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Investigating the Potential Response to Congestion Pricing in Dhaka

ABU BAKKARSIDDIQUE, BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY,SOHAG024@GMAIL.COM

PROBIR KUMAR MONDAL, BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY,PROBIR06@GMAIL.COM

CHARISMA F. CHOUDHURY, BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY,CFC@ALUM.MIT.EDU

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Abu BakkarSiddique, Bangladesh University of Engineering and Technology, sohag024@gmail.com

Probir Kumar Mondal, Bangladesh University of Engineering and Technology, probir06@gmail.com

Charisma F. Choudhury, Bangladesh University of Engineering and Technology, cfc@alum.mit.edu

Abstract

Dhaka, the capital city of Bangladesh and the home of more than 15 million people, is subjected to severe traffic congestion on a regular basis resulting in lost productivity, fuel wastage, commuter frustration and environmental degradation. The problem is getting more acute day by day due to alarming increase in car usage. According to Bangladesh Road Transport Authority (BRTA, 2012), the number of registered private cars per year in Dhaka city has increased more than 400 percent within the last 6 years. Car restraint policies like congestion pricing can therefore substantially reduce traffic congestion, particularly during peak periods.

This paper investigates the potential response to congestion pricing in Dhaka using Stated Preference (SP) surveys where users are presented with hypothetical choice scenarios involving varying amounts of congestion charge, travel time savings and improved public transport options. Two case studies have been conducted in this regard focusing on shopping trips and commute and business trips respectively. Discrete choice models have been developed to model the sensitivity towards congestion pricing and to quantify the potential effectiveness of such measures in different contexts.

Introduction

Dhaka, the capital city and central business hub of Bangladesh, is expanding at an alarming rate. The current urbanization level is around 30 percent and it is expected to rise to 50 percent by the year 2050 (STP, 2005). The city, which already hosts more than 15 million people, is currently the 11th largest city in the world and currently attracts 300000 to 400000 new migrants every year from different parts of the country (The World Bank, 2007). To meet the mobility demands of the rapidly growing population, the number of vehicles is also increasing at an alarming rate. According to Bangladesh Road Transport Authority (BRTA), the number of newly registered vehicles in Dhaka in 2004 was 21471which has more than tripled by 2011 (Figure 1).

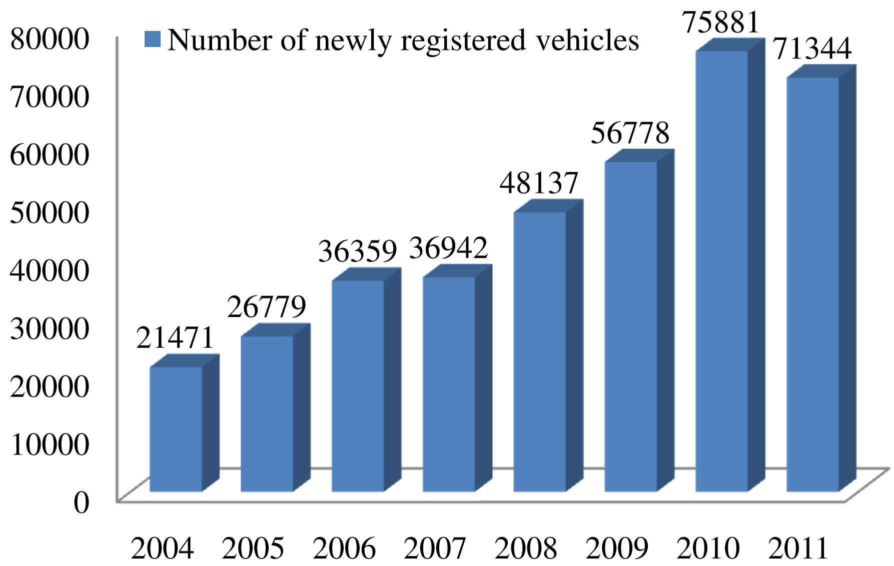


Figure 1- Year wise increase in newly registered vehicles in Dhaka (BRTA, 2012)

Private cars hold the predominant share (more than 50 percent) of these newly registered vehicles. According to BRTA, 127632 private vehicles (cars, jeeps and station wagons) have been registered in Dhaka city against 7696 buses and minibuses between 2004 and 2011 (Figure 2).Moreover, the occupancy rate of private vehicles is very low (reported to be 1.42 by Hasan, 2007) which is leading to very inefficient use of the road space. This tremendous growth rate in private cars and their low occupancy levels have led to increasing traffic congestion levels. A recent study by the Roads and Highways Department, Bangladesh has estimated that traffic congestion in Dhaka results a loss of 19,555 crore BDT[1]a year (The Daily Star, 2010) which is more than half the country's total annual development outlay and one fourth of the revenue collection target for that fiscal year. The study finds that about 3.2 million business hours are lost every day, which is about one hour per working people. Increasing the physical capacity is however a very difficult option for the city with its high ratio of built-up areas (estimated to be 70% in Bari, 2001) and financial constraints. Therefore the solution of the problem requires increasing the operational capacity through demand and supply management.

[1] 1 USD = 80 BDT

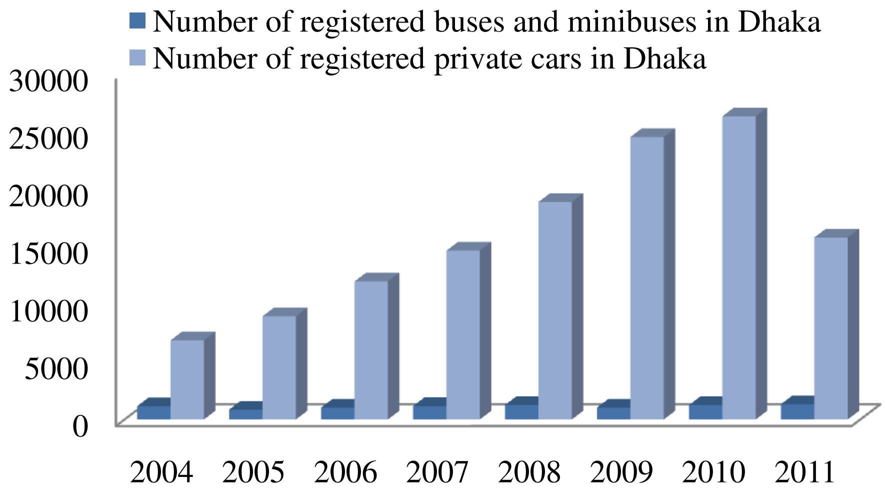


Figure 2-Comparison of the increase in number of cars and buses (BRTA, 2012)

Congestion pricing has emerged as one of the most effective regulatory measures against the severe traffic congestion problem in recent years which is already in effect in some countries of the world like Singapore (1975),Rome (2001), London (2003), Stockholm (2006), Milan (2008) etc.

Singapore introduced the world's first urban road pricing as an Area Licensing Scheme in 1975 which was upgraded to Electronic Road Pricing (ERP) in 1998.The results of the congestion pricing in 1992 showed that traffic entering the Central Business District (CBD) in the morning peak was about half the level before the scheme was introduced 17 years earlier and speeds had increased by 20% as well as accidents had fallen by 25% (May, 2003). Moreover, Public transport's share for working trips increased from 33% in 1974 to 67% in 1992. The conversion of the Area License Scheme to the ERP in 1998 by The Land Transport Authority (LTA) in Singapore to overcome the adverse impact of the manual charging resulted in more reduction (10-15%) in the traffic volume in the CBD.

London is another example of those countries that enjoying the benefit of congestion pricing. According to the Transport for London (TfL, 2004) after introducing the congestion pricing in February 2003, London has got the advantage of immediate reduction of 24,700 cars during peak hours and rise of traffic speed by 22%. The traffic in the congestion priced zone of 21 km^2 was reduced by 16% (30% for cars) with an increase of bus and cycle traffic and ultimately resulted into a 32% reduction in congestion measured in terms of delay per kilometre(TfL, 2004). Moreover, the number of car trips was shifted to the public transport by 50-70% (Quddus et al., 2007).

Stockholm has experienced 25 % reduction in traffic volume and 30-50% reduction in queue time after the implementation of this measure (City of Stockholm Traffic Administration, 2009; Borjesson et al. 2010).Tehran, the only developing country in the world who established traffic restricted zone to ease the traffic congestion in CBD in 1979 and have introduced Automatic Number Plate Recognition (ANPR) based traffic congestion pricing system to make it efficient in April,2010,is also getting the benefit of controlled congestion and reduced air pollution due to reduced private car usage (T.T.C.Co.,2012). From the international experience regarding congestion pricing, it is expected that this regulatory measure can be an effective solution to the chronic congestion problem in Dhaka. However, similar to experience of other developing countries (Mahendra, 2008), the difficulties associated with implementation of congestion pricing includes the lack of alternatives to the use of private vehicles and lack of public acceptance for the idea of paying a charge for personal mobility. This has motivated this research where we have investigated the effectiveness of congestion pricing for two major types of trip: commute and business trip and shopping trip. For each type of trip, a separate case study has been carried out to quantify the potential response to congestion charging by executing Stated Preference (SP) surveys where users were presented with hypothetical choice scenarios involving varying amounts of congestion charge, travel time savings along with improved public transport options. Discrete choice models are then developed using the collected data.

It may be noted that though Dhaka is an old city (dating back to 16th century), very few travel demand models have been developed for the city so far. Among the previous models, Ahsan (1990), DITS (1993), Habib (2002), STP (2005), Hasan (2007), DHUTS (2010) and Enam (2010) are noteworthy. However, these models are either based on Revealed Preference (RP) data and/or focus on SP data with improved public transport options, and none of them have explored the potential response to congestion pricing or any other car restraint policy.
The rest of the paper is organized as follows: the overall data collection plan and descriptions of the case studies are presented first. Then the preliminary analysis of the collected data is presented next which is followed by the model framework and estimation results. The policy implications are discussed in the concluding section.

Data and Methodology

The effect of congestion pricing has been investigated in this research for two trip purposes: shopping trips and commute and business trips. Two separate case studies have been conducted in this regard among current car users using face-to-face interviews in car-parks. For shopping trips, a major shopping hub of the city, New Market with an area of more than 35 acres, has been selected. For commute and business trips, the congestion pricing scenario has been tested for the Motijheel Area, which is the central business district of the city containing an area of more than 120 acres and predominantly (93%) covered by commercial and office buildings. The locations are shown on Figure 3. In each case, initial surveys have been conducted to get an idea about the origin zones, current trip durations, costs and routes taken by the travellers. These have been used to construct the congestion charging scenarios and formulate the available alternatives in the SP scenarios. Travel times and costs (congestion charges) are varied for private cars in the SP scenarios for each case study. Since the concept of congestion charge is new to the respondents (and need detailed explanation), the number of SP scenarios per respondent has been limited to two. The details of the survey design and data collection exercise for the two locations are presented below.

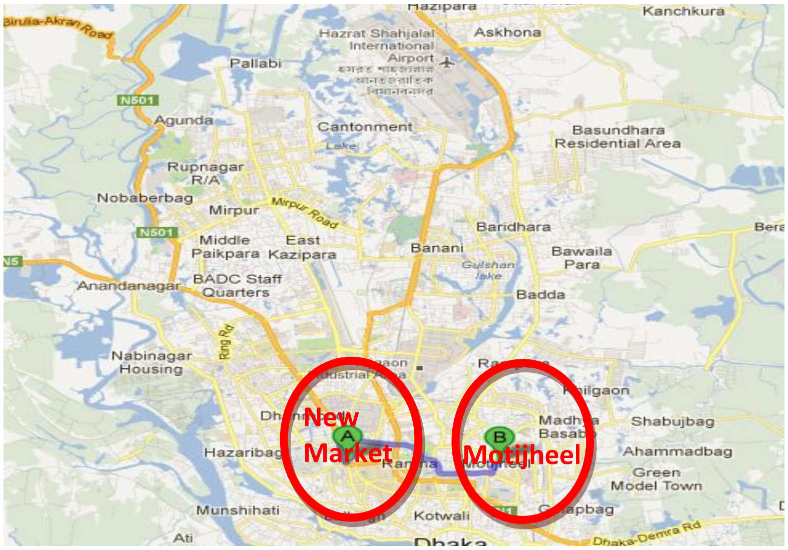


Figure 3- Location of case studies

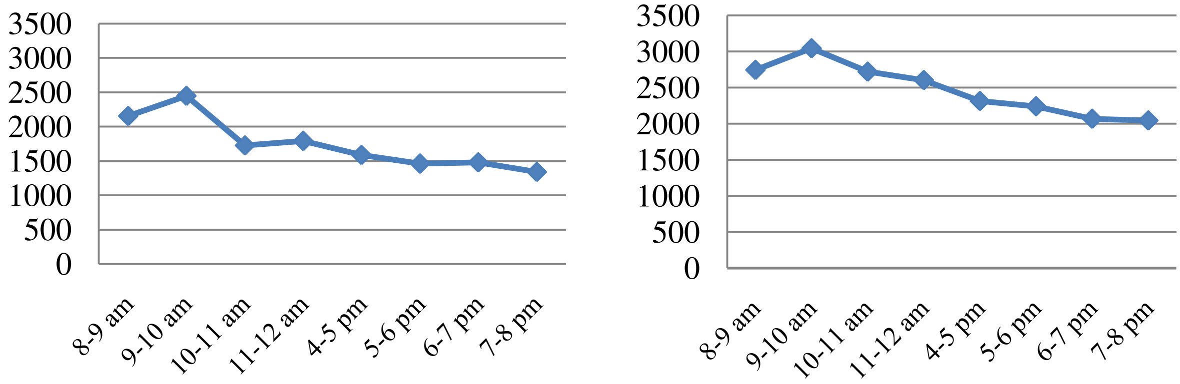
Case Study I: Shopping Trips

The New Market region, which is major shopping hub of the city and a major traffic bottleneck, has been selected for testing the potential response to implement congestion charging in the context of shopping trips. The SP survey has been conducted among shoppers travelling by car using face-to-face interview technique. The alternative modes presented to the respondents in this case included the following:

- Car (with congestion charge)
- Improved Bus (with improved frequency, accessibility, cleanliness, safety and reliability)
- Park-and-Ride

In order to construct the most effective schedule of the congestion charging, the traffic flow in the region was explored first using hourly traffic counts in the main access links to the area (DHUTS 2010). As seen in Figure 4, the traffic flow in the region does not have distinct peaks and congestion in the access links (which have three effective lanes each) persists from 8am-8pm. Therefore, the option of changing time of travel has not been included in the choice set.

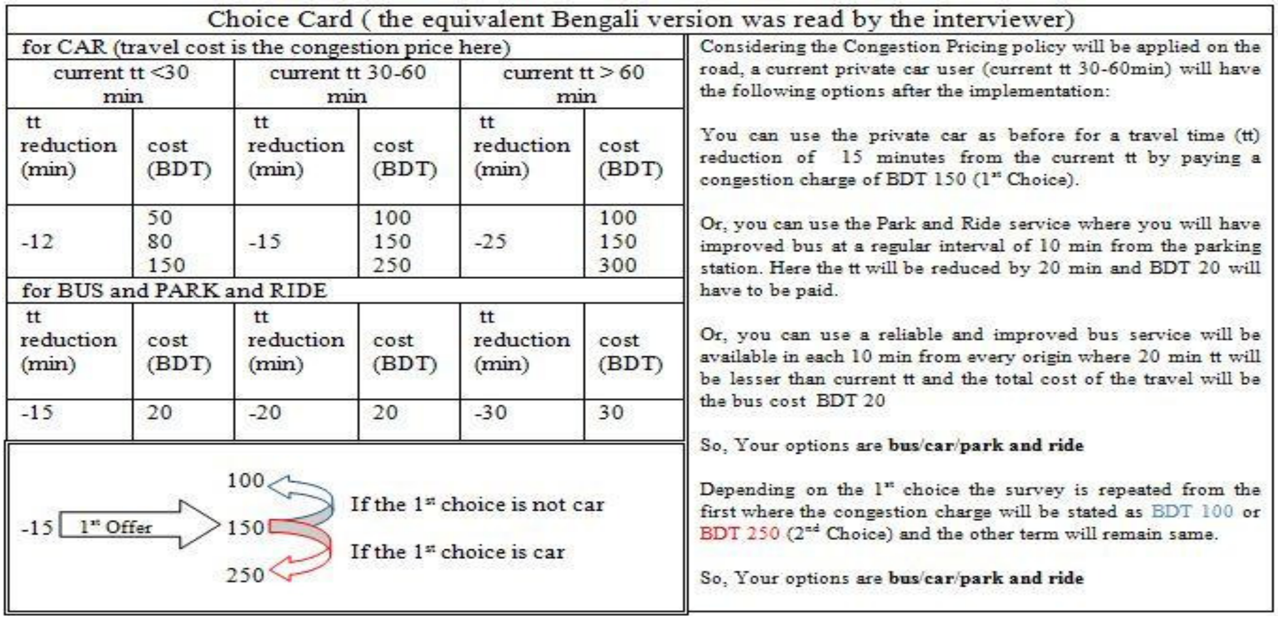
For each of the alternatives, the travel time and costs of the car alternative were varied using the current travel cost and travel times as the base. The travel costs for the car alternatives were increased by imposing a hypothetical congestion charge to the road used for coming to New Market (Mirpur Road). Since congestion is expected to reduce due to introduction of the congestion charge, the travel times presented in the SP scenarios were lower than the present travel times. The Improved Bus service was described to have improved frequency, accessibility, cleanliness, safety and reliability. The arrangements of the Park-and-Ride facilities as well as their locations (just outside the congestion charging zone) were described using pictures to make the alternatives clear to the respondents. Samples of show cards and a randomly chosen choice card (translated from Bengali) are presented in Figures 5 and 6 respectively.



(a) (b)

Figure 4- Time vs. flow graph (a) on a road connecting New Market with three effective lane only (b) on a road connecting Motijheel with three effective lane only (Data Source:DHUTS,2010)

Figure 5: Show cards for shopping trip: A. Location of charged link and congestion charge implementation B. Park-and-Ride



Choice Card (the equivalent Bengali version was read by the interviewer)

for CAR (travel cost is the congestion price here)					
current tt <30 min		current tt 30-60 min		current tt > 60 min	
tt reduction (min)	cost (BDT)	tt reduction (min)	cost (BDT)	tt reduction (min)	cost (BDT)
-12	50 80 150	-15	100 150 250	-25	100 150 300
for BUS and PARK and RIDE					
tt reduction (min)	cost (BDT)	tt reduction (min)	cost (BDT)	tt reduction (min)	cost (BDT)
-15	20	-20	20	-30	30

Considering the Congestion Pricing policy will be applied on the road, a current private car user (current tt 30-60min) will have the following options after the implementation:

You can use the private car as before for a travel time (tt) reduction of 15 minutes from the current tt by paying a congestion charge of BDT 150 (1st Choice).

Or, you can use the Park and Ride service where you will have improved bus at a regular interval of 10 min from the parking station. Here the tt will be reduced by 20 min and BDT 20 will have to be paid.

Or, you can use a reliable and improved bus service will be available in each 10 min from every origin where 20 min tt will be lesser than current tt and the total cost of the travel will be the bus cost BDT 20

So, Your options are **bus/car/park and ride**

Depending on the 1st choice the survey is repeated from the first where the congestion charge will be stated as BDT 100 or BDT 250 (2nd Choice) and the other term will remain same.

So, Your options are **bus/car/park and ride**

Figure 6: Sample choice card

The respondents were allowed to choose their options after comparing the travel time and cost of the three alternatives. Different sets of values of travel time savings and travel costs have been used depending on the duration of the current trip. Table I shows the time reductions and charges presented for different trip durations.

Table I-Congestion charge for each type of trip duration for shopping trips

Short tt < 30 min		Medium tt = 30-60 min		Long tt > 60 min	
Travel Time Reduction (min)	Charge(BDT)	Travel Time Reduction (min)	Charge(BDT)	Travel Time Reduction (min)	Charge(BDT)
5,8,12,15, 20	30,50,80, 100,150	10,12,15,20, 25	50,100,150, 200,250	12,20,25,30, 40	80,100,150, 200,300

For Improved Bus and Park-and-Ride, it was assumed that travel time will decrease 15, 20 and 30 minutes from the current travel times for the short, medium and long travel time respectively. It was explicitly mentioned that the Park-and-Ride will involve one additional transfer. The total travel costs by these modes were assumed to be 20 BDT, 20 BDT and 30 BDT for the three types of trip durations respectively.
An orthogonal design considering the main effects was produced first using the statistical software SPSS. Out of 82 combinations those containing unusual combinations and dominant choices e.g. very low travel time saving for very high congestion charge or excessive travel time saving for a little amount of charge were excluded and 21 reasonable combinations were retained. Randomly selected combinations from this list were presented to the respondents.

In addition to the SP responses, data have been collected regarding the trip details (availability of other modes, reason for using car, number of co-passengers, frequency of similar trips, etc.) and socio-economic characteristics (e.g. age, gender, income, occupation).

Case Study II: Commute and Business Trips

The Motijheel area, which is the central business district with the Headquarters of all major financial institutes, airlines, etc. and the one of the most congested areas of Dhaka, has been selected for testing the potential response to congestion charge in the context of commute and business trips. A data collection plan similar to Case Study I has been used for this case. The only difference is the consideration of having the facility of hypothetical Off-street Car Parking Facilities (replacing the currently free on-site parking in the Motijheel area) instead of the Park-and-Ride alternative presented in Case Study I. This was because of the fact that due to the existing land-use pattern in Motijheel and surrounding areas, it made more sense that travellers can park their cars in an off-street location close to their destination and walk the rest of the way, rather than using a bus from the parking lot. The choice set in this case therefore included the following:

- Car (with congestion charge)
- Improved Bus
- Off-street Parking

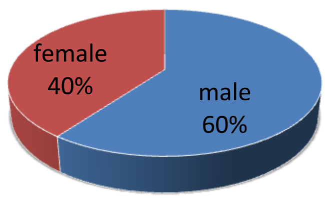
Similar to the previous case study, the trip duration types were classified as short, medium and long and travel times and costs were varied accordingly. The findings of the initial survey however revealed longer trip durations in this case compared to Case Study I. Moreover, because of the higher levels of congestion and lower capacities, the presented congestion charges were higher compared to Case Study I. Table II shows the time reductions and charges used in the SP scenarios for different trip durations. The questionnaire survey has been conducted in a similar way as the previous case study in order to maintain similarity and compatibility between the two.

Table II-Congestion charge for each type of trip duration for commute and business trips

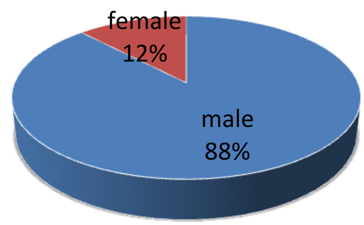
Short tt < 30 min		Medium tt = 30-60 min		Long tt > 60 min	
Travel Time Reduction (min)	Charge(BDT)	Travel Time Reduction (min)	Charge(BDT)	Travel Time Reduction (min)	Charge(BDT)
10,12,15,18, 20	50,70,100, 150,180	12,15,20,25, 30	100,150,200, 250,300	15,20,25,30, 40	200,250,300, 350,400

Data Findings

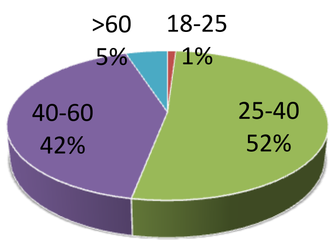
A total of 228 and 132 respondents participated in Case Study I and II respectively. Each respondent have been presented with two SP scenarios, so the total number of responses were 456 and 264 respectively. The respondents are both male and female of various ages and various socio-economic conditions (Figure 7). There were people of various professions including student, housewife, businessman, government service holder, military person etc. All the respondents are educated at least up to higher secondary (HSC) and majority of them use their own car (rather than cars provided from their offices). Almost all the respondents had chauffeurs.



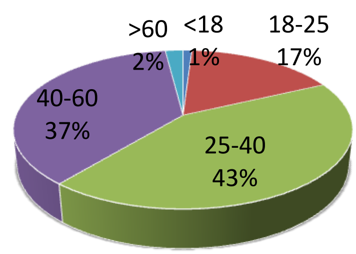
a. Gender: Shopping Trip



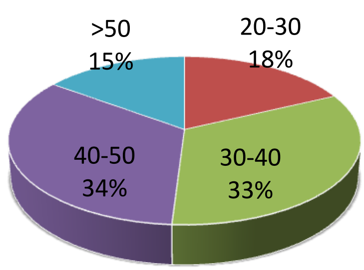
b. Gender: Commute and Business Trips



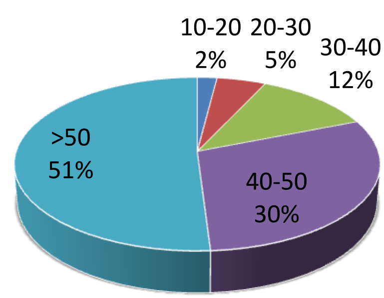
a. Age (years) : Shopping Trip



b. Age(years): Commute and Business Trips



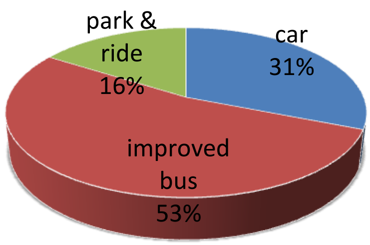
a. Income (000, BDT) : Shopping Trip



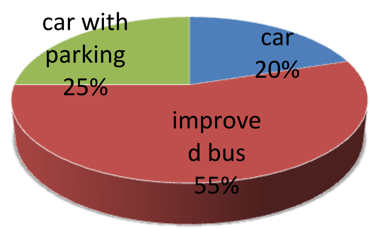
b. Income (000, BDT) : Commute and Business Trips

Figure 7-The distribution of socio-economic characteristics

All the respondents had the opportunity to use other modes for their respective trip. But they had used the car for their trip for various reasons. Majority of the people (65%) have listed safety and comfort as the principal reasons. Moreover convenience to reach the destination directly (responded by 25% of the participants) was also a dominating factor. They had not used the bus due to the unacceptable environment of the bus service and accessibility problems to the bus from their origin. In the SP scenarios, significant shift to Improved Bus has been observed (Figure 8). This trend has been found to be more prominent for mid-income people (with income ranging from 40000 BDT-50000 BDT per month).



a. Shopping Trip



b. Commute and Business Trips

Figure 8- Mode choices

Models

A discrete choice model structure (see Ben-Akiva and Lerman 1985, Bierlaire 1998, Train 2003 for details) has been used to establish the relationship between the chosen alternatives and the explanatory variables. The alternatives included trip attributes (e.g. trip duration, travel time, cost) and socio-economic characteristics. The candidate socio-economic characteristics likely to affect the choices are presented in the Table III.

Table III-Candidate variables and usual choice relationship

Attributes	**General Casual Relationship**
Congestion Price	As the congestion cost is an extra charge on the private car user other than the operating cost, people are likely to avoid this and shift to other alternatives
Monthly Income	The people with high income are likely to be less sensitive to cost and may be more interested to use car in spite of the charge.
Age	Old people are likely to have higher propensity to use car for comfort and better accessibility.
Gender	Due to social norms and culture male and female passengers do not feel free to share bus especially in congested situations and female passengers tend to avoid bus due to safety and privacy concerns. Female respondents are therefore more likely to opt for car.
Travel Duration	Travellers are more likely to favour Bus for longer trips since access time is a smaller portion of the total travel time in those cases.
Occupation	Highly educated white-collar employees are likely to have higher propensities of using cars. Housewives of higher income groups may also have additional inclination to use car.

Multinomial Logit Model (MNL) which is the simplest form of discrete choice model is used here to estimate the utility parameters of different choices in the choice sets. A linear utility function has been associated with each alternative in the choice set. The utility of choice *i* of individual *n* can be expressed as in Equation (1).

$$U_{in} = \beta_i X_{in} + \varepsilon_{in}, \forall i \in C_n; \quad (1)$$

Where, X_{in} = socio-economic characteristics of the individuals and attributes of different modes, βi = Coefficient of X_{in}, ε_{in} = Random error term and C_n = Choice set presented to individual n.

The model parameters are estimated by maximum likelihood technique using the software BIOGEME (Bierlaire 2003). The effects of different variables have been tested and the variables with correct signs and reasonable statistical significance have been included in the final models.

The final model for shopping trip is stated below. In this model the allowance for the monthly income of the respondents have been considered along with the travel time and travel cost of the trip.

U_{car}= *ASC_CAR* + $\beta_{time\ saving\_car\_pr}$* cts + $\beta_{cost\_car\_pr}$* ctc + $\beta_{hi\text{-}income\_cost\_car}$ * hi-income_cost_car dummy

U_{pr}= *ASC_PR* + $\beta_{time\ saving\_car\_pr}$* prts + $\beta_{cost\_car\_pr}$ * prtc

U_{bus}= $\beta_{time\ saving\_\_bus}$ * bts + β_{cost_bus} * btc

Where,

ASC = Alternative Specific Constant, PR = Park-and-Ride, cts, = car travel time saving, bts = bus travel time saving, prts = Park-and-Ride travel time saving, ctc = car travel cost (only congestion charge), btc = bus travel cost, prtc = Park-and-Ride travel cost.

hi-income_cost_car dummy=hi-income dummy * ctc
hi-income dummy = 1 for monthly income $\geq$ 40 thousands and 0 for others

In case of the commute and business trip the most statistically significant and meaningful model has been considered as the final model as before. The income of the people has been considered here which maintain the uniformity of the two models. The model for the commute and business trip is stated below.

U_{car}= ASC_CAR + β_{time_saving}* cts + β_{cost} * ctc + $\beta_{hi\text{-}income\_cost\_car}$* hi-income_cost_car dummy

U_{cwp}= ASC_CwR + β_{time_saving}* cts + β_{cost} * ctcwp + $\beta_{hi\text{-}income\_cost\_car}$* hi-income_cost_cwp dummy

U_{bus}= β_{time_saving}* bts + β_{cost} * btc

Where,

CwP= Car with Parking, ctcwp = car travel cost with parking,
hi-income_cost_car dummy = hi-income dummy* ctc
hi-income_cost_cwp dummy = hi- income dummy* ctcwp
hi-income dummy = 1 for monthly income $\geq$ 40 thousands and 0 for others

The results of the model for the shopping trip and the commuter trip are presented below on table IV.

Table IV. Estimated results for both types of trip

Shopping trips (Case I)				Commuter and Business trips (Case II)			
No. of Observations 456 No. of Parameters 7 Adjusted Rho Square 0.097				No. of Observations 264 No. of Parameters 5 Adjusted Rho Square 0.236			
Parameters	Affected Alternat-ives	Estimated Results		Parameters	Affected Alternat-ives	Estimated Results	
		value	t-test			value	t-test
ASC_CAR	Car	-1.06	-1.75	ASC_CAR	Car	0.898	2.04
ASC_PR	Park-and-Ride	-1.45	-2.54	ASC_CWP	Car with Parking	3.48	4.71
$\beta_{time\_saving\_car\_pr}$	Car and Park-and-Ride	- 0.0453	-1.73	β_{time_saving}	Car ,Car with Parking and Bus	0.0307	1.32
$\beta_{cost\_car\_pr}$	Car and Park-and-Ride	- 0.00517	-1.58	β_{cost}	Car ,Car with Parking and Bus	-0.0252	-6.71
$\beta_{time\_saving\_bus}$	Bus	0.0848	1.63	$\beta_{hi-income\_cost\_car}$	Car and Car with Parking	0.00823	5.62
β_{cost_bus}	Bus	-0.139	-2.31				
$\beta_{hi-income\_cost\_car}$	Car	0.00467	1.82				

The estimated result from the shopping trip states that all the values of constants are statistically significant at or more than 90% confidence level only except the value of the coefficient of travel cost for car and Park-and-Ride, $\beta_{cost\_car\_pr}$ which is significant at or more than 80% confidence level.

The relative magnitudes of the ASCs indicate that people prefer the improved bus most which is followed by car and Park-and-Ride. The coefficient of hi-income_cost_car dummy, $\beta_{hi\text{-}income\_cost\_car}$ indicates that the sensitivity to car cost (charge) is less for people with high monthly income. The utility of bus becomes more if the travel time rises. All constants show expected signs except the coefficient of travel time saving for car and Park-and-Ride, $\beta_{time\ saving\_car\_pr}$ which indicates that the utility of the car and Park-and-Ride will increase with increase in travel time.

Most of the trips to New Market take place due to shopping. These trips are basically pleasure trips which most preferably occur on leisure time of the people. People are not so concerned about the travel time in this type of trip purpose. If the travel time even increases, the car users can stay that time on the car with comfort. This may be the cause of finding $\beta_{time\ saving\_car\_pr}$ negative with increased travel time saving on road. Moreover, the responses of the people having very short travel time (< 30 minutes) may affect to find this result.

In case of the commuter trips, the sign of the coefficient of travel time (β_{time_savins}) is intuitive here. It indicates that the utility of the services will increase with increased travel time saving. The sign of generic coefficient of cost, β_{cost} refers that utility of the services will decrease with the increase in travel cost which conforms real scenario. The coefficient of income dummy, $\beta_{hi\text{-}income\_cost\_car}$ indicates that the sensitivity to car cost (congestion price) and parking cost is less for people with high monthly income. Moreover, from the ASC values it can be said that the respondents have a propensity of using car with or without parking facilities as the trips usually occur regularly and the people earning high monthly income are less likely to experience the service of public bus daily.

Model comparison

The discrete choice models obtained from the two case studies provides the utility of the modes which can be used to predict the choice probabilities in congestion pricing scenarios. To compare the probabilities of the two models, a hypothetical condition could be considered regarding as congestion pricing is already implemented on the road of Dhaka city. Let, A car user (male) of the current time with a age of 45 and monthly income of BDT 50 thousands (high income) is subjected to a congestion price of BDT 150 for a travel time saving of 20 minutes if he wants to use the car for the shopping trip or the commute and business trip. The other options prevail for the person for the shopping trip is to use bus or Park-and-Ride with a cost of BDT 20 for travel time saving of 20 minutes. On the other hand, the person has to pay BDT 30 for a travel time saving of 20 minutes for the commute and business trip if he wants to use the bus or has to pay BDT 120 more with congestion price if he wants to use the facility of the car with parking. So the utility of the modes can be calculated according to the models as follows which will suggest the maximum probability of choosing the mode.

For shopping trip (New Market trips):

Utility of Car, U_{car} = -1.06 + (-0.0453*20) + (-0.00517*150) + (0.00467*150) = -2.041

Utility of Bus, U_{bus}= 0+ (-0.139*20) + (0.0848 *20) = 0.338

Utility of Park-and-Ride, U_{pr} = -1.45 + (-0.0453*20) + (0.0517*20) = -2.45

For commute and business trip (Motijheel trips):

Utility of Car, U_{car} = 0.898 + (0.0307*20) + (-0.0252*150) + (0.00823*150) = -1.0335

Utility of Bus, U_{bus} = 0 + (0.0307*20) + (-0.0252*30) = -0.142

Utility of Car with Parking, U_{cwp}= 3.48+(0.0307*20) + (-0.0252*270)+ (0.00823*270) = -0.4879

The equation 2 refers to the multinomial logit choice probability.

$$P_n(i \mid C_n) = \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}} \qquad (2)$$

Here,
$P_n(i \mid C_n)$=Probability of individual *n* (with choice set *Cn*) choosing alternative *i* over other alternatives
Cn= Choice set of individual *n* (e.g. car may not be available to the individual)
V in = Systematic utility of alternative *i* to individual *n*

According to the above equation the probability of the modes are stated below.

Table V-Comparison of the preference of the modes from the two models

Probability of the Modes	Shopping trip	Commute and business trip
P_{car}	23%	19%
P_{bus}	61%	48%
P_{pr}	16%	-
P_{cwp}	-	33%

The data from the models reveal that substantial parts of the car user are willing to shift from car to bus at a congestion charge of 150 BDT. It also supports the fact that as the commute and business trips are more regular and frequent than the shopping trips, people become more careful and considerate to choose the mode.

Conclusion

The potential response to congestion pricing in Dhaka has been investigated in this research using Stated Preference (SP) surveys in the context of commute and business and shopping trips. From the aggregate level analysis, it was evident that substantial portion of the car users are sensitive to congestion pricing in Dhaka and are willing to shift to alternative modes with good levels of service. The fact that the results of the two models representing two locations of Dhaka city focusing on two different trip purposes are identical is very encouraging. Since the majority of the shift of choice has been to Improved Bus, improving the current bus service can be an important catalyst to this shift. These findings can be a useful tool for the traffic planners of Bangladesh to stall the rapid increase of cars and subsequently improve the traffic condition in Dhaka.

The study has several limitations though. In particular, the data sizes are small and collected from two selected locations. Similar case studies need to be repeated in other parts of the city and for other types of trips (e.g. social trips) to get more representative results. Moreover, in order to keep the choice task simple, the levels of services for the non-car alternatives have been kept fixed in this research. Varying the levels of services of those alternatives can help in reducing standard errors and subsequently to improve the statistical significance of the parameters.

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