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Investigation of Congestion Pricing Acceptability Among Commuters: An Indian Perspective

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Congestion Pricing Acceptability Among Commuters: An Indian Perspective

Abstract

Congestion pricing can be an efficient instrument to internalize the congestion externality and reduce traffic-related problems. However, commuters' acceptability, especially commuters' acceptability, is often a barrier that prevents its implementation. The acceptability of congestion pricing by Asian commuters has not been studied much, except for the cases of Singapore and Hong Kong. In the present study, a comprehensive approach to identify the key attributes affecting the acceptability of congestion pricing by Indian commuters was used. A survey was carried out at major shopping areas and workplaces in Hyderabad, India's fastest-growing city. Using binary logit and ordered probit models, the survey data were analyzed to identify the key attributes influencing commuters' acceptability of congestion pricing. Results indicate that higher income and education were associated with a higher likelihood of accepting congestion pricing. Age was also found to have a positive association with congestion pricing acceptability. Reduction in travel time and increased public transport satisfaction were found to be the two major perceived benefits (motivators) associated with congestion pricing. Based on the findings, the policy recommendation is that the generated revenue from congestion pricing is used to improve the public transport infrastructure and safety standards of the urban road network.

Keywords: Congestion Pricing, Road Pricing, Commuters' Acceptability, Binary Logit, Ordered Probit, Traffic Congestion

JEL Classification: R41 and R48

1. Background and Concept

Urban areas are hotspots for business development and employment opportunities (Das, 2015). Rapid economic growth coupled with improvements in the transit system has led to increased travel demand in cities (Roy et al., 2020), not just by transit but by car too, and India is no exception. Recent data show that India's urban population accounts for 34.7% of the total population (World Bank, 2019). The number of cars is projected to reach two billion, and the number of trucks, 790 million by 2040 worldwide (Matthew, 2016). In India, the number of registered motor vehicles increased from 141 million in 2011 to 230 million in 2016, with an annual average growth rate of 10% (MoSP, 2018). Meanwhile, the country's total length of roads only increased from 4.6 million km in 2011 to 5.8 million km in 2016, with an annual average growth rate of 3.7% (MOSP, 2018). Not surprisingly, congestion has got worse in Indian cities.

Congestion is characterized by longer travel times, higher vehicle operating costs, and incremental vehicular emissions. The intensity and duration of congestion depend on the type of transport facilities, mode choice, and time of travel (Daniel and Bekka, 2000). Traffic congestion is a very costly externality, with impacts on commuters' travel time costs and commuters' quality of life and quality of trip (Wang et al., 2015). Additionally, stop-and-go traffic has a higher probability of being involved in crashes (Zheng et al., 2010). Around ₹1500 billion (£18 billion) are being lost annually due to traffic congestion in metro cities across India (Dash, 2018). The average speed of vehicles in major Indian cities can be as low as 2.9 km per hour (Financial Express, 2018). For example, Bengaluru, Mumbai, Pune, and New Delhi all feature quite high in the ranking of most congested cities worldwide, with 1st, 4th, 5th, and 8th places, respectively (TomTom, 2020). In India, only 6-9% of all trips are made by public transport, including bus, railways, and air transport (MoRTH, 2016), whereas in most countries, the share is 30-35% (Poonam Sharma and Rajput, 2017).

Congestion pricing (CP) is regarded as an efficient traffic demand management (TDM) instrument, provided the congestion charge is equal to Marginal Congestion Cost. A congestion charge makes drivers bear the congestion costs they impose on others. Many are priced off and do not make the trip, and others manage to change route, time of travel, destination, or mode. In this sense, CP can trigger a switch to public transport. CP is an untapped transport demand management measure that can reduce traffic congestion, enhance air quality, and create adequate funding opportunities for transport infrastructure improvement (Abulibdeh et al., 2015). Commuters and political acceptability continues to be the main barrier, which is probably why there are very few examples of urban congestion charging around the world (Lindsey and Santos, 2020; Selmoune et al., 2020). These include Singapore (introduced in 1975), London (introduced in 2003), Stockholm (introduced in 2006), Milan (introduced in 2012), and Gothenburg (introduced in 2013). A number of other cities have also considered introducing congestion charging over the last few decades, but the plans have eventually been abandoned. Some of these cities are Hong Kong (which considered the idea in the 1980s, 1990s, and 2000s), Edinburgh (which held a referendum in 2005), New York City (whose then-Mayor proposed the concept in 2007), and Manchester (which held a referendum in 2008), but there are many others. More recently, all these cities except for Manchester have put the idea of CP back on the table (Bol D, 2019; Hong Kong Transport Department, 2021; Hu and Rubinstein, 2021).

1.1. Cities that have implemented CP

Singapore introduced the world's first road charging scheme in 1975, called the area licensing scheme (ALS), although it was a Cordon Based system. Under ALS, vehicles had to pay when crossing the cordon to enter a restricted zone, which included the central business district (CBD). Vehicles with four or more occupants were exempt from CP to encourage carpooling. As a result of the ALS, vehicles entering the restricted zone during peak hours dropped by 43% (Phang and Toh, 2004). In 1998, Electronic Road Pricing (ERP) replaced the ALS. The system combines a cordon-based scheme around the CBD with point-based CP on a number of roads (Goh, 2002). ERP rates vary with time of the day and vehicle size (Santos, 2005).

In 2003, London implemented CP. The system is essentially an area license. Private vehicles entering, leaving, or driving inside the Congestion Charging Zone pay a daily flat charge, which does not vary with time of the day or vehicle size. Between 2002 and 2014, there was a 39% reduction in the number of cars entering central London (London Assembly, 2017). Although average speeds initially increased, these returned to pre-charging levels due to road works by utilities, general development activity, and van traffic, a reallocation of road space toward public transport, pedestrians and cyclists, and an increase in ride-hailing traffic, such as Uber (Santos et al., 2020). By law, all revenues generated by CP in London are used on transport in London. Improving public transport may have helped increase the Commuters acceptability of CP in London (Santos, 2005).

In 2006, Stockholm implemented CP, known as the congestion "tax". This implementation was done as a trial, which was well-received, leading to implementation on a permanent basis in 2007 (Eliasson et al., 2009). The system is cordon-based, and the tax varies per crossing and by the time of day. The tax initially led to a 22% reduction of traffic crossing the cordon inbound (Eliasson et al., 2009), remaining relatively constant in the following years (Börjesson et al., 2012). In 2013, Gothenburg implemented CP too, and like in Stockholm, it is known as the congestion "tax". The system is cordon-based, varies per crossing and by the time of day, and led to an initial reduction in traffic of 12% (Börjesson and Kristoffersson, 2015).

The congestion charge in Milan was preceded by the Ecopass, whose aim was to price pollution. The Ecopass was in place between 2008 and 2012. In 2012, it was replaced by CP, known as Area C. The system is somewhat similar to the one in London in that it is essentially an area license with a flat charge. The original Ecopass led to a decrease in traffic of 16.6% between 2007 and 2011, and the Area C, implemented in 2012, led to a further decrease of 31.2%, relative to 2011 traffic levels (Croci and Douvan, 2015).

1.2 Examples of cities that considered CP but did not implement

In 1983, the Hong Kong Government commissioned a study to examine the viability of introducing ERP (Dawson and Catling, 1986). An ERP trial took place between July 1983 and March 1985, and the conclusion was that ERP was technically feasible (Hau, 1990). However, the proposals drew strong opposition due, in part, to concerns over the potential invasion of privacy, more feared because the decision to hand what was still a British colony over to China as a Special Administrative Region had just been made (Hau, 1990). The issue of privacy was an important factor in preventing the permanent introduction of CP in Hong Kong, as evidenced by the frequency with which it is mentioned in the studies that have appeared in the literature (Vonk Noordegraaf et al., 2014). In the 1990s, there was a substantial increase in the number of private vehicles, which led the Government to commission a feasibility study to examine the practicability of implementing ERP, which was followed by several other studies throughout the 2000s, with the idea still being considered as of today (Hong Kong Transport Department, 2021).

In 2005, Edinburgh held a referendum on the introduction of CP. The referendum opposed the plans, with 74% voting against and CP was not implemented (Seenan, 2005). Car owners opposed the scheme, whereas non-car owners weakly supported it (Gaunt et al., 2007). There was also limited understanding of the proposals, with many voters believing CP would not enable congestion reduction and public transport improvement (Gaunt et al., 2007), despite the scheme having the potential to raise around £760m for investment in public transport (Seenan, 2005).

In 2007, the then Mayor of New York City, Michael Bloomberg, proposed CP under a comprehensive sustainability plan (Schaller, 2010). However, the scheme failed as elected officials from the neighbouring Manhattan areas voted against its implementation. Lack of political support, the absence of a trial, equity concerns, and lack of commuters' acceptability may have been responsible for this outcome (Abulibdeh et al., 2015).

In 2008, Manchester held a referendum on the introduction of CP. The scheme allowed for exemptions, discounts, and substantial investments in public transport. The proposal was defeated in the referendum by a majority of 79% (Sturcke, 2008), and CP was not implemented. The plans to invest £1.5bn on public transport (tram, buses, and trains) and the various exemptions and discounts outweighed by the commuter's perception of the congestion charge being an extra tax on motorists (Carter, 2008).

Drivers' acceptability, especially commuters' acceptability, has been cited as the most significant barrier to introducing CP, more so than financial and technological challenges (Selmoune et al., 2020). The Indian Government has set an ambitious goal of increasing shared mobility to 35% by 2035 (Bhandari et al., 2018), so exploring commuters' acceptability of CP schemes in India is timely and relevant. The methodological approach used in this study aims at investigating commuters' perception towards CP acceptability in the Indian context. Commuters' acceptability is significantly correlated with their attitude, belief, and perception regarding CP (Selmoune et al., 2020). A detailed analysis of car users' acceptability of CP and related attributes can help decision-makers design a CP scheme. The present study contributes to the literature on CP by exploring commuters' attitudes and perceptions in an Indian city. This investigation is done within the framework of discrete choice modelling and within the context of the Indian culture.

2. Attributes Affecting Congestion Pricing Acceptability

Understanding user perceptions is critical for evaluating the acceptability of any scheme such as CP. In this section, we review the existing literature to identify the factors likely to affect CP acceptability. Several scientific databases were used to identify the relevant literature. The databases Scopus, ISI Web of Knowledge, and Google Scholar were used in combination to identify academic papers published in peer-reviewed journals, books, conference proceedings, and government and grey-literature reports. Reference lists from key papers were cross-checked for further referencing. Different combinations of the following keywords were used: congestion pricing, road pricing, road tolls, HOT lanes, traffic congestion, and congestion pricing acceptability. Over 30 papers and reports were reviewed with a focus on CP policy, implementation, and acceptability.

There are a number of factors likely to affect CP acceptability. From the existing literature, it is clear that socio-economic characteristics have an impact on CP acceptability. In addition, Gu et al. (2018) argue that four important factors are privacy concerns, equity considerations, the complexity of the system, and the uncertainty linked to it. Finally, cultural aspects may impact CP acceptability too. A brief discussion of each of these factors is provided below.

(i) *Socio-demographic characteristics:* Socio-demographic attributes like annual income, age, education qualifications, and residence location directly impact the acceptability of CP schemes. People from higher-income groups are more willing to accept CP than people from lower-income groups (Sun et al., 2016). Also, people aged 55 or over are more reluctant to accept CP than younger people (Jaensirisak et al., 2005). People with fewer years of education tend to oppose

the idea of CP more than people with more years of education (Odeck and Kjerkreit, 2010). Residential location is also expected to impact acceptability for obvious reasons: those who live in an area which is exempt from paying the charge, or which benefits from discounts, yet enjoys the benefits from reduced congestion, are likely to support CP, whereas those who live in areas that will not get exemptions or discounts, and usually drive to work and will be liable to pay the charge, are likely to oppose CP. This was the case in London (Santos, 2008), for example.

(ii) *Perceived benefits:* The benefits (motivators) from CP can be large, but often road users in general and commuters in particular, do not perceive these benefits as important, especially before they actually experience them. In Edinburgh and Manchester, drivers voted against the plans for CP and disregarded the benefits that CP would bring. The main benefit from CP is reduced congestion, with a consequent reduction in delays and travel times. In addition, as long as vehicles continue to run mainly on fossil fuels, CP can reduce air pollution and GHG emissions. The revenues can be used to improve public transport coverage, frequency, reliability, and comfort, which can benefit non-drivers. Once CP is implemented either on a trial or permanent basis, road users get to experience these benefits, and commuters acceptability tends to increase. This indeed was the case in London (Koh et al., 2010), Stockholm (Börjesson et al., 2012) and Gothenburg (Hansla et al., 2017).

(iii) *Privacy issues:* Enforcing the payment of a congestion charge requires the recording of the violation. For example, if Automatic Number Plate Recognition is used, then traffic cameras record the license plate numbers of the vehicles that should be paying the charge and send them to a processing center, where they are matched against the license plate numbers of the vehicles that have paid the charge. When they cannot be matched, the violator is fined. Importantly there is a record of the thereabouts of the vehicle at that point in time. This tracking of vehicles can be seen as an invasion of privacy. The CP trial in Hong Kong in the 1980s used now outdated technology, radio-frequency communications. Enforcement was through closed-circuit television, and the idea of this electronic monitoring was perceived as an invasion of privacy (Small and Gómez-Ibáñez, 1997). As already explained above, in the case of Hong Kong, this was a major obstacle, probably exacerbated by the fact that the trials took place at a time when the decision to hand Hong Kong over to China as a Special Administrative Region was very recent (Hau, 1990).

(iv) *Equity issues:* Equity refers to the degree of fairness associated with the scheme. Suppose the same charge is applied uniformly regardless of individual incomes. In that case, it is, in principle, regressive because it imposes a burden that represents a higher fraction of income for those on lower incomes. There are a number of ways in which this negative distributional impact can be reverted, including but not limited to rebates, exemptions, and discounts, and subsidized/free public transport for lower-income groups. Other negative distributional impacts may accrue to disabled individuals. However, all the CP schemes in operation cater for disabled individuals, typically with exemptions.

(v) *Scheme complexity:* A complex CP scheme may be so complex that it may be confusing for users. This complexity may make it less acceptable. For example, the proposals in Edinburgh and Manchester entailed double cordons, which may have been perceived as a complex system and may have been partly responsible for the referendum results (Hensher and Li, 2013).

(vi) *Uncertainty issues:* While introducing strategies like pricing schemes, we often experience commuters' opposition. The uncertainty associated with CP is responsible for the deficiency in commuters' support. They usually prefer the status quo over newer pricing schemes, precisely when no trials are executed (Samuelson and Zeckhauser, 1988). Following (Hensher and Li, 2013), uncertainty was categorized into two types: (a) uncertainty in efficiently utilizing toll revenue by politicians, (b) uncertainty associated with willingness to pay (WTP) of a user for car trips. De Borger and Proost (2012) found that individuals' uncertainty regarding WTP for car trips and uncertainty about using toll revenue by politicians had adverse effects and resulted in the scheme's rejection. In Edinburgh, the scheme was rejected mainly due to the commuters' misunderstanding (Gaunt et al., 2007). It was also found that citizens with incomplete

information about congestion charging would likely reject it 2.14 times than well-informed ones. Thus, creating public awareness is critical for successfully implementing the scheme, which can be achieved by conducting trials (Odeck and Kjerkreit, 2010).

(vii) *Culture*: In general, culture influences human behaviours in many aspects (Disli et al., 2016). Hofstede (2001) explained six dimensions of culture across the nation: 1) Power Distance Index (PDI) is the extent to which the less powerful members of an institution and organization within a country expect and accept that power is equally distributed 2) Individualism Index (IND) - the degree of interdependence, a society maintains among its members 3) Uncertainty Avoidance Index (UAI)-the extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid these, 4) Masculinity Index (MAS)- is the wanting for the best over liking what you do 5) Long-term orientation (LTO)- is how a society maintains some links with its past while dealing with the challenges of the present and future, and 6) Indulgence versus Restraint index (IVR)- is the extent to which people try to control their desires and impulses. These cultural aspects are useful in explaining various socio-economic issues and are used in social science, environmental, and economic studies. However, limited studies tried to understand the role of culture in CP acceptability (Nikitas et al., 2018; Schmöcker et al., 2012). Nikitas et al. (2018) evaluated the role of older age, social norms, pro-social values, and trust for urban policy-making in understanding the commuters' acceptability of road pricing. Schmöcker et al. (2012) investigated the impact of history and culture on CP in London. However, to the best of our knowledge, no study reported the influence of culture in determining CP acceptability in cities, where CP is yet to be implemented. The influence of cultural dimensions (PDI, IVR, LTO, MAS, IND and UAI) on the success of CP is discussed below.

- **Power Distance Index and Indulgence versus Restraint index**

  Income is found to be influencing the PDI and IVR indices of a country (Disli et al., 2016). India has a high PDI index of 77 on a scale of 100 compared to Sweden's 31, where the CP was a success. Thus, it can be inferred that the high value of PDI has a negative impact on the CP acceptability (e.g., Hong Kong's PDI is 68, and the scheme was a failure). The IVR has a positive relationship with the CP acceptability; the higher IVR values mean higher acceptability (e.g., Sweden (78), Australia (71), and Finland (57)). IVR of 17 can be attributed to the failure of CP in Hong Kong. However, income influences the acceptability of any pricing scheme up to a threshold value, beyond which the effect of income is negligible (Liu and Zheng, 2013). As most of the Indian population is in the middle- and low-income groups, suitable measures like equitable pricing, concessionary passes for public transit users, and free ride for differently-abled commuters need to be explored.

- **Long-term orientation**

  Higher population age increases the LTO index of a country. The nation with a higher percentage of the elderly population (e.g., Hong Kong has a high LTO value of 61 on a scale of 100) has a lesser chance of CP acceptability. A higher LTO value could be a possible reason for the scheme's rejection in Hong Kong, as the elderly population tries to maintain links with the past while dealing with the challenges in the present. As the LTO index of India is in the moderate range (51) and is similar to the nation where CP is successful, the Age and LTO don't seem to be the barriers to the successful implementation of the scheme.

- **Individualism Index, Uncertainty Avoidance Index, and Masculinity Index**

  The level of education plays an important role in the successful implementation of CP. Higher the education level, the likelihood of accepting CP increases. Thus, education-oriented policies can play an instrumental role in successfully implementing the scheme in the future. Education influences the MAS and UAI of a nation; the higher the literacy rate lower will be the MAS index, and the higher will be the UAI (Hofstede, 2021). The masculinity index of India (56) is very high as compared to Sweden (5) and Finland (22). Also, the UAI of India (40) is very low as compared to Greece (100) and Finland (59). The recent policies of the Government of India, such as "Beti Bachao, Beti Padhao Yojan," and "Sarva Shiksha Abhiyan," are implemented to promote the need for education for a better quality of life and to increase the literacy rate of the country. IND index of India (48) is in the moderate range. Thus, the inhabitants have both collectivistic and Individualist traits, which can also be increased by the increase in literacy rate and indirectly help in the successful implementation of the scheme.

Most of the past studies were conducted in cities where CP is previously implemented, and privacy, equity, scheme complexity was assessed from users' perception. However, as the scheme is at its' nascent stage in India, analyzing commuters' perception towards implementing CP needs to be investigated. This research carries out an in-depth study on the commuters acceptability of CP schemes in India. The study is amid at addressing the following primary research questions.

1. How does an urban car user's socio-economic characteristics such as age, annual income, level of education, and vehicle ownership influence CP acceptance?
2. Do perceived benefits (motivators) associated with CP such as congestion reduction, travel time reduction, environmental improvement, and road safety improvement influence CP acceptance?

3. Methodology

The study methodology consists of four components: 1) questionnaire design, 2) data collection and database development, 3) analysis, and 4) policy recommendations. After identifying the various attributes from the literature, an open-end discussion with the experts was done, and a travel behaviour questionnaire was designed to elicit users' perception towards CP, and CP's perceived benefits, using a five-point Likert scale. Face-to-face interviews were conducted using the structured questionnaire. As the structured interviewing methods are quantitative, being both interviewer and interviewee face to face, it brings another dimension to the research. The interviewer can steer or emphasise or explain the certain areas which would be misunderstood or left blank. Also, prior to the data collection a pilot survey was conducted both to finalise and to check the comprehensibility and readability of the questionnaire by the commuters.

3.1. Questionnaire Design

The questionnaire was designed to conduct face-to-face interviews to elicit the respondents' willingness to accept a CP scheme in Hyderabad. The questionnaire was divided into four sections; section A was about the respondents' socio-demographic characteristics. Section B was about the travel-related attributes of the respondents. Section C was intended to elicit respondents' agreement on various perceived benefits (motivators) of implementing a CP scheme. The level of agreement was measured on a five-point Likert scale. Finally, Section D captured the respondents' willingness to accept a CP scheme in Hyderabad city. Table 1 presents the summary of the designed questionnaire.

3.2. Data Collection

Car users in Hyderabad were considered as the target population. Hyderabad, the Telangana State's capital city - acts as the state's political, manufacturing, and commercial hub (Das, 2015). Hyderabad, with a population of about 7.7 million (The Census of India, 2011), projected to rise further to about 19 million by 2041(World Bank, 2019), has become one of India's fastest-growing metropolises. At present, 5.8 million vehicles are plying on the roads of Hyderabad, and every day 1000 new vehicles are being registered in the city (Sunny, 2019). Rather than curb the traffic on roads, the emphasis has been on managing vehicular traffic by widening the roads and constructing flyovers in Hyderabad. Hence, Hyderabad is an ideal candidate city for understanding commuters' perception towards such schemes and implement CP such that urban commuters' quality of life could be improved.

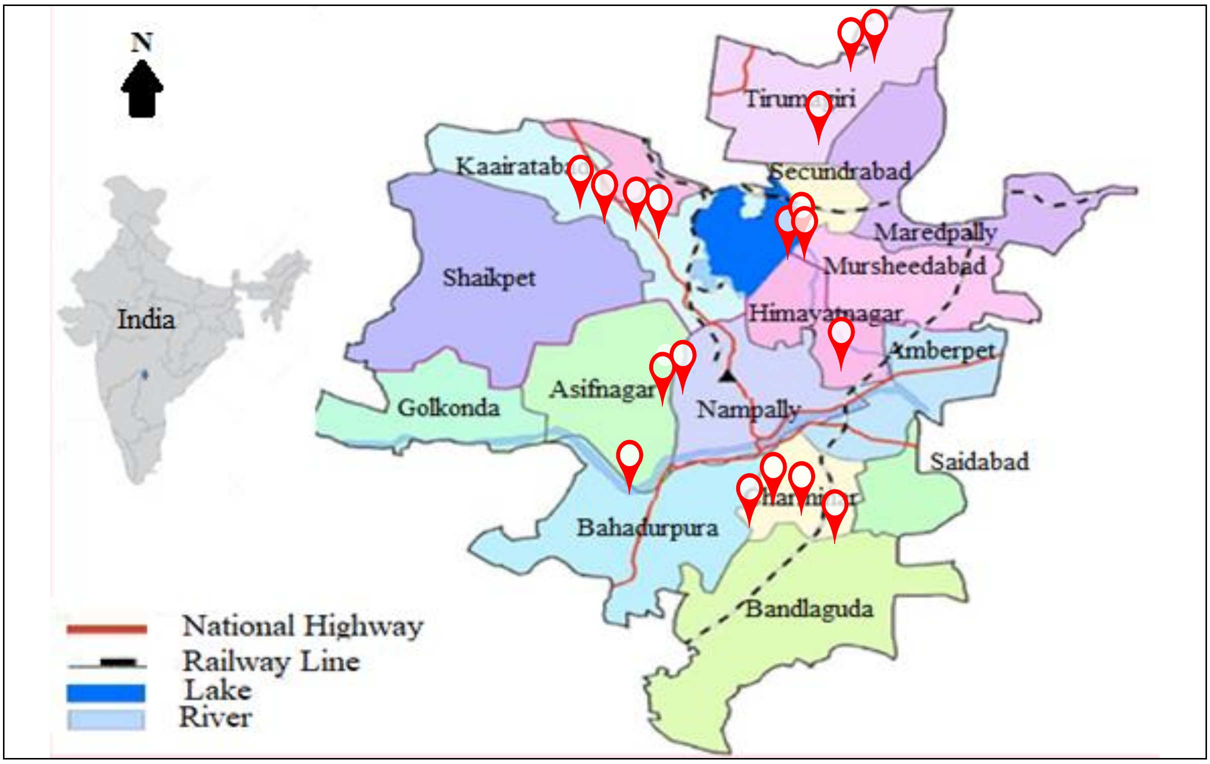

Figure 1 Identified Locations for Data collection across Hyderabad city

The researchers trained a group of interviewers for the collection of data. They were stationed at the identified centres such as workplaces, shopping malls, schools, universities, and marketplaces to intercept the survey respondents. A reconnaissance survey was conducted in Hyderabad to identify locations with a significant number of car commuters within the city limits. Then, 18 central locations spread throughout the CBD areas of the city's different zones were chosen as data collection points as shown in Figure 1. A team of interviewers and researchers were then deployed at those locations from 09:00 am to 05:00 pm during weekends at recreational centres and for only weekdays at other sites to capture car users' perceptions. For each complete response, the interview took approximately 15 to 18 minutes. During the data collection, nearly 1200 car users were approached for the survey, with 588 complete survey responses received from various locations around Hyderabad. Some of the reported responses lacked some information, and some respondents' socio-economic data were missing or contradict with the other information provided. Both such incomplete responses were discarded, and a total of 435 complete valid responses were eventually used for further study.

Table 1 Attributes Summary

Variable details	Description	Categories
Gender	Sex of respondent (Male, Female)	M = 0, F = 1
Age (AGE)	Age of the respondent in Years	Base: 18-30 years Dummy coded: 0,1 :31-40 years : 41-50 years : ≥ 51 years
Annual Income (ANN_IN)	Annual income (INR) of Respondent (1 INR = 0.012 Euro)	0: Up to 0.5 million (£5784) 1: > 0.5 million
Vehicle Ownership (VEH_OWN)	Number of vehicles owned by the respondent (4W-Only)	0,1,2,3…
Trip Length (TP_LN)	Average distance travelled per revenue-generating trip	0: ≤20km 1: >20km
CP Choice (CHOICE)	Considering CP is implemented, would you accept it and drive in the priced route (1), or would you opt-in for public transport (0) or an alternative route (0)?	0: No 1: Yes
Shift in Starting Journey Time (SFT_ST)	If CP is implemented, how likely would you change/shift your journey start time?	$1^*,2^*,3^*,4^*,5^*$
Travel Time Reduction (TT_RDN)	Degree to which respondents would agree that implementing CP would minimize travel time (Eliasson et al., 2009)	$1^*,2^*,3^*,4^*,5^*$
Public Transport Satisfaction (PT_SFT)	Degree to which respondents are satisfied with the existing transport system in their city (Hugosson and Jonas, 2006)	$1^*,2^*,3^*,4^*,5^*$
Improvement in Environment (ENV_IMP)	Degree to which respondents would agree that implementing CP would reduce GHG emissions (Eriksson et al., 2006)	$1^{**},2^{**},3^{**},4^{**},5^{**}$
Improvement in Road Safety (RS_IMP)	Degree to which respondents would agree that implementing CP would enhance road safety standards (Di Ciommo et al., 2013)	$1^{**},2^{**},3^{**},4^{**},5^{**}$
Congestion Reduction (CON_RDC)	Degree to which respondents would agree that implementing CP would minimize traffic congestion (Di Ciommo et al., 2013)	$1^*,2^*,3^*,4^*,5^*$
CP acceptability (CP_ACCP)	How likely are you to accept CP?	$1^*,2^*,3^*,4^*,5^*$

1^*: Very Unlikely, 2^*: Unlikely, 3^*: Neutral, 4^*: Likely, 5^*: Very Likely | 1^{**}: Strongly Disagree, 2^{**}: Disagree, 3^{**}: Neutral, 4^{**}: Agree, 5^{**} Strongly Agree

4. Analytical Approach

Following an exploratory analysis of the data, we examined potential associations between commuters' acceptance of CP and socio-economic characteristics and their perceptions. The examination was carried out in two stages: a) evaluation of commuters' acceptability of CP, and b) investigation of role of the major motivators influencing the successful implementation of CP. The survey responses were collected on a five-point Likert scale, thus yielding an ordinal data-set. First, user perception towards the acceptability of CP is assessed using the binary logit model. Further, probit models are used to analyze the role of major motivators of CP implementation (Hensher and Li, 2013; Zheng et al., 2014).

4.1. Evaluation of Congestion Pricing Acceptability

Commuters acceptability towards CP was investigated using binary logit model. The acceptability of CP *(CHOICE)* is considered a binary variable, where acceptability is coded as 1, and 0 for the CP's rejection (use of public transport or alternative route). The Binary logit model coefficient estimation was done using the econometric software NLOGIT version 6.

4.2. Investigation of Role of Major Motivators

Ordered Probit (OP) modelling technique was used for investigating the role of major motivators of CP. OP model is a widely used approach employing the probit link function. Our (ordinal) dependent variable was CP acceptability level, denoted CP_ACCP, and our independent variables were the major motivators of CP, i.e., congestion reduction, environmental improvement, travel time reduction, and public transport improvement. CP acceptability level was evaluated on a five-point Likert scale, where 1 indicates strong opposition and 5 indicates strong support towards the CP scheme.

5. Results

5.1. Descriptive Analysis of the Data

Based on the survey, a total of 435 valid responses were obtained from a total sample of 588 complete responses. The collected data's descriptive statistics show gender distribution with 53.5% male and 46.5% female respondents. Descriptive analysis of the respondents' age indicates that about 14% were between 18 to 30 years, 37% belonged to the age group of 31-40 years, 27% in 41-50, and 22% of respondents aged above 50 years. 58% of the respondents were married, and 42% were unmarried, respectively. Around 32% of respondents had education level up to or below high school, 23% of the respondents had up to intermediate level, 31% had a graduate degree, and 14% had post-graduation or above. The socio-economic attributes of the survey sample show that from the total respondents, 45% had an annual income up to 5 Lakhs, 27% had an income of 5-10 lakhs, and the remaining 28% were earning more than 10 Lakhs. Also, around 58% of the sample commute less than 20km on a daily basis, and the remaining 42% travel more than 20km to reach their preferred destination.

The Census of India (2011) doesn't provide any information about car users' socio-economic profiles in Hyderabad. As a result, the sample representativeness cannot be determined explicitly. However, the study population is compared to census-based Hyderabad population statistics for a better understanding and is provided in Table 2 (Directorate of Economics and Statistics, 2017). There are two possible explanations for the disproportion between the survey and the city profile. To begin with, the city characteristics do not only apply to car owners only, but to all the inhabitants. Second, among the non-responsive samples, there were a large number of elder commuters (over 50 years of age) who were less interested in being interviewed by the research team. Also, people under the age of 18 years were not included in the study. As a result, the surveys were observed to be biased against respondents in their 30s and 50s. Other socio-economic and trip features could not be compared because additional socio-economic information was not included in the census results. However, as opposed to the minimum sample size (385) needed for accurately representing an infinite or undefined population, this study's final comprehensive sample size (435) was found to be substantially greater. The minimum sample size needed for an infinite population-based analysis in this study, assuming a 95% confidence level, is expected to be 385 (Taherdoost, 2017). As a result, the sample size obtained in this analysis was also considered to be acceptable. Table 2 shows a summary statistic for the sample examined, and Figure 2 shows critical attributes major motivators response distribution.

Table 2 Sample summary statistics vs. Hyderabad population (n=435).

Respondents Characteristics	Category	Sample Size	Sample Percentage, %	Population Statistics of Hyderabad
Gender	Male (0)	233	53.5	51.2
	Female (1)	202	46.5	48.8
Age	18-30 Years	87	14	20
	31-40 Years	135	37	15
	41-50 Years	117	27	11
	≥ 51 Years	96	22	13
Marital Status	Married	252	58	53.6
	Unmarried	183	42	46.4
Education	Intermediate or lower (0)	231	53	NA
	Graduate or above (1)	204	47	NA
Income	Up to 0.5 million (0)	196	45	NA
	≥ 0.5 million (1)	239	55	NA
Trip Length	< 20km (0)	243	58	NA
	>20km (1)	192	42	NA
Vehicle Ownership	No Vehicle (0)	70	16	NA
	1 Car (1)	72	16.5	NA
	2 Cars (2)	169	39	NA
	2 Cars and 1 Two-wheeler (3)	124	28.5	NA
CP Acceptability	Acceptance (1)	184	42.3	NA
	Rejection (0)	251	57.7	NA
CP Acceptance Level	1- very unlikely	81	18.6	NA
	2- unlikely	157	36.1	NA
	3- Neutral	28	6.4	NA
	4- Likely	120	27.6	NA
	5- very likely	49	11.3	NA

NA- Not Available

As shown in Figure 2, most of the respondents agreed (40% strongly agree and 18% agree) with the statement that implementing CP could reduce congestion in Hyderabad city. The same was the case with improvement in environmental conditions. Around 30% of the respondents strongly agreed, and 10% agreed that CP implementation would improve the environmental conditions. It was also observed that about 26% of respondents strongly agreed, and about 16% agreed that CP implementation would improve road safety. And about 45% of the respondents agreed that implementing CP will reduce travel time.

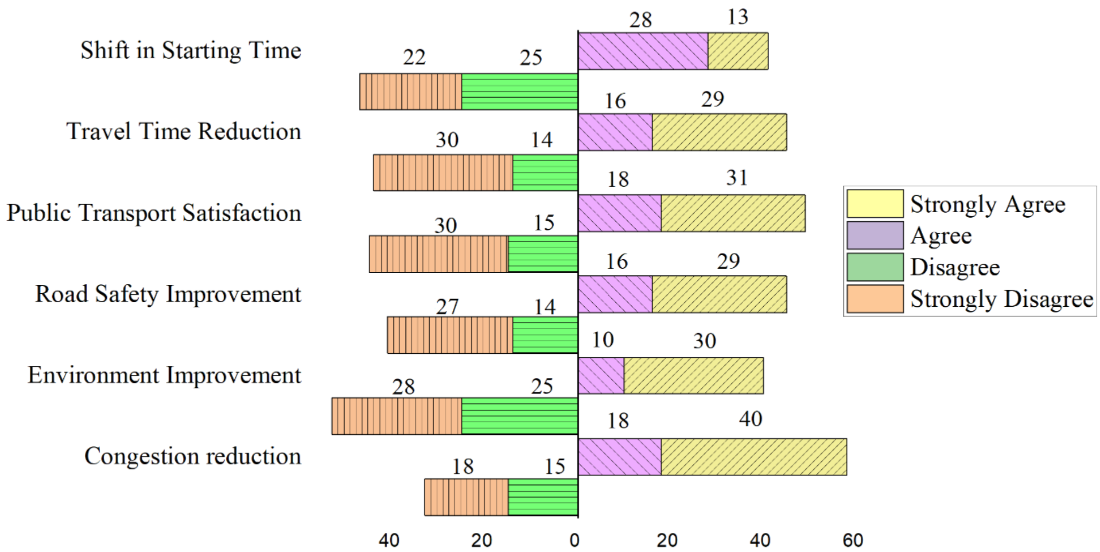

Figure 2 Descriptive Summary of Major Motivators of CP Acceptance

5.2. Congestion Pricing Acceptability

The estimated parameters obtained from the logistic regression model (accept vs. non-accept CP) are presented in Table 3. Overall, the goodness-of-fit of the models is good, as shown from the *McFadden Pseudo R-squared* value (0.489). Several models were developed, but Table 3 presents the model with the best fit.

Table 3 CP Acceptability

Variable	Coefficient	Standard Error	*p* – value	95% Confidence Interval	
CONSTANT	-1.141	0.589	0.053	-2.296	0.014
Age between 18-30	Reference	-	-	-	-
Age between 31-40	-1.596	0.251	0.000	-2.088	-1.104
Age between 41-50	0.772	0.237	0.001	0.307	1.235
Age ≥ 51	0.825	0.224	0.000	0.385	1.264
Annual Income	0.603	0.140	0.000	0.328	0.876
Level of Education	0.869	0.146	0.000	0.582	1.156
Vehicle Ownership	-0.415	0.142	0.003	-0.693	-0.137
Trip Length	-0.468	0.104	0.000	-0.672	-0.263
McFadden Pseudo R-squared	*0.489*				

The variables presented in the model have a statistical significance of 90% confidence level or higher. *Annual income* higher than five lakhs has a positive association with commuters' acceptability, i.e., all else being equal. The higher the respondent's level of *annual income*, the higher the support towards a CP scheme which is in line with previous findings (Rentziou et al., 2011). They also found that higher-income people consider CP as an effective measure to reduce congestion. A negative sign of the Age between 31-40 years means that this particular age cohort has a negative impact on the scheme's acceptability, which implies that respondents of this specific age group are more likely to reject the scheme. While as in other age cohorts, the positive sign shows a positive impact on CP's acceptability. The results show that respondents are more likely to accept CP in these particular age cohorts, thus increasing the overall probability of acceptability towards CP. Rentziou et al. (2011) also found that respondents from the younger age group consider roadway expansion as an effective measure other than CP. Also, *vehicle ownership* is negatively associated with the scheme acceptability, i.e., individuals living in households with a higher number of cars were less likely to accept CP. Harrington et al. (2001) also found that the households with a higher number of vehicles feel that implementation of CP will hurt them. Respondents with higher education qualifications are more likely to accept CP. Coef. *0.869 for the level of education (p-value 0.000)* highest in the model shows that education level is an essential attribute in accepting CP. Zheng et al. (2014) also found that respondents with higher educational qualifications show more support towards CP than Australia's lower academic qualifications counterpart. Finally, gender was insignificant; thus, the attribute was dropped in the final developed model. Sensitivity analysis was conducted for the binary logit model, and the results are discussed in section 5.3.

5.3. Congestion Pricing Acceptability Sensitivity Analysis

Results of sensitivity analysis of CP acceptability model represent the influence of the socio-economic variables by car users in Hyderabad. Seven different binary models were estimated for sensitivity analysis. The models were estimated by removing each variable sequentially, and the coefficient estimates associated with other parameters were calculated. Results of the sensitivity analysis are presented in Table 4.

McFadden Pseudo R-squared value is *0.401* for the model estimated without *'AGE_31'*, which means that this particular attribute plays a vital role in overall model prediction as compared to other age groups. From the other developed models, the binary logit model estimated without *education (EDUC)* has a *McFadden Pseudo R-squared* value of *0.418*. Therefore, the omission of *education (EDUC)* also affects the model's prediction compared to the base binary logit model. Vehicle ownership was also seen to play an essential role as the model developed without including *vehicle ownership* (*VEH_OWN)* was found to have a *McFadden Pseudo R-squared* of 0.436. All other models developed had a slight variation in the goodness of fit when any of the other attributes dropped, which means that omission of these attributes doesn't affect the model predictability.

Table 4 CP Acceptability Sensitivity Analysis

Variable	**Estimated model without Age_31-40**	**Estimated model without Age_41-50**	**Estimated model without Age_51+**	**Estimated model without ANN_IN**	**Estimated model without EDUC**	**Estimated model without VEH_OWN**	**Estimated model without TRP_LN**
	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)
CONSTANT	-1.770 (0.001)	-1.065 (0.027)	-1.267 (0.027)	-0.030 (0.952)	0.750 (0.108)	-1.779 (0.001)	-2.625 (0.000)
Age between 18-30	Reference	-	-	-	-	-	-
Age between 31-40	-	-1.155 (0.000)	-1.184 (0.000)	-1.65 (0.000)	-2.087 (0.000)	-1.5970 (0.000)	-1.674 (0.000)
Age between 41-50	-0.106 (0.561)	-	1.184 (0.000)	0.814 (0.000)	1.076 (0.000)	0.872 (0.000)	0.766 (0.000)
Age ≥ 51	0.106 (0.559)	1.156 (0.000)	-	0.832 (0.000)	1.011 (0.000)	0.726 (0.000)	0.909 (0.000)
Annual Income	0.543 (0.000)	0.621 (0.000)	0.603 (0.000)	-	0.656 (0.000)	0.609 (0.000)	0.639 (0.000)
Level of Education	1.156 (0.000)	0.956 (0.000)	0.946 (0.000)	0.905 (0.000)	-	0.840 (0.000)	0.866 (0.000)
Vehicle Ownership	-0.422 (0.001)	-0.479 (0.005)	-0.342 (0.013)	-0.430 (0.002)	-0.382 (0.004)	-	-0.415 (0.002)
Trip Length	-0.513 (0.000)	-0.468 (0.000)	-0.494 (0.000)	-0.496 (0.000)	-0.450 (0.000)	-0.475 (0.000)	-
McFadden Pseudo R-squared	0.409	0.470	0.465	0.455	0.418	0.436	0.453

5.4. Investigation of Role of Major Motivators

The estimated results of the ordered probit model are presented in Table 5. All estimated coefficients are significantly different than zero at 99% confidence level. A positive value for the coefficient of any attribute (motivator of CP) indicates that an increase in the attribute level increases the respondent's propensity to accept CP and vice versa. Results revealed that except '*shift in starting time'*, all other attributes were associated with positive coefficient estimates. This observation indicates that except for '*shift in starting time'*, an increase in all other attribute levels would positively influence the commuter's CP acceptability probability. A *McFadden Pseudo R-squared* of the O.P. model of *0.151* indicates a good model fit. The following section briefly discusses the results and key findings derived from the OP model.

Based on the OP results, perceived improvement in the road network's overall safety scenario due to the introduction of CP schemes would significantly increase the propensity to pay and drive among all identified benefits. Previous studies (Selmoune et al., 2020) also state that CP's implementation has reduced 23.8% of four-wheeler crashes in Milan, Italy. Such findings point towards devising suitable plans for introducing a CP scheme in a city such as Hyderabad, where on average, 300 fatal crashes occur in a calendar year (Hyderabad Traffic Police, 2020). Road safety improvement has a positive coefficient of *0.367*, I.e., with the unit increase in respondents' statements for improving road safety, the likelihood of acceptability for CP is more likely to increase.

Results also indicate that a higher level of *public transport satisfaction* (0.277) is positively associated with CP acceptability level. This finding suggests that individuals would accept the CP schemes in the presence of good public transport infrastructure. Similar observations were made by Schade and Schlag (2003). They found that improvements in public transit systems can contribute to the higher acceptability of such innovative road pricing schemes in an urban context. Other attributes such as reducing traffic congestion levels and reduced greenhouse gas emissions also have positive coefficients.

The positive responses can be attributed to the commuters' perceiving the policy to achieve its stated objectives efficiently. Out of these, the *reduction in traffic congestion* has a coefficient of (0.222). This finding agrees with Eriksson et al. (2006)'s conclusions, who stated that the acceptability rate increases if the commuters perceives the scheme to be an effective solution in minimizing congestion. Reduction in greenhouse gases has a coefficient of 0.211. This coefficient signifies that with an increase in respondents' level for the improvement in environment, acceptability for CP scheme is more likely to increase, and the results are in accordance with past studies (Wang et al., 2015). They stated that improvement in the environment is an important attribute. Reduced traffic congestion with clean air and enhanced safety needs to be promoted as the primary motivators for CP's successful implementation in Hyderabad - a city with an emerging economy, where the traffic level of service is expected to fall in the near future. The following section presents the marginal effect analysis estimation for a micro-level understanding of CP's perceived benefits (motivators).

Table 5 Result of Modelling Levels of CP Acceptance with Major Motivators

Variable	Coef.	Std. Error	*p*-value	95% CI	
				UB	LB
Constant	-1.345	0.503	0.007	-2.332	-0.357
Shift in Starting Time	-0.388	0.068	0.000	-0.523	-0.253
Travel Time Reduction	0.221	0.063	0.008	0.096	0.346
Public transport satisfaction	0.277	0.063	0.000	0.152	0.401
Environmental Improvement	0.211	0.059	0.004	0.094	0.328
Congestion Reduction	0.325	0.061	0.000	0.205	0.445
Road safety Improvement	0.367	0.067	0.000	0.234	0.500
Threshold Parameters for Index					
Mu (01)	2.231	0.109	0.000	2.016	2.445
Mu (02)	2.623	0.111	0.000	2.405	2.842
Mu (03)	4.752	0.182	0.000	4.395	5.110

McFadden Pseudo R-squared	*0.151*

5.5. Marginal Effects Estimation and Interpretation of Major Motivators

Several methods are developed to express the association between the attributes and the outcome from the logistic regression. One preferred technique is a marginal effect; it is the change in the probability of the outcome with the change in one unit of various attributes. In the case of continuous attributes, the change in the likelihood of outcome with the unit change in the attribute is the marginal effect. In the case of ordered attributes, the change in probability is the incremental effect.

To understand the impact of the change of the attributes' magnitude on each CP acceptability level, marginal effects are calculated for each attribute. A positive marginal effect indicates that an increase in the attribute's magnitude increases the likelihood of a respondent perceiving the respective category and vice versa. For example, a marginal effect of 4.75% for *public transport satisfaction* concerning the acceptability level-4 indicates that a unit increase in respondents' perception about *public transport satisfaction* will increase users' probability of accepting CP level-4 by 4.75%. The marginal effects result for different attributes are presented in Table 6 and are explained in the following section.

Table 6 Summary of Marginal Effects

Variable	**Marginal Effect (%)**				
	Level-1	Level-2	Level-3	Level-4	Level-5
Shift in Starting Time	3.95***	5.63***	-0.70**	-.6.7***	-2.26***
Travel Time Reduction	-2.26***	-3.22***	0.40**	3.80***	1.28***
Public transport satisfaction	-2.83***	-4.03***	0.50**	4.75***	1.61***
Environmental Improvement	-2.16***	-3.07***	0.38**	3.62***	1.22***
Congestion Reduction	-3.32***	-4.73***	0.59**	5.57***	1.89***
Road safety Improvement	-3.75***	-5.34***	0.66**	6.29***	2.13***

****99% significance level, **95% significance level, * 90% significance level*

(i) **Shift in Starting Time.** *Shift in starting time (SFT_ST)* was found to influence the respondents' perceived CP acceptability levels the most among all the attributes. The marginal effect analysis results concerning shift in staring time indicate that 1% increase on this attribute will result in a 3.96% increase of probability of respondent's perceiving level-1 and level-2 of CP acceptability by 5.64%. An increase of 1% in this attribute for the level-4 category will decrease the respondent's probability by 6.6%. Hence, it can be inferred that users would be less willing to pay and drive-by, shifting their journey start time. Holland and Watson (1987) also reported that many car commuters shifted their starting travel time to avoid the CP.

(ii) **Travel Time Reduction.** From the marginal effects, it can be seen that *travel time reduction (TT_RD)* reduces the probability of the respondent by 3.22% for level-2 and increases by 2.3% for the level-4 category of CP; that is if the travel time is reduced by a unit, the overall acceptability of scheme increases by 2.3% for level-4. Therefore, it can be inferred that the respondent's perception of *travel time reduction* will positively affect the scheme implementation and is in line with Bhatt et al.'s conclusions (2008). In general, the respondent would expect that the reduction in traffic volume due to CP would increase the traffic speed and reduce travel time.

(iii) **Environmental Importance.** *Environmental importance (ENV_IMP*) is one of the critical attributes and positively impacts the scheme's acceptability. From marginal effects, one-unit improvement in *ENV_IMP* will increase CP's acceptability by 3.62% for level-4. Respondents' perception of *environmental improvement* plays a vital role in the implementation of such schemes. Similar observations were also made by previous researchers (Zheng et al., 2014). Moreover, many researchers have argued that environmental concerns are the most important long-term benefit of CP.

(iv) **Congestion Reduction.** An increase in *Congestion reduction (CON_RDC)* attribute increases the respondent's probability for accepting the CP level-4 by 5.57%. This indicates that *congestion reduction* can be an instrumental attribute in the implementation of the CP scheme. Daniel and Bekka (2000) found that environmental improvement benefits are smaller than

congestion reduction benefits. Cain et al. (2005) found that all the age groups strongly support the congestion reduction as CP's perceived benefit (motivators).

(v) **Road Safety Improvement.** From the marginal effect analysis of *road safety improvement (RS_IMP)*, it can be observed that the probability of acceptability of CP level-4 increases by about 6.29% with improvement in road safety. The revenue generated can be utilized to improve the roads' safety concerns and level of service. From the results, it can be inferred that the attributes such as *road safety, environmental improvement*, and *travel time reduction* have an important influence on the respondent's perception of the CP implementation.

5.6. Sensitivity Analysis of Major Motivators

A sensitivity analysis of the ordered probit model is performed in this section to determine the impact of each attribute on model prediction accuracy. Sensitivity analysis is a modelling tool that determines how the outcome is affected based on the attributes' changes (Patil et al., 2021). The model is also referred to what-if model. And for the same, seven different models are estimated. One independent variable is excluded from each model, and the coefficients for other parameters and the threshold parameters are calculated. Results of the sensitivity analysis for the ordered probit model are summarised in Table 7.

Results show that the ordered probit model estimated without *Shift in starting time (SFT_ST)* has a *McFadden Pseudo R-squared* of 0.126. This suggests that the omission of *Shift in starting time (SFT_ST*) from the model would significantly impact its accuracy. The ordered probit model calculated without *ENV_IMP* has a *McFadden Pseudo R-squared* of 0.141, indicating that the model's prediction potential is important even without *ENV_IMP*. Therefore, the omission of Environmental Improvement (*ENV_IMP)* will slightly affect the model's prediction compared with the other attributes.

Table 7 Sensitivity Analysis of Ordered Probit Model

Variable	**Estimated model without SFT_ST**	**Estimated model without TT_RDN**	**Estimated model without PT_SFT**	**Estimated model without ENV_IMP**	**Estimated model without CON_RDC**	**Estimated model without RS_IMP**
	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)	Coef. (*p*-value)
Constant	-3.083 (0.000)	-0.664 (0.147)	-0.506 (0.269)	-0.797 (0.092)	-0.413 (0.373)	-0.344 (.454)
Shift in Starting Time	-	-0.412 (0.000)	-0.433 (0.000)	-0.398 (0.000)	-0.409 (0.000)	-0.426 (0.000)
Travel Time Reduction	0.259 (0.000)	-	0.229 (0.000)	0.226 (0.000)	0.236 (0.000)	0.212 (0.000)
Public transport satisfaction	0.333 (0.000)	0.283 (0.000)	-	0.281 (0.000)	0.269 (0.000)	0.319 (0.000)
Environmental Improvement	0.228 (0.000)	0.216 (0.003)	0.216 (0.000)	-	0.229 (0.000)	0.221 (0.000)
Congestion Reduction	0.348 (0.000)	0.334 (0.000)	0.318 (0.000)	0.337 (0.000)	-	0.334 (0.000)
Road safety Improvement	0.407 (0.000)	0.362 (0.000)	0.404 (0.000)	0.374 (0.000)	0.375 (0.0000)	-
Mu (01)	2.122***	2.19***	2.166***	2.183***	2.147***	2.145***
Mu (02)	2.489***	2.574***	2.543***	2.567***	2.516***	2.513***
Mu (03)	4.520***	4.672***	4.621***	4.671***	4.545***	4.542***
McFadden Pseudo R-squared	0.126	0.141	0.136	0.141	0.129	0.128

****99% significance level, **95% significance level, * 90% significance level*

6. Discussions

The coefficient estimates associated with various socio-economic factors and perceived benefits (motivators) obtained from the binary logit and the ordered probit model, respectively, are statistically significant for car users belonging to different socio-economic strata. This observation indicates substantial scope for introducing the CP scheme in India. The study models and the inferences from the modeling results are crucial inputs for assessing the perceived benefits (motivators) from CP's implementation. The following sub-section describes the effect of income on the CP acceptability.

6.1. Effect of income on CP acceptability

Mode choice is influenced by income and lower income groups are sensitive to travel cost (Papagiannakis et al., 2018). Thus, it is prudent to analyze the income effect on CP acceptability. However, due to the unavailability of income data of Indian car commuters, we could not able to verify the income inequality representativeness in the sample. Having said this, we attempted to understand how different income groups (refer Table 2) perceive the CP acceptability by developing two models for the two income groups. All the socioeconomic attributes of the respondents other than the income were employed in the model estimation. The results are presented in Table 8.

Table 8: CP Acceptability Models for Lower and Higher Income Groups

Variable	Lower Income (Up to ₹ 0.5 Million)	Higher Income (More than ₹ 0.5 Million)
Constant	-0.175	0.272
Age between 18-30	Reference	-
Age between 31-40	-1.525***	-1.521***
Age between 41-50	0.622*	0.918***
Age ≥ 51	0.904***	0.702**
Level of Education	0.817***	1.030***
Vehicle Ownership	-0.501**	-0.336*
Trip Length	-0.558***	-0.409***
McFadden Pseudo R-squared	0.437	0.441
****, **, * Significance at 1%, 5%, 10% level.*		

The commuters belonging to the age group of 41-50 years from the lower income are less likely to adopt the scheme as compared to the commuters belonging to the higher income group in the same age cohort. At the same time, commuters aged greater than 50 years are found to more likely accept the scheme from the lower-income group than the higher-income counterpart. No such difference was found in the acceptability of CP by commuters belonging to the age group of 31-40 years.

Vehicle ownership is influenced by income and is negatively associated with CP acceptability. Commuters with higher vehicle ownership from the lower-income group are more likely to reject the scheme than the higher-income counterpart. This finding indicates that commuters from lower-income groups are travel cost-sensitive and is in line with Papagiannakis et al. (2018).

6.2. Policy Level Implications

The results derived from Binary Logit, Ordered Probit, and the sensitivity analysis offers valuable insights towards the acceptance of CP by the Indian commuters. Most importantly, the transport planners and local planning bodies could use the research findings to introduce CP in Indian metropolitan cities. In this regard, a set of policy interventions are recommended towards the successful implementation of the CP in India.

1. It was found that highly educated car owners have a higher propensity to pay extra to avoid congested roads. Similar findings could also be observed in previous researches (Zheng et., al 2016). Therefore, the scheme could initially be introduced in areas with high-density car users with high educational qualifications, such as government office complexes, state-level administrative offices, and universities. Additionally, several awareness campaigns need to be

conducted before implementing such schemes for better market penetration through printed and electronic media.

2. It was observed that respondents with higher annual income are more interested in accepting CP compared to their counterparts. In line with our study, De Borger and Proost (2012) found that users with higher income will continue to drive and adopt the scheme quickly. They help generate the revenue that can be employed in improving public transport, and suitable financial incentives such as tax benefits and payback policies upon paying congestion charges may be implemented, enhancing the appeal of such pricing schemes. The lower-income users should also be benefited from the scheme, other than concessionary travel pass for using public transport, they must be priced equitably if they are car users. Furthermore, the policymakers may consider taxi drivers and other low-income car users while developing any such scheme. Users belonging to economically weaker sections can also indirectly benefit from the scheme. The extra revenue generated from CP can be used for the aforementioned public transport infrastructure improvement, such as introducing more buses, subsidizing the economically weaker section, and improving the bus system.
3. Formulation of pro-elderly car user's policy such as the provision of free accessible off-peak intra-city bus travel (Nikitas et al., 2018) and concessionary travel passes (Preston, 2008) would increase the probability of elderly car owners choosing to pay and drive during peak hours and shifting to public transport during off-peak hours. Furthermore, as Indian culture values collectivism over individuality, and is mostly influenced by elderly people, thus elderly people might promote the scheme if they see the benefits, which can be instrumental in implementing the scheme.
4. Higher vehicle ownership being negatively associated with pricing acceptability indicates that those with more than one vehicle would continue traveling on roads without pricing, leading to severely congested roads. In this regard, policies such as the recently adopted odd-even policy could be instrumental in a metropolitan like Hyderabad.
5. It is suggested to promote safety benefits perceived from pricing schemes while implementing CP. Siddique and Choudhury (2017) stated that the number of accidents in London decreased by 25% after implementing CP in 1992. The revenue generated from the scheme can be utilized for improving the safety scenario of the charged roadways. The present research found that Indian commuters are motivated by the perceived environmental benefits from the CP. The pro-environmental attitude in Indian culture may push the scheme, thereby enhancing the scheme's reach.

Apart from the above-mentioned policy-level interventions, introducing an easily understandable scheme could improve the commuters' acceptability levels. The masses often misunderstand complex pricing schemes, leading to the scheme's rejection (Vonk Noordegraaf et al., 2014). Finally, conducting trial runs at suitable locations before final implementation would help the government/policymakers gain long-term sustainable operation experiences.

7. Conclusions

This study has evaluated the association between various socio-economic attributes, the role of perceived benefits (motivators), and CP's acceptability by Indian car users. This study has also recommended a set of policy interventions. Based on the analysis and findings, the following concluding remarks can be made.

The coefficient estimates of the OP model and the related interpretations are crucial inputs for assessing the perceived benefits (motivators) from CP. There is a statistically significant association between t socio-economic factors and user acceptability. The study has developed a ranking of users' perceived benefits (motivators), which could be of use to Indian policymakers in Hyderabad. For example, following the study results, safe roads can be promoted as one of CP's significant benefits.

Moreover, the generated revenue could be utilized to improve the safety status by implementing several mitigation measures. Subsequently, the study findings also point towards formulating necessary policy measures to improve the city's overall public transport infrastructures. Such actions would be central to provide seamless, safe, and sustainable transport options for the economically weaker sections throughout the day and economically affluent users during off-peak hours. Results indicate that users feel CP is a valuable tool to mitigate congestion in India. Therefore, it is recommended to introduce CP on a trial basis in some of the heavily congested roadways before implementing any other traffic demand management (TDM) tools. The study also presents a successful appreciation of binary logit and ordered probit model to evaluate the pricing behavior and user perception of CP motivators. Researchers working in a similar area could sequentially apply the method to test the similar hypothesis. The sensitivity analysis indicates a strong influence of model specification on CP's overall acceptability level. The omission of attributes such as education in the binary logit model and shift in starting time in the OP model has led to a substantial reduction in the goodness of fit. Such analysis is helpful to understand the role of different attributes on user perception theoretically. In this study, both models were developed with fixed parameter coefficients; however, model estimation concerning random parameters remains a future scope.

Apart from the above-mentioned concluding remarks, this study also makes a specific contribution in this particular field. This demonstrated methodology has explored and identified an important group of attributes influencing car users' perception and attitude towards CP in India. Due to substantial differences in socio-economic, demographic, and transport-related characteristics, attributes used or derived from past research in developed countries such as UK or Singapore cannot be directly used in the India. Hence, the attributes explored in this study can serve as a preliminary basis for introducing CP in India. Second, the methodology has been successful to examine the impact of socio-economic attributes on CP acceptance. Through which, a significant influence of socio-economic characteristics on CP acceptance was established. Such evidences strongly suggest that no CP implementation planning should be taken up without considering for socio-economic characteristics. Another key contribution of this study lies in the form of insights obtained through a sensitivity analysis of major motivators influencing CP acceptability levels. Findings derived from such analysis would help to understand on how car users might react to a specific motivator. The assessment of different attributes is particularly useful when only a certain motivators could be targeted while introducing CP.

Before closing, authors would like to state that due to the unavailability of socio-economic characteristics of car users in Hyderabad (India), the sample representativeness could not be checked in this study. However, analysis of a more extensive data set comprising data collected from more cities with different socio-demographic settings needs to be carried out in the future. Even though this study intended to develop a methodological structure for studying commuters' perceptions towards CP acceptability in Indian metropolitan cities, the findings were not tested for transferability to other cities. As a result, similar research may be conducted in other areas of the world to develop CP implementation guidelines. The study methodology and survey instrument can be applied to other cities not only in India but also elsewhere with comparable size and characteristics, with the findings acting as a baseline for comparison. It is specifically applicable for metropolitan cities trying to focus on CP as a useful TDM tool.

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