MOTORCYCLIST TO PUBLIC TRANSPORT: DRIVING FORCE AND AFFECTING FACTORS

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1. Introduction

In the recent decade, public transport has become a main issue in regards to solving transportation problems in Indonesia. Indonesian Ministry of Transportation records from 2003 show that 95.15% of vehicles in Jakarta, the capital city of Indonesia, are private vehicles. Motorcycles have increasingly become the most desirable private transport mode because of its easiness in mobility and cheap operational costs. In Yogyakarta, one of the major cities in Indonesia, motorcycles compose 79.72% of road traffic. The unreliability of public transport, most commonly buses, is the cause as to why people prefer to use private vehicles rather than public transport. Lately, Indonesia government is considering the urgency of a public transport reform to provide a proper service for passengers. The Trans Jakarta bus which using a separated lane and also the Trans Jogja bus have become an embryo of public transport reform in Indonesia. Unfortunately, the Trans Jakarta program which operated since January 2004 still could not yet sway the private vehicle user to public transport. This paper attempts to investigate the factors which may influence the people's motivation to use public transport. In regards to this, this research uses Trans Jogja as a case study. It is expected that the problems plaguing the Trans Jakarta project do not occur. This paper also shows the percentage of the willingness to shift from motorcycles as a choice of transport mode to Trans Jogja with or without additional motorcycle movement restriction policies.

2. Model Development

Factor analysis was used to find the factors influencing the transportation choices of the Trans Jogja passengers. The respondents, consisting entirely of motorcyclists, are surveyed regarding fifteen variables shown in Table 1. These determined variables are the desired properties of Trans Jogja. Thus, the direct opposite these values are the negative variables which will render general public transport (paratransit) avoided, such as bad physical conditions, inconvenience, unavailability of transport schedules, long dwelling times, speeding, and uncertain bus operating times.

Table 1: Respondent question variables

No.	Question	Target	No.	Question	Target
X_1	Bus security staff	Security	X_9	No dwelling time	Time Efficiency
X_2	Staff on the halt	Security	X_{10}	Easiness in access and egress	Reliability
X_3	Air conditioner availability	Comfort	X_{11}	Bus operation time until night	Service
X_4	Bus cleanliness	Comfort	X_{12}	Monthly subscriber ticket	Service
X_5	Politeness of bus staff	Comfort	X_{13}	Integrated ticket	Service
X_6	Time table and punctuality	Reliability	X_{14}	Subsidized ticket	Service
X_7	No mechanical problem	Reliability	X_{15}	Flat ticket prices	Service
X_8	Passenger boarding and unloading on the bus stops only				Time Efficiency

Since the factor analysis is limited to analyzing the potential variables, the ordered probit model was applied to estimate the percentage of transport modal movement. Powers, D.A. and Xie, Yu (1999) explained that there is no significant different between ordered probit model and ordered logit model. The difference between the two is largely historical, as they were developed independently of each other in separate disciplines, with probit model in social science (McKelvey and Zavoina, 1975) and logit model in biostatistics (McCullagh, 1980)[5].

Preliminary survey where respondent requested to choose three undesirable policies related to motorcycle movement restriction, shows that parking fee increasing, road pricing, compulsory lift zone, traffic ticket fee increasing, special lane for motorcycle, and speed limit were undesirable parameters by respondent respectively. Thus, three highest factors were presented to the respondents in eight scenarios as shown in Table 2.

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Table 2: Scenarios within ordered probit model

Type of Scenario	Scenario number							
	1	2	3	4	5	6	7	8
Increased parking fee		O			O	O		O
Road pricing			O		O		O	O
Compulsory lift zone				O		O	O	O

Subsequently, since the willingness to shift of motorcyclist as dependent variable and three policies in Table 2 above as independent variables, Equation 1 shows its mathematic formulation.

$$y_i^* = \alpha . f(\text{parking tariff}) + \beta . f(\text{lift zone}) + \gamma . f(\text{road pricing}) + \text{constant} \quad (1)$$

3. Model Application

(1) Data aggregation

This section depicts how the survey was achieved and what data must be provided. As formerly explained, motorcyclists are chosen as the sample respondents. In this case, not only workers but also students are considered in this research as the data from Bureau of Yogyakarta Regional Transportation shows that 46.85% of travel purpose in Yogyakarta city is going to and from schools/universities. It should be noted that Yogyakarta is a popular city in regards to educational institutions. The two hundred and eighty respondents are divided into 2 categories: (1) a group whose destinations can be reached using the Trans Jogja bus (hereby referred to as Pass Respondents), and (2) a group whose destinations cannot be reached with Trans Jogja bus (hereby referred to as Non Pass Respondents).

The questionnaire form is divided into three segments. First is a segment consisting of general questions like occupation, sex, travel purpose, and transport cost. The second segment contains questions regarding desirable public transport service. Respondents are required to give a priority scale ranging from 1 to 5 concerning the desirable factors in Trans Jogja operation as shown in Table 1. Respondents should give a score of five when the offered variable is deemed very important, and a score of one when deemed unimportant. The third segment concerns undesirable policies regarding restriction of motorcycle movement. The state preference survey method was used in this segment. Respondents are questioned regarding their willingness to change transport preferences if motorcycle movement restriction policies are enforced and public transport services are improved. For each scenario provided, the respondent is to state the percentage of willingness ranging from 0% to 100% in 10% range groups. When the respondent chooses 0 – 10% in requested scenario, it represents that they only have a weak desire to change their transportation means. Conversely, if they choose 90 – 100%, it shows a strong desire to change transportation means.

(2) Public transport passenger expectation

To obtain the desirable factors regarding the Trans Jogja bus operation with respect to transport modal shift, factor analysis using the SPSS v.15 (Statistical Product and Service Solution) software was used. First, sampling adequacy is measured to know the correlation and accuracy of each variable by calculating the Kaiser Mayer Olkin (KMO) value ranging from 0 to 1. When these values are less than 0.5, the related variable is considered unpredictable and must be left out from the next analysis[3)]. From analysis process, the result shows that all KMO values are more than 0.5 either for pass or non pass respondents with a minimum value is 0.574 for the bus security staff variable, thus concluding that all variables can be processed. The second step is the extraction process on the set of variables thus producing one on more factors. From the fifteen analyzed variables, five latent factors were generated both for pass and non pass respondents. The latent factors were determined based upon presence of Eigen values greater than or equal to 1[3)]. Following this, the original fifteen variables are then to be included in each suitable latent factor based on the highest loading factor value. This value shows the correlation tendency among the original and latent variables. For the final step, a rotation process is carried out to strengthen the correlation by maximizing or minimizing the loading factor value and this result is shown in Table 3.

Table 3: Variable categorizing in each latent factor

No	Latent Factor	Pass Respondent	Non Pass Respondent
1	A	X_{15}(0.782), X_{12},(0.778) X_{11}(0.612), X_{14}(0.537)	X_9(0.759), X_6(0.719), X_7(0.718), X_{14}(0.549), X_{11}(0.487), X_8(0.398)
2	B	X_1(0.804), X_2(0.769)	X_{13}(0.827), X_{12}(0.806), X_{15}(0.473)
3	C	X_3(0.817), X_4(0.686), X_5(0.488), X_{13}(0.425)	X_2(0.886), X_1(0.881)
4	D	X_{10}(0.709), X_7(0.692), X_6(0.579)	X_4(0.792), X_3(0.757), X_5(0.484)
5	E	X_9(0.771), X_8(0.725)	X_{10}(0.613)

Dillon (1984) explained that factor naming is based upon the highest load factor value. If there are two or more consists of a derivative from the same attribute, factor naming is corresponds with its attribute name[1)]. Based on this it can be seen from table 3 that for pass respondents that X_{15} represents latent factor A (service), X_1 represents latent

factor B (security), X_3 represents latent factor C (comfort), X_{10} represents latent factor D (reliability), and X_9 represents latent factor E (time efficiency). While for non pass respondent, X_9 represents latent factor A (time efficiency), X_{13} represents latent factor B (service), X_2 represents latent factor C (secure), X_4 represents latent factor D (comfort) and X_{10} represents latent factor E (reliability).

From above result can be reported that for pass respondent, the bus service category: flat ticket prices, monthly subscriber tickets, bus operation time until night (10.00 pm), and subsidized tickets are the main parameters to shift motorcyclists to Trans Jogja. For non pass respondents, time efficiency is the main parameter thus emphasizing that vehicle dwelling times should be non-existent (the bus does not wait idly for passengers), time table availability and bus punctuality, no occurrences of mechanical problems, subsidized ticket, bus operation times until night (10.00 pm), and boarding and unloading passengers only at the bus stops. Also, the results reveal that that bus operation time and subsidized tickets are two variables chosen both pass and non pass respondent. Thus it can be concluded that respondents greatly expect that Trans Jogja buses will be operate until night time and inexpensive bus ticket prices compared to motorcycle operating costs.

(3) The Percentage of Transport Modal Movement

This section attempts to find the movement percentage of transport modal in regards to policy implementation. Based on the selections by respondents in each scenario, a log likelihood function was used to find each parameter in Equation 1. The values are displayed on Table 4. The ordered probit model also correlates the percentage choice ranges with the range of the dependent variable, y_i^* values as shown in table 5. The LIMDEP v.7 (LIMited DEPendent variable model) software was used to solve all of the ordered probit model processes.

Table 4: Estimated parameters of equation model

Parameter	Pass Respondent	Non Pass Respondent
α	0.4776	0.4972
β	0.2768	0.3357
γ	0.3383	0.2945
Constant	0.7776	0.3023

Table 5: Percentage of modal movement

y_i	Range	Pass Respondent	Non Pass Respondent
0	0% – 10%	$y_i^* \leq 0$	$y_i^* \leq 0$
1	10% – 20%	$0 < y_i^* \leq 0.3503$	$0 < y_i^* \leq 0.3054$
2	20% – 30%	$0.3503 < y_i^* \leq 0.7662$	$0.3054 < y_i^* \leq 0.6843$
3	30% – 40%	$0.7662 < y_i^* \leq 1.1251$	$0.6843 < y_i^* \leq 0.9974$
4	40% – 50%	$1.1251 < y_i^* \leq 1.5798$	$0.9974 < y_i^* \leq 1.3572$
5	50% – 60%	$1.5798 < y_i^* \leq 1.8504$	$1.3572 < y_i^* \leq 1.6411$
6	60% – 70%	$1.8504 < y_i^* \leq 2.1041$	$1.6411 < y_i^* \leq 1.8278$
7	70% – 80%	$2.1041 < y_i^* \leq 2.4638$	$1.8278 < y_i^* \leq 2.1064$
8	80% – 90%	$2.4638 < y_i^* \leq 2.8972$	$2.1064 < y_i^* \leq 2.4023$
9	90% – 100%	$2.8972 < y_i^*$	$2.4023 < y_i^*$

Independent sample t test using a significance level of 98% was carried out to reveal whether or not there is a difference between model result and field data. The result shows that t= 2.047 for pass respondent and 2.235 for non pass respondent, both within the 98% confidence intervals of $t_{-\alpha/2}$= -2.326 and $t_{\alpha/2}$= 2.326. The values of t give a probability value for pass respondents of 0.041 and a value for non pass respondent of 0.026, both greater than α/2= 0.01. Thus, it can be concluded that there is no significant difference among model and observation result and above parameters can be accepted.

From Table 4 and Table 5 it can be seen that if no policies are be implemented, y_i^* for pass respondent is a constant value of 0.7776. Referring to Table 5, a y_i^* of 0.7776, is correlated to a willingness to move percentage range of 30% - 40%. But basically, this value does not consider the actual value of y_i which ranges from 0 – 9 thus due to the Equation 1 incorporating the x-attribute only (parking tariff, lift zone, and road pricing). Therefore, a formulation that describes the probability of willingness to move that incorporates the value of y_i must be found. Greene (1998) formulates the mathematic equation as follow (Equation 2)[2].

$$\text{Prob}\,(y_i = j) = f\,(\mu_j - \beta.x) - f\,(\mu_{j-1} - \beta.x) \quad (2)$$

Where, j is movement level in percent, μ is threshold parameter, and -β.x is the model calculation result. This paper only shows the probability value using a y_i value of 9 which considers a strong confidence answer from the respondent to stay or leave their transport modal shown in Table 6.

Table 6: Probability of transport modal movement for $y_i = 9$ (90% – 100%)

Respondent	Probability							
	1st scenario	2nd scenario	3rd scenario	4th scenario	5th scenario	6th scenario	7th scenario	8th scenario
Pass	0.0170	0.0505	0.0329	0.0375	0.0853	0.0979	0.0668	0.1515
Non Pass	0.0179	0.0548	0.0392	0.0351	0.1020	0.0951	0.0708	0.1660

Table 6 explains that if there is no policy to restrict the movement of motorcyclist, there is only a probability of 1.70% for pass respondent and 1.79% for non pass respondent to change their transport modal and use the Trans Jogja bus. As also shown in Table 6, the highest transport mode movement occurs when three policies are applied, giving a 15.15% and 16.60% probability of shift. If only two scenarios applied, the increase of parking fee and issuing of compulsory lift zones become the potential scenarios to shift motorcyclist to use the Trans Jogja bus, with 6.68% for pass respondents and 7.08% for non pass respondents.

As the final analysis, this paper attempts to show the supporting data if above recommended policies are implemented. Relating to parking fees, Rp. 1000 - Rp. 3000 is the range of parking fees which felt to be burdensome by motorcyclists. Then, along Malioboro Street and Mangkubumi Street are route will be avoided by motorcyclist if road pricing policy or compulsory lift zone policy is implemented. The summary of the results from data survey are show in Figure 1 below, where such determined road (Maliboro – Mangkubumi Street, Sudirman – Diponegoro Street, and Urip Sumoharjo Street) based on the main roads in Yogyakarta city where congestion often occurs everyday particularly at peak hour.

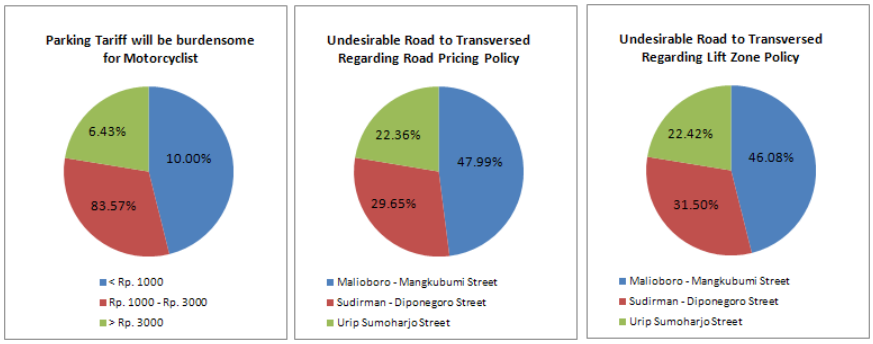

Figure 1: Supporting data result

4. Conclusions

This research attempts to propose the influencing factors of motorcyclist to leave their transport modal and use Trans Jogja bus. Hopefully, this paper can be used as a reference for consideration of the Bureau of Regional Transportation in Yogyakarta to operate Trans Jogja bus. This study shows that bus operation time until 10.00 pm and subsidized tickets are the two main desirable factors chosen both for pass and non pass respondent. Also, bus service is the main parameter considered by pass respondents, whilst time efficiency is main parameter for non pass respondents. If there is no policy to restrict motorcycle movement, only 1.70% of pass respondents and 1.79% of non pass respondents will change and using Trans Jogja bus. However, when all policies are implemented (increase of parking fee, road pricing, and compulsory lift zone) 15.15% of pass respondents and 16.60% of non pass respondents will use the Trans Jogja bus. If there is only two policies will be chosen, the policy of parking fee increasing and compulsory lift zones are deemed sufficient to shift motorcyclists with 6.68% and 7.08% for both pass and non pass respondents. Further research will be carried out to find the travel behavior of students in Yogyakarta related to the Trans Jogja operation and its competition with paratransit and motorcycle transport after 1 year implementation of Trans Jogja bus.

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