Public Perception of Shifting from Private Transport to Public Transport in Kandy, Sri Lanka: Willingness to Pay Analysis

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Abstract

Severe traffic congestion in main urbanized cities such as Kandy is one of the major developments Sri Lanka is currently dealing with. Existing road capacity is insufficient to meet the transport requirements of increasing vehicle population. In this context, this study aims at attracting private vehicle users to improve public transport as a sustainable solution to this severe traffic congestion. In this context, this study attempts to address the question of what is people's willingness to pay for the improved public transport to reduce traffic congestion. As a research methodology, willingness to pay for public transport was estimated to identify the affordability and people's attitudes pertaining to shifting from private transport to public transport by using single bounded dichotomous choice method. Derived estimates indicate that mean willingness to pay to enter Kandy City through Kadugannawa is approximately four times higher than the average ticket price of bus, indicating the high tendency of utilizing public transport if certain criteria are met. Further, results reveal that income, travel time as major determinants of peoples' willingness to pay towards improved public transport and educational level, employment category and age also have considerable impact. Based on these findings, this study argues that the public is willing to substitute private transport with improved public transport, allowing a significant reduction of traffic congestion which leads to reducing its burden on the national economy.

***Keywords**: Single bound dichotomous choice, Traffic congestion, Transport, Willingness to Pay*

1. Introduction

Kandy, one of the main cities in Sri Lanka is subjected to severe traffic congestion daily, because of several root causes. As Jayatilaka (2003) reveals, 331,000 passengers daily enter the city and 69 percent of them travel by bus while only 31 percent use other modes of transport.

Differently, the contribution of bus and other modes of transport for traffic congestion are 14 percent and 86 percent respectively which highlights the massive usage of private vehicles. Further, 41,579 vehicles enter the city daily while only 29,165 vehicles leave the city which emphasize that, 12,165 vehicles are added to the traffic congestion by the internal roads of the city (Jayatilaka, 2003). A limited area, topographic features, location of major institutions such as hospitals, schools, railway stations, and bus stands, etc., massive private vehicle usage and weak public transport (PT) can be identified as traffic creators of Kandy.

Similarly, as the economy reaches greater development levels, subsequently vehicle population increases, which is followed by the rising per capita income of the economy (Kumarage A., 2019). Existing road capacity is insufficient to meet with the transport requirements of the increasing vehicle population. As statistics of the Department of Motor Traffic indicate, the total vehicle population has increased by an average 8.6 percent within 2008 to 2018 which is greater than both the average population growth and the average economic growth of Sri Lanka.

However, this severe traffic congestion in the Kandy city can be identified as a significant problem which should be tackled immediately. The increasing vehicle population growth coupled with high-intensity urbanization which makes the traffic condition in the Kandy city worse. Similarly, this creates negative impacts on all the individuals at the micro-level by weakening their productivity and presence on socioeconomic activities which ultimately affect the national economy.

As mentioned, a large volume of vehicles and limited road capacities intensify traffic congestion, which increase the economic cost. To overcome this problem, many recommendations have been made based on several studies and projects which have been implemented. Even though most of the projects focus on improving transport infrastructure to increase capacity, they are not substantial solutions that have the capability to address the problem of traffic congestion in the long term. Differently, even though vehicle ownership correlates with economic development and per capita income, utilizing private means of transport can be altered. Reducing private vehicle usage by attracting private vehicle users to improved PT can be identified as a sustainable solution for this massive traffic congestion (Kumarage, 2004). Thus, identifying the individuals' preference, response, and willingness to pay (WTP) for improved PT are major pre-requirements to provide and implement such policies.

1.1. Problem Statement

Severe traffic congestion can be identified as one of the major problems in Kandy city today mainly because of several reasons as mentioned above. This incurs an enormous loss to the individuals and national economy through several aspects. Differently, most of the traffic reducing projects mainly focus on improving the capacity of road network through infrastructure development which is not a sustainable solution because of the inability to answer the root cause of traffic congestion: increasing vehicle population. With development, the purchasing power of people is increasing and majority will be able to afford private vehicles for their transport requirements. Meantime, quality and attraction of the public transport has reduced which critically affects people to shift to private means of transport. Therefore, this paper attempts to investigate whether the attracting private vehicle users to improved public transport is a sustainable solution for the traffic congestion by addressing the question of what is people's willingness to pay for the improved public transport system.

1.2. Research Objectives

The general objective of this study is to estimate the people's willingness to pay for the improved public transport system. The study has two specific objectives,

1. Estimate the people's willingness to pay for the improved public transport system.
2. Identify the factors affecting individuals' WTP for PT in Kandy city.

2. Literature Review

Contingent Valuation (CV) is a method developed to identify respondents' preferences or WTP (Seck, 2016) which was introduced by Davis (1963) in his article on Recreation Planning as an Economic Problem. Originally CV was basically an intellectual exercise with limited practical relevance. Many authors have criticized the methodology of CV which is the subject to various forms of biases. In addition, different results have been found depending on the elicitation methods employed and the way in which the context of the product provision is described (Sakashita, Jan, & Ivers, 2012). These issues regarding the practical relevance of CV were answered through the commission appointed by the National Oceanic and Atmospheric Administration, which concluded that CV was capable of generating estimates reliable enough to be used in court. Further, the commission emphasizes that the design of the questionnaire, its application, and the analytical technique are key attributes when developing a reliable CV study (Lopez-Feldman, 2012).

Based on varying perspectives, different authors have examined WTP for improving PT in several ways. Jain, Aggarwal, Kumar, Singhal, and Sharma., (2014) identified public preferences using multi-criteria decision making for assessing the shift of urban commuters from private to PT in Delhi and discovered that commuters were willing to pay more for better PT service seeing as the travel cost was not considered to be an important criterion. Bachok and Ponrahono (2017) studied WTP for improved PT service by adopting chi-square analysis as operational methodology. However, this study emphasizes that modeling the exact utility function of preferences for higher fares cannot be carried out successfully at 95 percent confidence level, due to the relatively small number of respondents stating their undecided response to WTP for the additional fare rate. Mahirah, Azlina, Nazirah, Yacob., (2015) conducted a logit analysis to estimate the valuing road user's WTP to reduce traffic congestion in Kalang Valley, Malaysia, and found that the mean WTP is about RM 1.95 for toll payment in Kalang Valley highways. Furthermore, results also showed that household income, respondents' occupation, and price bid toll payment have significant effects on the WTP to reduce traffic congestion. Miskeen, Alhodairi, Borhan, and Ismail, (2016) measured car drivers' WTP for improved intercity transportation service while taking Libya as a case study. In this study, different models namely the logit and spike models are applied to estimate the mean of the WTP and as a large number of respondents were unwilling to pay any money for the different proposed policies on transportation, the spike model was used to avoid errors in estimation and create a WTP pricing model for the different proposed policies on transportation. Authors have concluded that spike model outperforms the logit model, significantly. In contrast, Eboli and Mazzulla, (2008) adopted both MNL and ML models to estimate the WTP of public transport users for improvement in service quality, and as the results of the study emphasized, Rho squared corrected statistic and LR statistic both confirm that ML is statistically better that MNL. The obtained WTP value suggests that users would pay 22.8 Euros in order to have 68 runs/day, which is 0.34 Euros per run.

Moreover, Sakashita, et al., (2012) conducted a methodological review of the CV techniques such as open-ended question versus referendum format; ex-ante valuation versus ex-post valuation, and confirmed the relative efficiency of Single Bound Dichotomous Choice (SBDC) method. (Sakashita, et al., 2012)

Therefore, this study employed the SBDC technique to estimate the WTP for improved public transportation in Kandy city.

To construct the empirical model, as the basic form, WTP for improved public transport can be estimated by assuming it as a linear function as follows,

$$WTP_i(x_i, \varepsilon_i) = x_i\beta + \varepsilon_i \quad (1)$$

Where x_i is a vector of explanatory variables which explain the WTP for improved PT, β is a vector of parameters and ε_i is an error term. As mentioned above, it is assumed that the respondent will answer "yes" if his WTP for improved PT is greater than the suggested amount ($WTP_i > P_1$).

In the SBDC method, the respondent is asked whether he/she would pay some given amount (P_1) for an improved PT and the conditional probability of responding "yes" can be expressed as,

$$\begin{aligned} Pr(yes \mid x_i) &= Pr(WTP > P_1) \quad (2) \\ &= Pr(x_i\beta + \varepsilon_i > P_1) \\ &= Pr(\varepsilon_i > P_1 - x_i\beta) \end{aligned}$$

if ε_i is assumed to be normally distributed [$\varepsilon_i \sim (0, \sigma^2)$],

$$\begin{aligned} Pr(yes \mid x_i) &= Pr\left(\varepsilon_i > \frac{P1 - xi\beta}{\sigma}\right) \quad (3) \\ &= 1 - \Phi\left(\frac{P1 - xi\beta}{\sigma}\right) \\ Pr(yes \mid x_i) &= \Phi\left(x_i\frac{\beta}{\sigma} - P_1\frac{1}{\sigma}\right) \end{aligned}$$

Where Φ is the standard cumulative normal which makes this model a Probit model.

The estimation can be conducted based on the likelihood function which is given below,

$$Ln(\beta, \sigma \mid x, P) = \sum_{i=1}^{N} \{ I_i \ln [\Phi(x_i\frac{\beta}{\sigma} - P_1\frac{1}{\sigma})] + (1 - I_i) \ln [1 - \Phi(x_i\frac{\beta}{\sigma} - P_1\frac{1}{\sigma})]\} \quad (4)$$

Where N is the sample size and *Ii* is considered as an indicator; which takes value 1 if the respondent answer "yes" and 0 otherwise. Maximizing this function provides an estimation of the parameter vector β and σ. Based on those findings, it can estimate the WTP:

$$E(WTP \mid \tilde{x}) = \tilde{x}\tilde{\beta} \quad (5)$$

Where the $\tilde{\beta}$ vector comprises of the values of explanatory variables and setting those values to the means will give the mean WTP while the median values provide the median WTP.

3. Methodology

3.1. Sources of Data

3.1.1. Questionnaire

To collect the primary data a survey was conducted between the 12th of October 2019 and the 20th of October 2019 and data were collected through face to face interviews based on a structured questionnaire. The questionnaire mainly comprised four sections of socio-demographic questions, the ability to pay questions, questions related to individual's transport behavior and willingness to pay questions. Further, both open ended and close ended questions were included in the questionnaire according to the requirements of the study.

3.1.2. Location

Kadugannawa to Kandy corridor is one of the major entrances to Kandy city. As the city located in the middle of the country, there are several types of journeys made for various purposes to and through Kandy. Therefore, Kadugannawa -Kandy entrance is used by passengers not only to enter the city but also to go to other destinations and can be considered as one of the busiest corridors to enter Kandy as it needs immediate attention due to the problem of traffic congestion. In order to collect the data, a household survey was conducted because of the inability to conduct the survey on the road. By employing simple random sampling method, 389 individuals from 10 Grama Niladhari Divisions were selected located within the Kadugannawa Urban Council and Yatinuwara Division. Further, households were selected from the electoral lists of respective Grama Niladhari Divisions according to the random numbers generated by Microsoft Excel.

3.2. Empirical Model

Table 1: Description of Explanatory Variables

Variable	Variable Code	Description
		Individual Characteristics
Gender	GENDER	Individual's Gender (1=Female, 2=Male, 3=Other)
Age	AGE	Individual's age in number of years (1=< 20 years, 2=20-30 years, 3=30-40 years, 4=40-50 years, 5=50-60 years, 6=60<years)

Marital Status	MARRY	Individual's marital status (1= Married/ In Union, 2= Divorced/ Separated/ Widowed, 3= Single)
Highest level of Education	EDU	Individual's level of education (1= No Schooling/ Primary, 2= G.C.E (O/L), 3= G.C.E (A/L), 4= Diploma or equal, 5= Technical/ Vocational Training, 6= Bachelor's Degree, 7= Master's Degree and Above)
Employment	EMP	Individual's employment situation (1= Student, 2= Unemployment 3=Government Sector, 4= Private Sector, 5=Self Employed, 6=Owned Business, 7=Other)
Income	INCOME	Individual's monthly personal income in LKR
	Trip Characteristics	
Distance	DISTANCE	Distance from starting point to the end point of a trip of an individual in kilometers
Destination	DESTIN	Time spend at the destination by individual in minutes
Travel Time	TT	Time spent to go to the destination in minutes
Travel Cost	TC	Individual's cost per trip in LKR

Note. Author's compilation.

As revealed in the literature, the Single Bound Dichotomous Choice (SBDC) method was adopted when estimating individuals' WTP for improved PT service in Kandy city. One major constraint faced in the adoption of SBDC was the irrationality of providing specific bids to all respondents as ticket price of public transport depends on several factors such as distance to destination, type of PT, service level of PT and etc. Individuals' responses are directly affected by this as the bid does not show the true value of the improved PT. To overcome this limitation, this study has adopted an innovative method of offering bids to respondents based on the current cost of one trip of PT to Kandy city (100 percent of current ticket price). Also, respondents were offered a hypothetical situation related to improved PT based on the guidelines given by the Sri Lanka Transport Board.

WTP modeling consists of model specification and estimating of WTP for improved PT. In model specification pertaining to WTP modeling, it is necessary to identify which independent variables have a significant impact on the individual's WTP. Socio-economic characteristics of the respondent and trip characteristics (Table 1) are considered as the independent variables in the model specification. The coefficients of the explanatory

variables and the mean WTP is estimated by maximizing the log-likelihood function derived in the literature review by using the maximum likelihood estimation method.

4. Results and Discussion

Under the Single Bound Dichotomous Choice (SBDC) method, the mean WTP for improved PT is LKR 282 with the controls and it is not significant as shown in Table 2. Nevertheless, WTP without controls is LKR 152 under the 99 percent confidence level. According to survey data, the current mean ticket price of PT (Bus) from Kadugannawa to Kandy city is LKR 35.30, and the mean WTP amount for an improved PT system is LKR 152 which has been increased by 334 percent. In addition, survey results emphasize that the mean distance from the surveyed area to the city is 15 km approximately. It highlights that the current bus fare of LKR 2.33 per km gets increased to approximately LKR 10 per km with an improved PT. Further, an individual's WTP for an improved PT system is higher than the current charges of PT and it emphasizes the people's tendency of shifting towards an improved public transportation system.

Table 2: Mean WTP for Improved PT service

With control	162.7395
	(0.284)
No Control	152.6379
	(0.000)

Table 4 shows the determinants of the individual's WTP for further analytical purposes. People's WTP for an improved PT system is directly influenced by several characteristics of individuals and their transport requirements.

Table 3: Determinants of WTP for Improved PT

Variable	Coefficient	P-vale
Constant	1.804286**	0.015
Bid 1	-.0066247	0.422
Income	6.59e-06**	0.071
Time	-.0008256***	0.002
Cost	.0004233	0.923
Male= (Reference Category)		
Female	-.267318	0.218
< 20 years = (Reference Category)		

20 -30 years	.3949989*	0.0638
30-40 years	.5885166*	0.097
40-50 years	.0715179	0.841
50-60 years	.0119416	0.978
60< years		
Single = (Reference Category)		
Married/ In Union	-.7415072**	0.026
Divorced/ Separated/ Widowed	-.1433351	0.675
No Schooling/ Primary = (Reference Category)		
G.C.E (O/L)	-.6520008**	0.010
G.C.E (A/L)	.1063917	0.746
Diploma or equal	-.2376771	0.449
Technical/ Vocational Training		
Bachelor's Degree	-.9569113**	0.034
Master's Degree and Above	.5476289	0.291
Student = (Reference Category)		
Unemployed	.0071433	0.992
Government Sector	.5768327***	0.002
Private Sector	-.0149943	0.952
Self Employed	-.083463	0.791
Owned Business		
Other	.8532175	0.178
No= (Reference Category)		
Yes	-.4753724**	0.019
Log likelihood	-113.1208	
LR chi^2	47.40	
P-value	0.0013***	
Pseudo R^2	0.1732	
N	369	

Note. *, ** and *** represent statistical significance at 10%, 5% and 1% respectively.

As per the table 3, income is a significant determinant of WTP for improved PT. High-income earners have relatively higher purchasing power and they tend to respond positively for the bid amounts. This was also proved by Seck (2016) as his results suggested that income is a significant determinant of willingness to pay, and according to him, it is due to a higher tendency of higher-income visitors to accept bid offers. Moreover, costlier private modes of transport are already utilized by most of the high-income earners and paying these bid amounts to an improved PT system is not a burden for their daily financial activities. Paying this bid

amount for an improved PT is still profitable for them as most of them have already utilized private vehicles with a higher cost to travel in Kandy.

Furthermore, as results indicate, individuals who travel a long time are willing to pay a higher price for the improved PT. This situation also can be rationalized with the concept of higher opportunity cost as discussed before. With higher travel times, people have to compromise other activities and if people are able to minimize the travel time, they are able to utilize that time elsewhere. Further, reducing travel time is a part of the hypothetical situation which was given to the respondents when they respond to WTP questions. Therefore, it can be argued that one of the current constraints of using PT is higher travel time. Hence, these findings emphasize the possibility of attracting private vehicle users to PT, given the ability to fulfill the requirements of individuals. Several previous studies also support these findings (Eboli & Mazzulla, 2008).

Married (in union) people are more likely to pay higher charges for an improved public transport system than single individuals with a significant positive coefficient under 95 percent confidence. As mentioned before, married people are more stable in their financial and economic perspectives compared to others and independent as households (Dew, 2016). Additionally, most of the married people have relatively better purchasing power in their daily transactions to make their own lives better by being a member of the country's labor force (Vogler & Pahl, 1994). This argument is applicable to explain the behavior of the age group of 20-30 and 30-40 years which have a positive significant coefficient under 95 percent of confidence. People in these age brackets are more likely to pay a higher price for improved PT than individuals younger than 20 years. Individuals in these age brackets have relatively higher earning capacity than the base category which clearly allows them to pay a higher amount for improved PT. In addition, results show that government servants are more likely to pay higher prices for improved PT relative to students. Such behavior can be rationalized employing the argument of increased purchasing power. On the other hand, government servants are staying at the destination around 6-8 hours and it is very difficult and ineffective to utilize private vehicle for this travelling purpose. Furthermore, because of the parking cost and higher risks that align with private vehicles, there is a higher opportunity cost involved as well. Therefore, government servants are more likely to pay higher charges for an improved PT service.

As results show highly educated individuals who have above the level of education from technical/vocational training and master's degree are more likely to pay a higher price for an improved PT system. As Ashford (2010) emphasizes higher education level increases the productivity of the individuals which creates a higher internal and external value and increase the purchasing power of the people. Not only that, as previously mentioned, using private vehicles has intrinsic risks and higher costs due to the insufficient parking space. Therefore,

likelihood to pay higher price for improved PT is higher in people who have higher education levels.

5. Conclusion

This study is entirely based on people's perception of shifting from private transport to public transport and mainly focuses on estimating people's WTP for improved PT. In order to carry out the analysis, this study has taken 389 individuals in Yatinuwara Divisional Secretariat, Kandy as the sample through simple random sampling technique. To estimate the individual's WTP for improved PT, WTP analysis was conducted by adopting the single bound dichotomous choice method. Findings indicate that people's WTP for improved PT is LKR 152 and travel time, income, gender, employment and education can be considered as the major determinants of it. As the findings reveal, determinants of the WTP for improved PT can be taken into account to attract the people towards PT. Moreover, people tend to pay a higher price for improved PT by reducing the use of private vehicles if certain conditions are satisfied. Finally, the analysis emphasizes the possibility of attracting private vehicle users to PT which would directly mitigate the traffic congestion.

5.1. Policy Recommendations

As this paper argues, Sri Lanka needs a sustainable solution to tackle the problem of traffic congestion as soon as possible. Even though the government and several other organizations try to expand the infrastructure, it does not have the potential to deal with the increasing vehicle population. Improving public transport can be identified as a priority to handle this problem. Sri Lanka Transport Board (SLTB) has published guidelines that public and private bus services should follow and the government needs to establish a system to check whether these guidelines are followed. On the other hand, without limiting to conventional public transport systems such as bus service and railway, the country should enhance its public transport capacity by introducing new methods such as Light Rail Transit (LRT). It will be a great help for the general public through several dimensions including minimum traffic congestion.

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