PILOT STUDY FOR THE MODELLING OF CONGESTION PRICING IN KOTA KINABALU, SABAH

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Abstract

Congestion pricing is a policy at which road users being charged with certain amount for using particular road during peak hours. It is as much about meeting the demand of car drivers for road space as allocating road space between road users. It has been successfully implemented in some other countries such as Stockholm, London and Singapore with various scheme of congestion pricing. Hence, the main aim of this pilot study is to evaluate and create model based on the willingness of the Kota Kinabalu City residents' to shift to public transport due to the implementation of congestion pricing. A total of 60 respondents were randomly chosen within Kota Kinabalu City. Data collection is being conducted using stated preference survey and analysed with Microsoft Office Excel 2010 in order to conduct regression analysis and develop a logistic transport model analysis. It is found that the number of people who willing to shift to public transport is parallel with the congestion charge amount. The results from this pilot study indicate that 71.67% of respondents are willing to shift to public transport when the congestion charge price is RM4.00. This study can give contribution for further transportations planning in order to achieve sustainable transportations in Kota Kinabalu, Sabah.

Keywords

Pilot Study, Congestion Charge, Public Transport, Modal Shift, Logistic Model

1. Introduction

Traffic congestion continues to escalate as the number of vehicles increases year by year. It might occur due to various reasons including bottlenecks, accidents, road conditions, driver's attitude and many more. Yet, it is also undeniable that the rise of population density in certain areas becomes the significant factor for the increasing number of vehicles on the road. In Sabah, the Department of Statistics has reported that the population is steadily increasing from 3.67 million in 2014 to 3.90 million in 2018 from all cities (Department of Statistics Malaysia, 2019) as shown in Table 1.

Table 1: *The Sources of Malaysia's Statistics*

Population (Million)	2014	2015	2016	2017	2018
Male	1.92	1.94	1.99	2.01	2.04
Female	1.75	1.78	1.82	1.84	1.86
Total	3.67	3.72	3.80	3.86	3.90

The economy in Kota Kinabalu is developing rapidly that most of the people afford to have private vehicles and hence the vehicle population has also boomed. In 2010, Statistics shown that Kota Kinabalu as the main city of Sabah has around 492,000 registered vehicles of which around 200,000 vehicles are motorcars and only 10,000 are public buses (Sabah Tourism Board, 2011). The fact that the city itself is one of the major tourist destinations and a popular gateway for travellers to visit Sabah and Borneo and one of the major industrial and commercial centres of East Malaysia makes Kota Kinabalu one of the fastest growing cities in Malaysia.

Though, the abundance of vehicles with lack of urban city planning caused the road lanes to be unable to meet the travel demand and contributes to gradually worsening traffic conditions. Traffic congestion turns down the speed of traffic and lengthens the short trip duration due to long queues on the road. These will affect the economic productivity as well as wasting the fuel and time. The quality of life will be affected due to the increased amount of carbon monoxide released from vehicles and inhaled by the population. According to the Borneo Post, traffic congestion in Kota Kinabalu is becoming an economic challenge (Borneo Post, 2015).

Due to that, in order to combat the congestion problems, most transport economists and urban planners in other countries supported the implementation of congestion charges with various suitable schemes. Its efficiency in relieving the traffic congestion problems has been demonstrated in London, Singapore and Stockholm (Börjesson et al., 2012). Congestion pricing has been designed to act as a policy which encourages people to choose alternative transit modes or routes. Its main aim is to convert the time wasted due to congestion as well as its negative environmental impacts into toll revenue that can give benefits to the transport system. (Yang and Huang, 2005; Liu et al., 2013).

As the personal vehicle drivers evaluate their use of private transit in terms of its cost and benefits, they are not including any external costs that they impose on others. This is the ultimate aim or solution of the concept of congestion pricing. Congestion pricing is not only help in reducing congestion, it also increases the revenue and transit ridership, enhances the transit services and facilities, reduces travel time due to the reduction of vehicles on the same road as well as improving the environmental and public health aspects. After all, the benefits for its implementation of congestion pricing are reported to be more critical than associated costs such as its implementation and operational costs (Leappe, 2006; Eliasson, 2009).

Based on study by Schuitema et al., 2010, the escalating acceptance for the implementation of congestion pricing was driven by benefits such as less congestion and more

parking spaces induced by the congestion charge scheme which shows that they are more concerned with its efficiency compared with its personal cost. Hence, it is really necessary to conduct this pilot study by highlighting their deep understanding towards the concept of congestion pricing.

2. Methodology

The approach used for collecting the data throughout this pilot study was Stated Preference Survey (SPS) and was analysed using linear regression to create a transportation model. This study was conducted in Kota Kinabalu City area. To achieve the aim of this study, there were a few procedures to be conducted. The first process is designing the questionnaires which were then distributed among respondents. They respondents were the residents of Kota Kinabalu City. Collection and analysis of data was conducted based on the response obtained through the survey. Linear regression was used to develop the logistic model.

The questionnaire was distributed using the online system among 60 respondents being the residents of Kota Kinabalu City. It was being conducted in May 2019 across a time span of 14 days. For this pre-testing, there were a total of 35 questions given and open-ended questions were used for certain inquiries that required their personal opinions. It included demographic background data in Section A, Section B is the public transport evaluation, perception towards the implementation of congestion pricing in Kota Kinabalu City on the Section C and Section D is the willingness to shift to public transport based on the amount of congestion charges. In order to ensure the credibility of this study, 3 experts who have a background in engineering field were also involved. Hence, all these useful recommendations were collected to create a better questionnaire for real survey in the future. The response collected through the survey using Google Form was then chosen for the linear regression process. By this process, the data can be analysed and developed into an equation which will be useful for future design in the field of transportation. For this study, only some relevant data will be used from the analysis. As was mentioned before, linear regression analysis that was used to develop the logistics functions and is commonly used in transport modelling is shown in Equation (1):

$$P = 1\frac{1}{1+De^{-\alpha x + \beta Y + \cdots)}} \qquad (1)$$

Where,

P is the probability

x and y are the independent variables

α and β are coefficients that should Calibrated

D is constant

3. Result and Discussion

The findings obtained were classified into categories as stated in the questionnaire form and were discussed and presented below. Firstly, they were aggregated based on Gender and Type of vehicle used for travelling in KK City, shown in Figure 1, and Monthly income and Vehicle ownership shown in Figure 2, respectively.
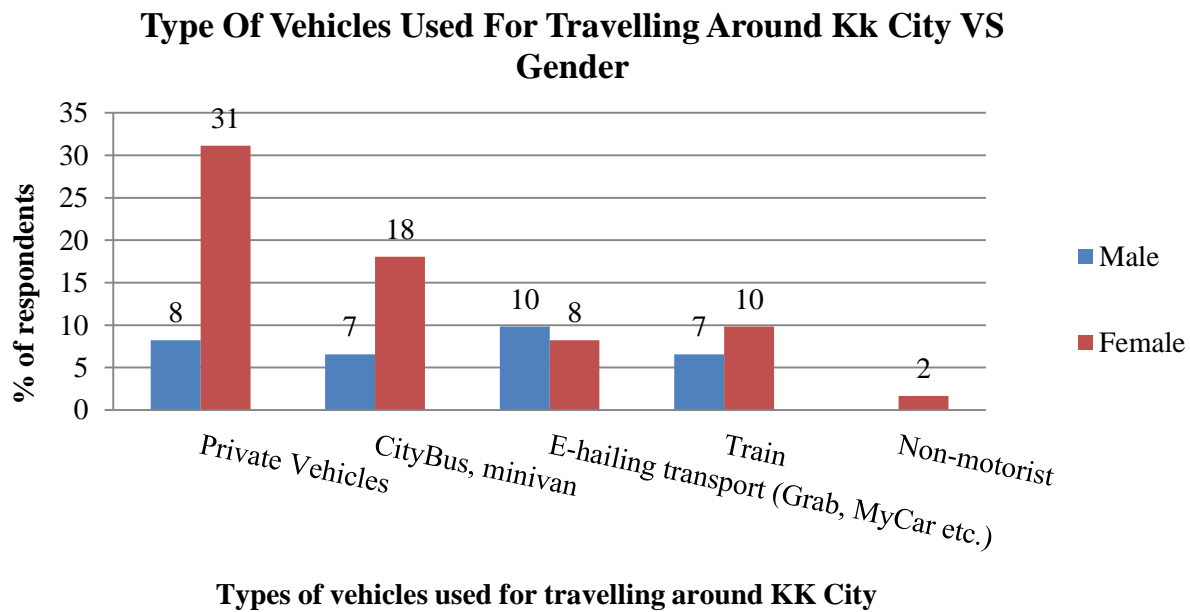

Types of vehicles used for travelling around KK City

Figure 1: *Type of Vehicles Used for Travelling around KK City based on Gender*

Based on Figure 1, the type of vehicles that is mostly used for travelling around KK City by female respondents are private vehicles and male respondents is E-hailing transport (Grab, MyCar) with 31% and 10% respectively. This is probably due to public transport services not being really safe or perceived to be unsafe by the female residents. This is in line with the study in Hanoi and Jakarta in which safety was the top priority insisted upon by women as a condition for their use of public transport (Bray and Holyoak, 2015). Then, it is also found that greater number of female respondents use city bus or minivan compared to male respondents. This is relevant to the previous study, which concluded that women prefer walking and the use of buses to make short trips to their destinations while men prefer the use of private vehicles or high-speed vehicles such as monorail for their trips which can have long duration to fulfil their various activities (Grieco et al., 1989). As Sabah does not yet have the upgraded transit like monorails, E-hailing transports such as Grab or MyCar are found to be convenient in terms of its reliability which fulfils the customer satisfaction to arrive at the destination on time as the driver usually uses the GPS system so that they will choose the fastest and shortest route available (Indra and Ibrahim, 2017).
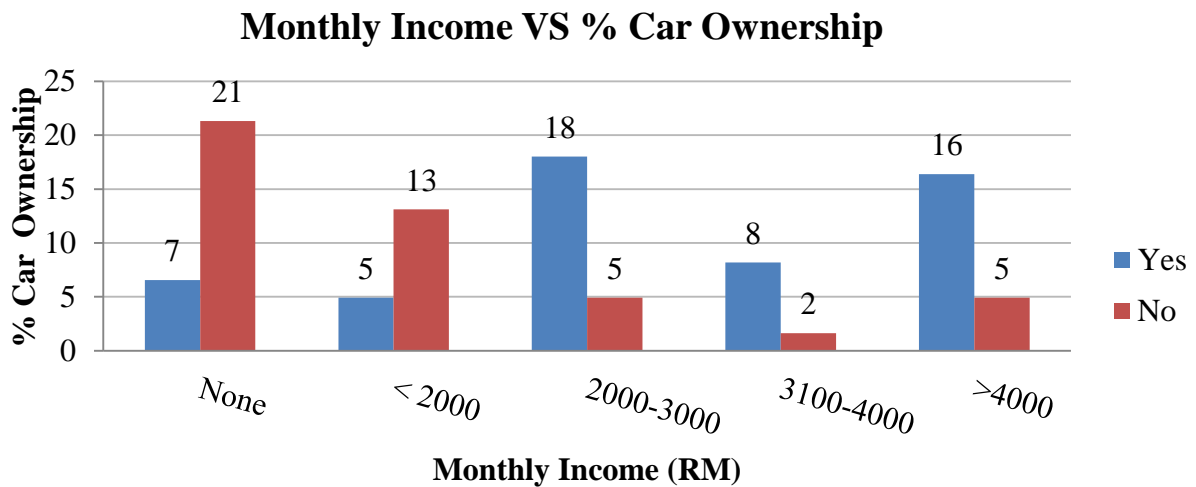

Figure 2: *Percentage of Car Ownership Based on Monthly Income*

Figure 2 shows the relationship between the monthly incomes of the respondents with the car ownership. Based on the results, it is found that regardless of the income, 54% of the respondents own vehicles while 46% of them do not own any. 42% of the respondents with income in between RM 2000 to greater than RM4000 have their own vehicles while 12% of them do not have any. Meanwhile, respondents in the low-income group (less than RM2000)

have lower percentage of car ownership which is 12%. This statistics is parallel to a previous study in which those in the steady-income group have the potential to own private vehicles and those in middle-low income groups commonly use public transport (Mohd Noor and Md Nor, 2016).

In Figure 3, the rating for the service of existing public transport in Kota Kinabalu City is shown below.
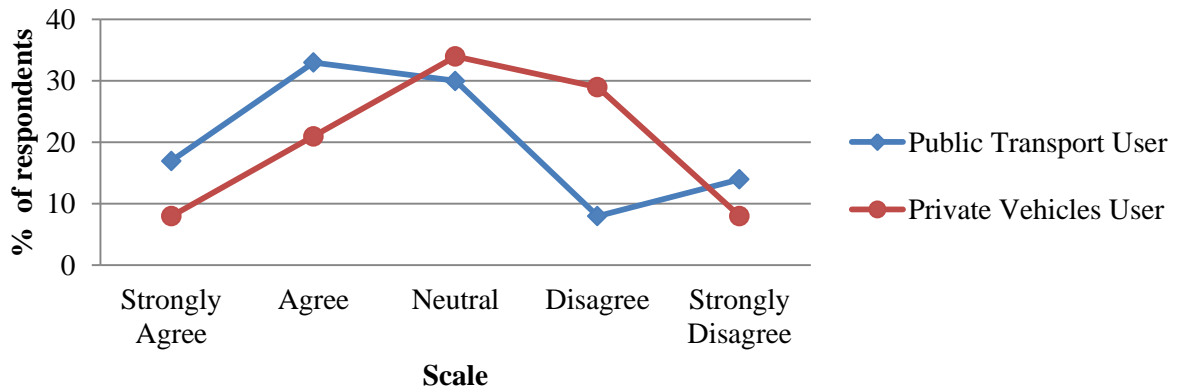

Figure 3: *Rating for the Public Transport Service in KK City*

Based on the results, it can be seen that the fares being charged can be considered as reasonable which fulfil the satisfaction of the residents. Meanwhile, the rating is fair in terms of security which means that some of the residents of Kota Kinabalu are feeling doubtful to use public transport due to the safety concerns. The results also illustrated that the factor which get the lowest rate were in terms of cleanliness and maintenance and punctuality of the existing public transport in Kota Kinabalu City.
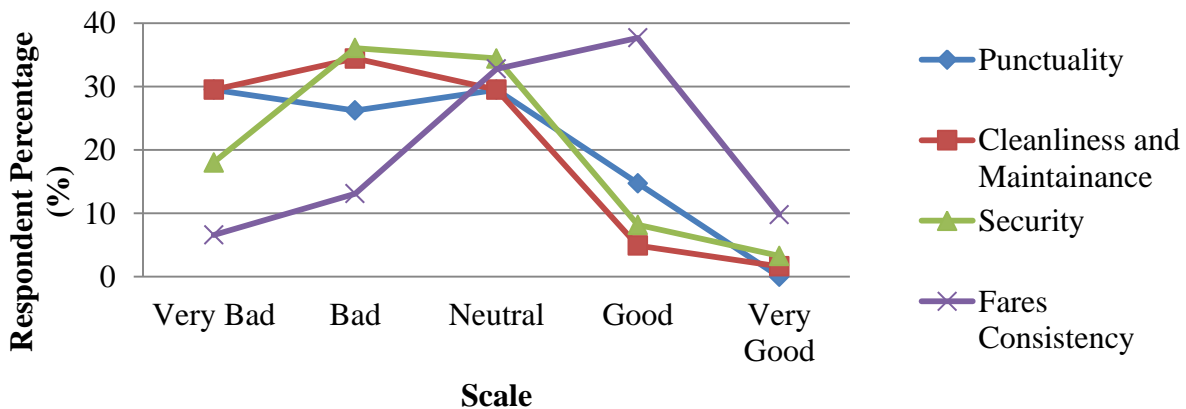

Figure 4: *Percentages of Improvement Factors Recommended by Respondents*

Hence, Figure 4 shows the improvements which have been highly recommended by the respondents towards existing public transport in Kota Kinabalu City. It can be discovered that, in public transport, the factor which needs to be enhanced most is the quality of services and facilities. It is then followed by the safety, punctuality and reliability, upgraded transit, reasonable fares and widening the transportation network. Due to that, the government should take effective actions in order to attract the residents of Kota Kinabalu City to use the public transport as such by upgrading pedestrian bridges, adding more transit stations, efficient security system of transit, systematic and accessible schedule and many more.
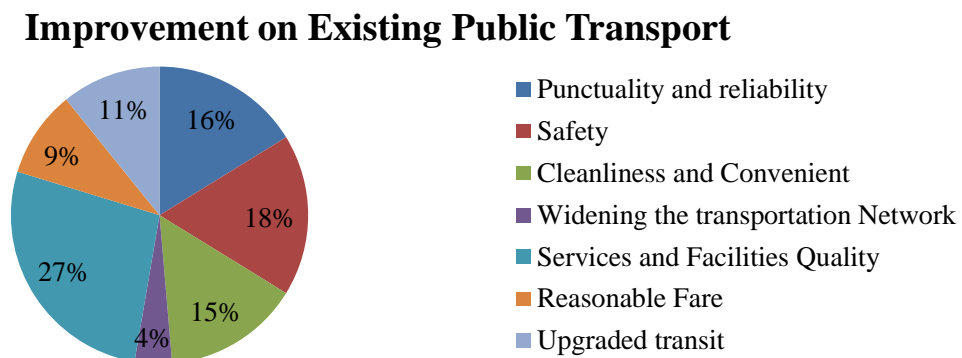
Improvement on Existing Public Transport

Figure 5: *Response of Road Users towards Implementation of Congestion Pricing in KK City*

Next, Figures 5 shows the response towards implementation of congestion pricing if the services of existing public transport has been improved. The analysis has been done by categorising them into types of user; private vehicles users and public transport users. 50% and 20% of the public transport users and private vehicles users respectively agrees with the implementation of congestion pricing. The results indicate that respondents whose primary transport mode is public transport show much stronger support for the congestion charge than their counterparts who predominantly drive to the city. It must be due to the costs needed to be paid by the personal drivers to fulfil their travel demand within the city compared with the public transport users. This is parallel with the previous findings in which initial travel pattern is a crucial factor determining a congestion charge's net effects on people's everyday life (Eliasson and Mattsson, 2006).

The data collected in Section D of the survey were analysed according to the amount of congestion charge to which the respondents are willing to pay and shift from private vehicles to public transport. It was done by using linear regression to develop a logistics model from the

shift percentage of private vehicle to public transport with two different determinants. Table 2 shows the percentage shift from private vehicles to public transport based on the charging amount.

Table 2: *Percentage Residents Shift to Public Transport Based on Congestion Charge Price (RM)*

Congestion Charge Price (RM)	Will Shift	% Shift Percentage
3	24	40
4	43	71.67
5	55	91.67
6	57	95.00
7	59	98.33
8	60	100.00

Based on the table, it is found that there are only 40% of the residents will shift to public transport when the congestion charge amount is RM3.00 and the maximum amount of RM8.00 will cause all the respondents to shift to public transport. Table 3 shows the probability of residents to shift to public transport based on the gender. There are two logistic models were developed based on data from Table 3.

Table 3: *Probability Residents Shift to Public Transport Based on Gender*

Congestion Price (RM)	Will Shift		% Shift Percentage	
	Male	Female	Male	Female
3.00	5	19	27.78	45.24
4.00	12	31	66.67	73.81
5.00	16	39	88.89	92.86
6.00	16	41	88.89	97.62
7.00	17	42	94.44	100
8.00	18	42	100	100

The result shows that the maximum amount of congestion charge for the female to shift to public transport is RM 7.00 while for the male is RM 8.00. This is parallel to the study which

shows that female is more supportive towards the use of public transport than the male (Grieco et al., 1989).

4. Conclusion

For this study, the aims were achieved, namely to evaluate and analyse the response of Kota Kinabalu City residents' towards the implementation of congestion pricing as well as to obtain the modelling for their readiness to shift to public transport if the congestion pricing is implemented in Kota Kinabalu City. The logistic model for the person who shifts to public transport according to the price of congestion charge (RM) is shown in Equation 2 below:

$$P = 1\frac{1}{1+1.26136e^{-0.34350x}} \qquad (2)$$

Next, the model developed for individuals who are ready to shift to public transport based on gender is shown in Equation 3, which is for males and Equation 4 for females respectively:

$$P = 1\frac{1}{1+1.89274e^{-0.31994x}} \qquad (3)$$

$$P = 1\frac{1}{1+0.21718e^{0.05599x}} \qquad (4)$$

Based on the study, it can be concluded that the congestion charge price (RM) affects the readiness of Kota Kinabalu City residents to shift from using their personal vehicles to public transit. The higher the amount being charged, the more people will decide to shift to public transport. Hence, it is really important for the transportation experts and city planners to enhance the existing system of public transport as to ensure that it will attract the users especially among the women as this pilot study has proven that if the residents of Kota Kinabalu City are charged with the congestion pricing, women are more likely to switch to public transport as compared to men. Hence, for the future research, this pilot study can be used as the guidance for creating the questionnaire of real survey with the close-ended questions. However, the limitation for this study is that the proposed congestion charged area should be specified so that the respondents can examine for the suitability of its introduction.

5. Acknowledgements

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