	0.131	1.916	0.008
20,000-40,000	-1.147	0.013	-0.888	0.032	0.097	0.880	0.696	0.091
40,000-60,000	-0.614	0.123	-0.405	0.270	0.022	0.952	0.436	0.241
60,000-80,000	-1.487	0.001	-0.641	0.105	-0.088	0.818	-0.415	0.292
80,000-1,00,000	0.633	0.571	1.042	0.280	0.697	0.448	-2.325	0.011
1,00,00-1,20,000 (Base Case)								
Education level								
Uneducated	1.536	0.778	0.301	0.708	1.032	0.195	0.005	0.995
Up to Highschool	1.823	0.560	1.201	0.117	1.098	0.148	0.256	0.733
High school Diploma	-2.162	0.084	-0.391	0.438	0.396	0.405	-1.092	0.028
Graduated	0.268	0.034	-0.686	0.082	0.699	0.063	0.069	0.008
Postgraduate	0.128	0.000	1.836	0.000	0.633	0.086	-1.643	0.000
Doctorate (Base Case)								
Type of vehicle								

	Single Occupancy Vehicle (SOV)		High Occupancy Toll (HOT)		Dynamic Toll pricing		Distance-Based pricing	
	Coefficient	**Sig.**	**Coefficient**	**Sig.**	**Coefficient**	**Sig.**	**Coefficient**	**Sig.**
Car	2.921	0.231	0.458	0.191	-0.415	0.707	-3.241	0.003
Light Commercial Vehicle	1.538	0.023	-1.448	0.683	0.519	0.644	-2.212	0.046
Bus	1.389	0.086	-0.252	0.720	-0.166	0.817	0.942	0.017
High Commercial Vehicle	1.682	0.317	-0.032	0.955	-0.362	0.521	0.321	0.056
Multi-Axle Vehicle (Base Case)								
Trip purpose								
Work	0.644	0.057	-0.680	0.024	-0.580	0.055	-0.348	0.236
Education	2.805	0.000	-0.004	0.920	0.462	0.179	1.416	0.000
Shopping	1.712	0.000	-0.121	0.722	-0.588	0.080	-0.769	0.022
Leisure	2.821	0.000	0.657	0.082	-0.564	0.142	-0.234	0.516
Business	-0.566	0.000	-1.852	0.000	-1.369	0.001	0.999	0.015
Commercial (Base Case)								
Travel Distance								
45-60km	1.732	0.000	-0.750	0.009	0.374	0.154	-0.782	0.006
60-90km	0.774	0.003	-0.025	0.911	-0.415	0.058	0.182	0.420
90-120km	0.059	0.085	-0.106	0.717	0.480	0.065	-0.107	0.698
120-150km	-0.458	0.198	0.510	0.630	0.673	0.100	0.526	0.000
150-180km	-1.385	0.855	0.702	0.570	1.382	0.000	1.035	0.004
More than 180 km (Base Case)								
Aware about toll roads								
Yes	-0.092	0.602	0.551	0.383	-0.131	0.000	0.034	0.820
No (Base Case)								
Opinion on toll rates								
Economic	1.426	0.000	1.680	0.000	0.996	0.052	-0.403	0.150
Reasonable	1.041	0.000	0.868	0.000	0.511	0.000	0.771	0.000
Expensive (Base Case)								
Opinion on travel time savings								
Yes	-0.710	0.047	-0.514	0.117	0.424	0.018	-1.126	0.001
No (Base Case)								
Travel time savings	-0.080	0.012	0.075	0.009	0.017	0.539	0.018	0.508
Travel Cost	0.049	0.000	-0.023	0.046	-0.160	0.029	0.147	0.009

The model for the exploring acceptability of DTP results shows that attitudinal factors have a strong influence on users' perceptions. Among the socio-economic and travel-related characteristics, there was no logical significance found in the categories of variables (age, income level, vehicle type) which were found significant in the above two pricing schemes. Long-distance trips users are leaned more toward the DTP. The acceptability of DTP is more for the users who feel the current toll system is not an appropriate mechanism to make funds.

In line with the preliminary analysis, the probability of supporting distance-based pricing is more because almost all categories or subgroups of variables are statistically significant. These findings may reveal that among the considered pricing schemes the acceptability is more for distance-based pricing irrespective of the characteristics of the respondents. The socio-economic characteristics, and income level affect negatively higher income level groups because of the truck drivers choose this pricing scheme. Education is also significantly affecting the user's acceptability of this pricing scheme. As a vehicle, it is more acceptable for commercial vehicle type users because they tend to travel more on toll roads. However, this pricing scheme does not affect significantly the opinion on toll roads but it affects more on the perception of travel time savings. Even with the increase in travel costs, this pricing scheme seems more acceptable.

the McFadden pseudo-R-square value of 0.39 was observed for the model that lies between 0.2 and 0.4, so it may be considered acceptable. In this case, the existing pricing scheme is considered as a base for comparison. Accordingly, the interpretation of the coefficient is made by comparing the same with the best alternative.

For the model validation, the study considered 20% of collected responses for checking the accuracy of the estimated model. The study prediction rate is around 74%, hence it indicates a good agreement between the user-chosen pricing scheme and model predicted pricing scheme.

Predicted acceptance levels for different pricing schemes

This presents the predicted acceptability levels for different pricing schemes with concern to travel cost and travel time savings. The analysis considered its different scenarios whichever the levels considered for the design of stated choice sets. The percentages shown in the analysis are based on the observed frequencies from the sample that is considered. These findings show a difference in the acceptable levels for the variation of travel cost and time savings. The variation in the acceptability shown in **Figure 4** illustrates that the predicted level of acceptability for distance-based pricing increases even when travel cost increases. As SOV and HOT were chosen by most higher income group users, the acceptability increases with an increase in travel cost up to some value. However, in contrast with distance-based pricing, other pricing schemes show a decreasing trend. From these results, it is feasible to say that majority would be acceptable to charge levels in the range of 65 to 80 with the travel time savings of 5 to 10 %.

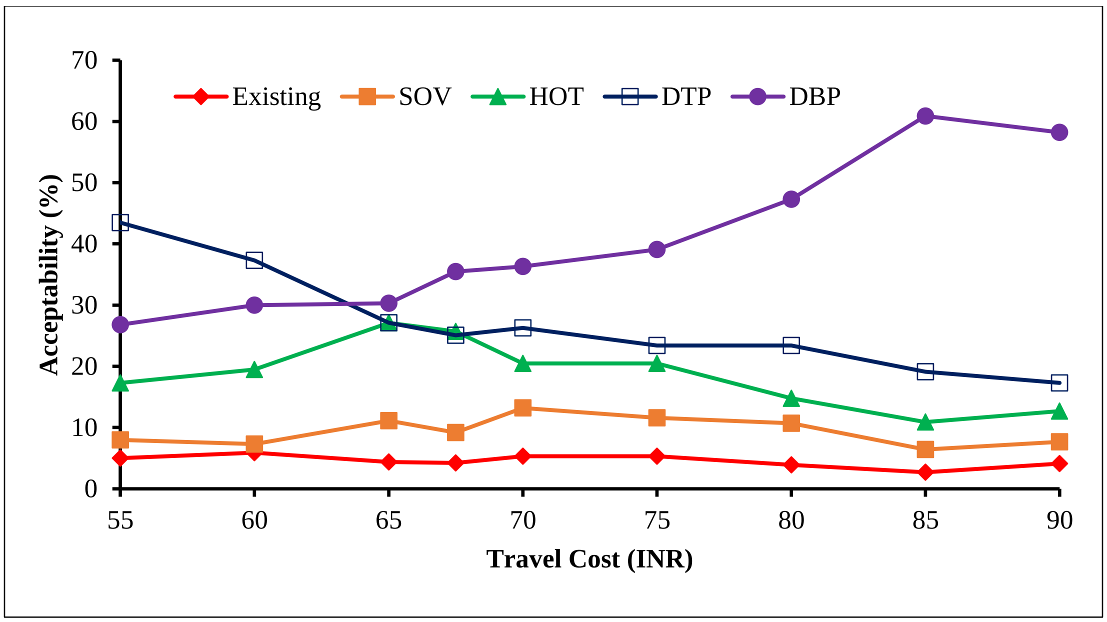


Figure 4 Plots of Acceptable Levels

Elasticity Analysis and Marginal Effects

In this study, the elasticities of different pricing schemes with different levels of toll charge are computed and analyzed to understand the impact of a unit increase in toll rate for each pricing scheme on the choice probabilities of each alternative. Elasticity means with an increase in attribute value how the preference towards those alternative changes. This is especially useful in deriving policy insights for an increase in toll charges to each pricing scheme. For calculating the travel demand elasticities, the point elasticities are calculated[3] and are shown in Table 4.

The levels of toll rates are taken as levels used in the stated preference study and the elasticities are calculated. From the results, it is observed that all the elasticity values are negative, and this is logical means an increase in toll rates results in to decrease in travel demand and vice versa.

Table 4 Price Elasticities

Pricing scheme	**Toll charge (INR)**	**Elasticity**
Single Occupancy Vehicle	65	-3.10
	70	-2.20
	80	-1.58
High Occupancy Toll	60	-3.90
	65	-1.50
Dynamic Toll pricing	55	-4.80
	60	-2.40
Distance-based Toll	70	-1.35
	80	-1.10
	90	-0.45

The elasticities are in the range from -0.45 to -4.80 for all pricing schemes. The elasticities for DTP are more when compared with other pricing schemes, but it is negative. This implies that a maximum shift has been seen for DTP for lower prices, but as travel cost increases the shift decreases. The elasticity for SOV is -3.10 at a toll charge of 65, which means with an increase of 1% of the toll the traffic changes by 3.10 percent. Similarly, the maximum elasticity for HOT is -3.90. In the case of the distance-based toll, the elasticities are less when compared with other pricing schemes, it shows the more acceptability of the pricing scheme as compared to other ones. Because this pricing scheme is a general one which means it does not require any specific criteria related to time and occupancy. The differences that were observed in each pricing scheme are due to its applicability. The elasticity values of the present study are more than the elasticity values of the previous literatures[3,9]. Hence the present price elasticity values will help policymakers and decision-makers for fixing toll charges for each pricing scheme.

Further, the cross elasticities are found for all the modes by using the equation (2) considered by Iyenger and Gupta[24]

$$\rho_{kj} = \frac{\partial P\ (k)}{\partial\ Travel\ Cost_j}\frac{Travel\ Cost_j}{P\ (k)} = -P(j)Travel\ cost_j\beta_{Travel\ cost} \qquad (2)$$

Where, ρ_{kj} = cross elasticity of pricing scheme k and reflects the percentage change in the probability of choosing pricing scheme k with a 1% change in the travel cost of pricing scheme j.

P(j) = Probability of choosing scheme j

$\beta_{Travel\ cost}$ = Coefficient from MNL model for travel cost.

The obtained results are shown in Table 5.

Table 5 Cross Elasticities from developed MNL model for travel cost.

		Change in Probability of Pricing Scheme k			
Change in Travel Cost of Pricing Scheme j	**Schemes**	**SOV**	**HOT**	**DTP**	**DBP**
	SOV	-3.465	-0.327	0.000	-3.920
	HOT	1.626	0.153	0.000	1.840
	DTP	11.313	1.066	0.001	12.800
	DBP	-0.626	-0.980	-0.001	-11.760

The results showed that increasing the price of SOV by 1% decreases the probability of choosing SOV by 3.46%. On the other hand, increasing the price of SOV negatively affects others. In contrast with SOV, HOT and DTP show an increase in the probability of choosing the schemes. The highest increase is for DBP with respect to DTP. Thus, this elasticity analysis can give the effect of one pricing scheme on another considering travel costs. Further, the marginal effects of each variable on the probability of choosing each system are calculated as given in Table 6.

Table 6 Marginal effects for each coefficient

	Single Occupancy Vehicle (SOV)	High Occupancy Toll (HOT)	Dynamic Toll pricing	Distance-Based pricing
Gender	-0.2566	-0.0124	-0.2689	-0.3661
Age				
21-29	0.0003	-0.1252	-0.2013	-0.8538
30-39	-0.0012	-0.4205	0.1496	0.7381
40-49	0.0009	-0.1680	0.0956	0.0714
50-59	-0.3082	0.4178	-0.3601	-0.2963
Over 60 (Base Case)				
Type of vehicle				
Car	0.0033	-0.6593	0.3259	-0.0451
Light Commercial Vehicle	0.0133	0.3832	-0.3464	0.9471
Bus	0.0063	0.1535	-0.2057	-0.1006
High Commercial Vehicle	-0.3082	0.0291	0.3295	-0.2226
Multi-Axle Vehicle (Base Case)				
Travel Distance				
45-60km	-0.0135	0.1699	-0.2922	0.2694
60-90km	-0.1855	-0.0629	0.4865	-0.1547
90-120km	-0.4638	0.3481	0.1067	0.3683
120-150km	-0.2617	0.0468	0.0499	0.0598
150-180km	0.6891	-0.3207	-0.4400	-0.3517
More than 180 km (Base Case)				
Aware about toll roads	0.0200	-0.1101	0.0325	-0.0077
Opinion on toll rates				
Economic	0.0442	0.0043	0.0045	0.3461
Reasonable	-0.2560	-0.2539	-0.2198	-0.2495
Expensive (Base Case)				
Opinion on travel time savings	0.1673	0.1223	-0.1005	0.2742
Travel time savings	0.0173	-0.0165	-0.0042	-0.0082
Travel Cost	-0.0104	0.0051	0.0397	-0.0329

The marginal effects give the slope of the prediction equation at the given value of the independent variable. Thus, it shows the change in probability with a change in the unit value of the independent variable. It can be seen that gender has a negative marginal effect, which means males have more tendency toward the acceptability of any scheme. Within the scheme, it can be seen that the age group between 30-39 years has the highest marginal effect for distance-based pricing (0.7381), than the other groups. A unit increase in travel time saving increases the probability of the use of SOV by 0.0173 units. Similarly, the travel cost also affects the probability; thus, it can be seen that with an increase in a unit of travel cost, the probability of choosing SOV and distance-based pricing decreases while HOV and dynamic toll pricing increases. Thus, it can be seen that the different factors affect marginally on the probability of acceptance of any scheme.

Conclusions

The present study aims to investigate a hypothetical adoption of four different road pricing schemes, for the user's who use toll roads. From the extensive literature review, factors related to user perception and acceptability are considered. Based on these factors a questionnaire has been designed to know the user's preference toward these pricing schemes.

The results reveal the preferred strategies; SOV, HOT, DTP and distance-based pricing are strongly affected by various variables. There is no common direction to be followed by variables for each pricing scheme. The study outcomes also showcased that socio-economic factor possess less impact on acceptability as compared to attitudinal factors. The distance-based pricing projects the highest acceptability rate as compared to the others. The results of elasticity analysis show that the elasticity value of DTP is more which means the maximum shift observed in this scheme. The elasticity values of this study will assist in computing the effective toll for these pricing schemes.

Considering the above-mentioned findings together the outcomes may be specified that this study will be extremely beneficial for the transportation practitioners and executers to evaluate the correct assessment of these pricing schemes before it is implemented. For successful implementation of these pricing schemes, the transport planners may create awareness of particular pricing schemes. The study also indicates that users' acceptability may be varied with the conditions that exist and also a kind of pricing scheme proposed. The research outputs generated from this study will assist the practitioners working in similar domains developing various schemes and estimating the acceptance after the implementation. The applicability of the HOT for commercial vehicles either for different strategies such as dedicated HOT for commercial vehicles or left-most lane for them, etc., will be studied in the future.

In the present study, the travel cost and the travel time saving are assumed to follow a linear relation. For the future studies, the travel cost can be taken as function of distance as cost per unit length. Further, the sample size is lower to make the policy decision for the whole country as it is a case study; hence, it is recommended that the sample analysis can be carried out with more sample size for country-level analysis.

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