Key factors to reduce current driving commuters in inner Bangkok

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ABSTRACT

The paper represents the response of the current driving commuters on the number of trips made in inner Bangkok. We estimated a driving commuter trip and reported the driving factors. The study area was chosen in business area wheremost intensively mass transit network in Bangkok exists. The objective is to understand the drivers and investigate the key factors to reduce current driving commuter trips. Driving commuters who regularly experienced traffic congestion, lived outsideand worked in inner Bangkok were surveyed by questionnaire.The outcome from the survey reveals that the statistically significant factors which can increase the trips are the available parking space at workplace, education, number of cars in household, travel time to work and the highest acceptable toll level. Conversely, statistically non-significant factors are sex, age, hurry, driving distance, farness to the nearest mass transit station, parking fee, the south direction of their residence and tendency to change job to the area outside. The results are beneficial for recommendation on demand management policy. The analysis showed that in order to limit car trips in inner Bangkok, parking limitation at workplace as a non-monetary, and an area pricing as a monetary measure are the main key factorsfor success.

Key words

demand management, driving commuter, driver survey, inner Bangkok, toll .

1. INTRODUCTION

This paper reports a driving commuter model into inner Bangkok if the congestion charging scheme exists. The work is part of the project of finding on optimal toll value for a congestion charging scheme in inner Bangkok, supported by Thailand Research Fund.

In estimation of urban car travel demand, there are numbers of literature. For the price effect, Goodwin [1] pointed out that considering the elasticity of demand with respect to fuel prices can prove outthe understanding of the price effect, showing that rising fuel prices reduce car travel. Travel demand is also affected by an income effect. Mogdridge [2] used the distribution of incomes and expenditures to estimate the number of cars there would be thirty years later. Dargay and Hanly [3], and Bresson et al. [4] have shown there to be a positive relationship between income and car use. Orturzar et al. [5] pointed out that economic growth leads, in particular, to higher car ownership rates. One of the difficulties of attempting to investigate income is that the effect of income is even more correlated with socio-demographic variables than the effect of the other variables [6]. These variables include household size [7] and the economic situation [8].Schafer and Victor [9] consider the effect of income on travel practices, they brought in the concept of Travel Time Budget (TTB) developed by Zahavi [10] and Roth and Zahavi [11]. Zahavi showed that ''on average, humans spend a fixed amount of their daily time budget travelling'', the travel time budget (TTB). Moreover, the per traveler travel time budget is typically higher for the lowest incomes [11].For quality effect, Mogdridge [7,12] showed that demand is also affected by quantity available of goods and services, measured in terms of the number of car trips, car ownership rates [13] and the number of passenger-seat kilometers [4]. More generally, an increase in the amount of a good that is available (cars or public transport) has a positive impact on demand.

Lastly, urban travel demand can also be affected by spatial factors. In this paper, we investigate the direction of origin of drivers in terms of distance and direction. Other papers looked at other points. Kain and Fauth [14] have considered urban development as measured by the population density in each zone and the socioeconomic characteristics of the households and the location of their jobs and residences in order to explain their modal choice. In Small and Verhoef [15], travel decisions are influenced by the density of buildings and the type of activity. Button et al. [16] have demonstrated that there is a positive relationship between car ownership rates and the level of urbanization. But this relationship applies only up to a point. Beyond this point, the infrastructure becomes so saturated that the higher the urban density the more car use, car ownership rates, the number of trips and energy consumption are reduced [17]. Moreover, Handy [18] has shown that the urban activities mix has a negative effect on car use, while emphasizing the complexity of this finding. This complexity is also apparent when we consider the form of the city, even if a polycentric structure seems to result in lower energy consumption by traffic. This scholar shows, for example, that the larger the city the longer

individuals' journeys, but the size of the city does not seem to have a direct effect on modal choice. The user cost of a given transport mode, income and the available quantities of goods and services have therefore become classical structural variables for estimating urban travel trip.

This paper investigated price effect, time budget effect, quantity effect and spatial effect. Variables maybe the same or some are different from other works based on available data obtained. The paper are to modeling trips per week based on their personal characteristics and travel information in particular on their acceptable toll level before they change modes or desire not to travel.

2. DATA COLLECTION AND STUDY AREA

Since the survey is aimed at respondents who use a car and face traffic congestion, we select respondents only who drive to work regularly on day-to-day basis from the outside area into the study area.The data were obtained by conducting an interview survey among drivers in the area. It is all done in office buildings and shopping centers. The study area is chosen in business area with high income levels and with the existence of most intensively mass transit network in Bangkok with the distance of 0.5 kilometer approximately to the nearest mass transit stations, i.e. the station is 1 km far from each other. The sampling area was defined as in fig.1.The sampling was based on a random technique. For sampling, the area was divided roughly equally into 10 portions, of which one portion did not contain a mass transit station and were larger areas than the other 9. The 10 area covers one at Ratchathewi station, four stations on Rama 1 Rd. and four stations(running from the left in fig.1) on Rama 4 Rd. and the last area at Pratunam area. Each area is approximately set from the station and spread to the half distance to its nearest stations or the boundary of the study area. The survey was done in 2013. The survey procedure ensured that each of the 500 respondents answered all questions completely.

The survey started with general questions regarding general characteristics and the travel background of the respondents. In the first part of the survey, we asked about some socio-economic characteristics (such as education and income). In the second part, we asked about travel behavior which may be indicators in making response decision to the experiment. Responses were sought on fuel expense; whether the respondent was in a hurry, the purpose of each trip, the number of persons dropped off/ picked up, information on parking, distance to an existing mass transit station, the accessibility and their willingness to walk to mass transit station.

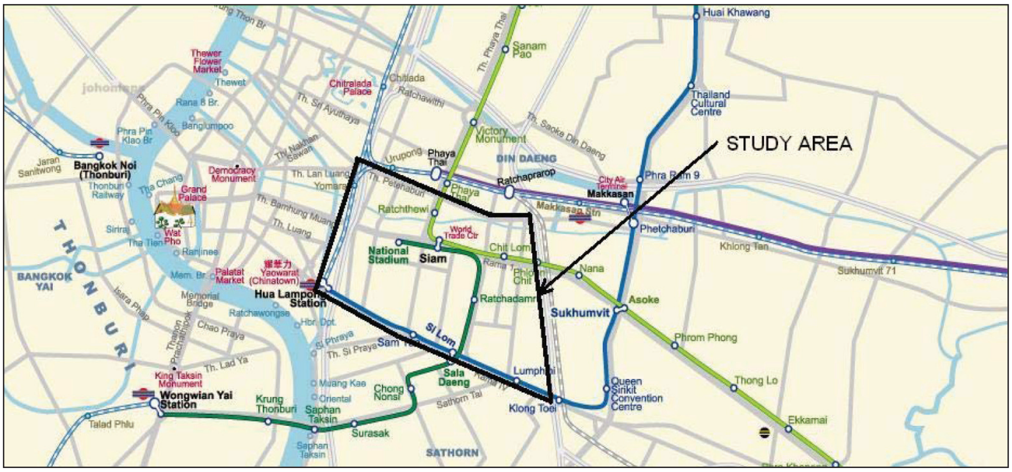

Figure 1 Study area

In the third part, respondents were asked for their reaction to a toll to reduce travel time caused as a result of reduced traffic congestion. The objective is to make a new independent variable associated with the decisions in paying the extra charge to save some travel time in return, in other word the time saved. The next questions asked them to identify the charge level at which the cost became unacceptable and to split their 10 trips into each mode including not travelling.

3. METHOD AND RESULTS

1. Analysis of general questions

A majority of the respondents were between 36 and 45 years old. Most respondents had achieved a graduate level of education. The largest number of respondents reported an average income of more than 35,000 baht/month. About half of the households of respondents owned 2 cars. They mostly drove alone, and only a very small portion was accompanied by 1, 2 or more family member. The largest number of respondents made 10 trips per week, closely followed by respondents who made 12 trips per week. It is found from this sample that the average trips made is 10.7 trips average. The largest number of respondents had fuel expenses between 3,000 to 5,000 baht/month. Almost 80% answered that they were daily in rushdue to their little spare travel time.

The majority left home about 06:30, arrived at work around 08:00, left the workplace between 18:00 and 19:00 and arrived home between 19:00 and 20:00. More than 80% had their own fixed parking space. More than 60% had no inclination to change their work location to outside the city's business center and 20% planned to do so in 3 years. For accessibility to mass transit, we found an interesting issue. Despite the study area being served by most intense network of mass transit in Bangkok, we found that 55% answered that the nearest station (relative to either their origin or destination) was not within walking distance.

In addition, we asked the respondents to evaluate their acceptance of a new transport system for an additional cost that would reduce their travel time. Four different toll options were presented to the respondents: 60 baht toll-no congestion, 30 baht toll-15 minute congestion, 10 baht toll-30 minute congestion, and no toll-45 minute congestion. Respondents were asked to allocate a total of 10 trips among the 4 options.

2. Model calibration results

All the variables in Table 1 were investigated for their impact. The estimated model coefficients were determined using STATA software. The results are summarized in Table 2. It is noted that before finalized the results, we analyzed in different models and found it is rather not possible to model a relationship 1). between the number of trips after the toll and the other factors, and 2). between the number of delta trips and the other factors. The relationship can be explained for price elasticity but not in the scope of this paper. Therefore, the relationship based on trip change is not included here.

Table 1 Description of Input Variables

Variable	Description	Min	Max	Mean	SD
Age	1 = 20-30yrs ,2 = 31-40 yrs, 3 = 41-50 yrs,4 =51-60 yrs, 5 = more than 60	1	5	2.98	0.906
Education	1 = Lower than secondary, 2 = Secondary, 3 = Undergrad, 4 = Postgraduate	1	4	2.96	0.579
OccEmployee	Occupation: employee 0 = no, 1 = yes	0	1	0.62	0.485
OccGovernment	0 = no, 1 = yes	0	1	0.18	0.383
OccOwner	0 = no, 1 = yes	0	1	0.19	0.390
IncomeInterval	1 = less than 10,000 Baht, 2 = 10,000-15,000 Baht, 3 = 15,001-20,000 Baht, 4 = 20,001-25,000 Baht, 5 = 25,001-35,000 Baht, 6 = more than 35,000 Baht	1	6	4.78	1.258

CostTimeIncomePerTrip	Income/workinghour* traveltime/trip, in baht per trip	19.35	818.45	230.58	131.765
CostTime	Income/workinghour* travel time/trip* trip/week, in baht per week	77.40	9,821.43	2,519.67	1,681.019
IncomePerWk					
CarInHH	1 = 1 car, 2 = 2 cars, 3 = more than 2 cars	1	3	1.84	0.712
VehicleTypeCar	0 = no, 1 = yes	0	1	0.86	0.347
VehicleTypePickup	0 = no, 1 = yes	0	1	0.14	0.345
DistanceToWork	Distance from home, km.	0.2	56.4	15.61	11.396
DirectionE	Living in the east side of the study area. 0 = no, 1 = yes	0	1	0.07	0.249
DirectionN	0 = no, 1 = yes	0	1	0.30	0.460
DirectionW	0 = no, 1 = yes	0	1	0.06	0.250
DirectionS	0 = no, 1 = yes	0	1	0.09	0.289
DirectionNE	0 = no, 1 = yes	0	1	0.17	0.379
DirectionNW	0 = no, 1 = yes	0	1	0.07	0.255
DirectionSW	0 = no, 1 = yes	0	1	0.08	0.275
DirectionSE	0 = no, 1 = yes	0	1	0.04	0.191
FuelPerTrip	In baht per trip	11.2	595.24	109.35	475.024
HurryToWork	0 = no, 1 = yes	0	1	0.788	0.409
TimeToWorkPerWk	The go-to-work hours time the (H to W and W to H) trips per week, in hour per week	1	36	12.169	6.207
PersonDrop	Number of person dropped 0 = 0 person,1 = 1 person, 2 = 2 or more	0	3	0.342	0.629

ParkSpaceWithin	Having a parking space at office. 0 = no, 1 = yes	0	1	0.810	0.393
ParkCost	Baht per day	0	100	13.511	24.403
Move	Tendency to change job to outside area. 0 = No, 1= May be in 3years 2= 3-5 years, 3=< 5 year	0	3	0.585	0.894
MetroFar	Metro far from office. 0 = no, 1 = yes	0	1	0.546	0.498
MetroNotUse	Not willing to use metro. 0 = no, 1 = yes	0	1	0.070	0.255
ValueOfTimeChoice	Value of time calculated from the chosen tolls from the four alternatives, in baht per hour	0	80	28.004	22.870
CostTimeChoice	The multiple ofValueOfTimeChoice and the travel time per trip, in baht per trip	0	240	32.916	33.026
TollPerDay	Reported acceptable daily toll, in baht per day	0	142.84	31.69	19.746
TollPerWk	Baht per week	0	1,000	221.84	138.224

Table 2 Regression model including all input variables for the number of trips per week.

Dependent variable: Number of trips per week.

(R^2 =0.6389, Root MSE = 1.7693)

Variable	Coef.	Std. Err.	t-test	P-value	[95% Conf.Interval]	
Constant	7.297	0.563	12.960	0.000	6.190	8.403
FuelPerTrip	-0.017	0.001	-14.460	0.000	-0.020	-0.015
TimeToWorkWk	0.204	0.016	12.400	0.000	0.171	0.236

TollPerWk	0.006	0.001	8.510	0.000	0.004	0.007
CostTimeChoice	-0.017	0.003	-5.650	0.000	-0.023	-0.011
DirectionNW	-0.950	0.319	-2.980	0.003	-1.576	-0.324
DirectionS	0.663	0.283	2.350	0.019	0.108	1.218
Education	0.450	0.158	2.850	0.005	0.139	0.761
CarInHH	0.280	0.120	2.330	0.020	0.043	0.516
ParkSpaceWithin	0.542	0.219	2.470	0.014	0.111	0.972

4. DISCUSSION AND CONCLUSION

The results indicate that constant value of commuter trip per week is 7.297 trips. Generally, an increase in the factors (including the available parking space at workplace within the area, education, number of cars in household, travel time to work and the highest acceptable toll level) increases the number of trips. On the other hand, factors which decrease the car trips are their perceived value of time, the fuel cost and the south directionof their residence.

Moreover, it is found that some factors do not have significantly impact, as they are not included in Table 2, such as the driving distance,farness to the nearest mass transit station, sex, age, hurry, parking fee, and tendency to change job to the area outside.

Directions of their residence compared to inner Bangkok also do affect the driving trips. The trips are increased 0.663 trips for those driving from the south and decreased for those from the northwest direction. The result canimply the less and more transit service quantity and quality available for people travelling from subsequently directions.

Money-related factor such as the fuel cost per trip is a statistically significant factor but with a small coefficient size as its unit is larger than the other factors; an extra 10 baht per trip (or 20 baht per day) decrease 0.17 trips per week (or about 1.6%). We also found that the impact of the highest acceptable toll level is more than that of fuel cost in that for every extra 100 baht toll per week (or at the same amount of 20 baht per working day) can decreases 0.6 trip (or about 5%). This finding reveals the significant of the toll charge that, even on the same monetary unit, it can effectively reduce more trips than the fuel costs.

The factor which helps recommending an important issue is the parking space available at workplace. The known space available for each individual at destination clearly has a high influence in increasing the number of trips (with the coefficient of 0.542), following by number of cars in household (with the coefficient of 0.28

per car). Surprisingly, parking cost does not show its impact on this sample. This result confirms the government an importance of parking space policy in demand management scheme.

The overall results are beneficial for demand management policy in conjunction with an area pricing scheme. The analysis identifies that a crucial policy to reduce the increasing driving trips to inner Bangkok is parking limitations.

5. ACKNOWLEDGEMENTS

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