URBAN TOLL ROAD USERS' VALUE OF TIME SAVING

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Abstract: One important component in determining toll road charges in Indonesia is value of time. This paper is focused on the derivation of value of time savings for toll road users from stated preference (SP) data.

Route choice and SP surveys were conducted during two weeks commencing in mid of January, 2000, at several places located around Jakarta. First location is Jakarta Intra Urban Toll Road (JIUTR) with the opened system tariff, in which the flat fare is applied. Second, is several links with closed system tariff, such as Jakarta Outer Ring Road (JORR), Jakarta-Tangerang, Jakarta Cikampek and Jakarta-Ciawi link (Non-JIUTR), in which the fare is applied as function of distance.

Toll road users are grouped in two main market segmentations, trip to work and travel as part of work. Travel as part of work place a higher value of time savings than trip to work, about 22% higher using maximum likelihood or 13% using regression analysis. The value of travel as part of work time savings expressed as a percentage of wage rate is about 18.5%-25% compared to 34%-47% for trip to work using maximum likelihood, and 18%-24.5% compared to 31%-43% using regression analysis. The value of time for overall data, Jakarta without segmentation, is Rp 4,422/person hour using maximum likelihood and Rp 4,378/person hour using regression analysis.

Key Words: stated preference, toll roads, timesaving, value of time

1. BACKGROUND

The determination of toll road charges in Indonesia, until now, has been based on formulation of vehicle operating cost (VOC) calculations. The determination of maximum allowable charge is based on a certain proportion of VOC saving from travelling on the toll road. There

are two key principles mentioned in the classification of Indonesian Road Law Number 13, 1980:

1. Toll charges plus vehicle operating costs of using a toll road shall not be higher than the total vehicle operating costs of using ordinary non-toll road.
2. The component of vehicle operating cost comprises fuel, lubricant oil, depreciation and time value.

Furthermore, the maximum allowable charge shall not be higher than 70% of VOC saving.

Based on the law, the component of value of time is included in the VOC savings. Until now, in Indonesian practice, the determination of VOC does not include the stipulation of empirical time values based on field surveys of toll road users.

The value of time savings, hereafter called time value, of toll road users is very important, considering the high contribution of the time cost component to the VOC savings. Unfortunately, until now there are still very limited studies on time values based on Indonesian toll road users' route choice behavior.

This paper reports on the derivation of value of timesaving based on stated preference data obtained from urban toll road users in Jakarta.

2. UNDERSTANDING TRAVEL BEHAVIOUR

2.1 Basic Theory of Choice Behaviour

The basic theory of choice behavior is based on the classical economic concept of individuals deriving "utility" from the consumption of a particular product. "Utility" represents the satisfaction on benefit that a person enjoys when spending his or her resources on different things. The utility measured by the stated preference techniques being discussed here is properly described as "indirect utility", because individuals choose between the different options, subject to constraints on their resources.

2.2 Random Utility

The random utility approach, formalised by Manski (1977), is more in line with consumer theory. The observed inconsistencies in choice behaviour are taken to be a result of observational deficiencies on the part of the analyst. The individual is always assumed to select the alternative with the highest utility. However the utilities are not known with certainty and are therefore treated as random variables. From this perspective the probability that the utility of alternative i for individual n, U_{in}, is greater than or equal to the utilities of all other alternatives in the choice set C. This can be written as follows:

$$P(i|C_n) = Pr[U_{in} \geq U_{jn},\ all\ j \in C_n] \quad (1)$$

Note that it is assumed that no ties occur.

In this approach choice probabilities are derived by assuming a joint probability distribution for the set of random utilities $\{U_{in},\ i \in C_n\}$.

In general, the random utility of an alternative as a sum of observable (or systematic), V_{in}, and unobservable (or random), ε_{in}, component of the total utilities can be expressed as follows:

$$U_{in} = V_{in} + \varepsilon_{in} \quad (2)$$

and expression (1) can be written as

$$P(i|C_n) = Pr[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}, \text{ all } j \in C_n] \quad (3)$$

There is such a way to think about the relative nature of the utilities. Let consider a choice between two alternatives, that is C_n as $\{i,j\}$, and rewrite the probability that n chooses alternative i in equation (3) as,

$$\begin{aligned} P_n(i) &= Pr(U_{in} \geq U_{jn}) \\ &= Pr(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}) \\ &= Pr(V_{in} - V_{jn} \geq \varepsilon_{jn} - \varepsilon_{in}) \end{aligned} \quad (4)$$

In other words, the probability that an individual, n, drawn randomly from the sampled population, will choose i from choice set C_n equals the probability that the difference between the random component of alternative j and alternative i is less than the difference between the systematic component of alternative i and alternative j for all alternatives in the choice set (Hensher and Johnson, 1981).

In this version, it can be seen that for a binary choice situation, the absolute levels of V and ε do not matter; all that matters is whether the difference in the V's is less than the difference of the ε's.

Ben Akiva and Lerman (1985) concerned with two criteria for selecting a functional form. First, the function should reflect any theory about how the various elements in x influence utility; second, the function should have convenient computational properties that make it easy to estimate their unknown parameters. In most cases of interest, the functions that are linear in parameters are commonly to be chosen.

$$V(x_{in}) = \beta_1 x_{in1} + \beta_2 x_{in2} + \beta_3 x_{in3} + \ldots + \beta_K x_{inK} \quad (5)$$

where $\beta_1, \beta_2, \beta_3, \ldots, \beta_K$ are parameters to be estimated.

2.3 Logit Analysis

The most widely available of 'random utility' analysis technique in practice is probably the Logistic Probability Unit, or Logit, model. To construct this probabilistic model, it is necessary to make some assumptions about the size and nature of the random component of random utility. The logit model depends on the assumption that the random components are (1) independently distributed, (2) identically distributed and (3) scattered according to the "Gumbell distribution". Assuming that ε's are independently and identically Gumbell distributed is equivalent to the assumption that $\varepsilon_n = \varepsilon_j - \varepsilon_i$ is logistically distributed,

$$F(\varepsilon_n) = \frac{1}{1 + e^{-\mu(\varepsilon_j - \varepsilon_i)}}, \mu > 0, -\infty < \varepsilon_n < \infty \quad (6)$$

where μ is a positive scale parameter. Besides approximating the normal distribution quite well, the logistic distribution is analytically convenient.

Under assumption that ε_n is logistically distributed, the choice probability for alternative i is given by

$$P_n(i) = Pr(U_{in} \geq U_{jn}) = \frac{1}{1 + e^{-\mu(V_{in} - V_{jn})}} = \frac{e^{\mu V_{in}}}{e^{\mu V_{in}} + e^{\mu V_{jn}}} \quad (7)$$

This is the binary logit model. Note that if V_{in} and V_{jn} are assumed to be linear in their parameters,

$$P_n(i) = \frac{e^{\mu\beta x_{in}}}{e^{\mu\beta x_{in}} + e^{\mu\beta x_{jn}}} = \frac{1}{1 + e^{-\mu\beta(x_{in} - x_{jn})}} \tag{8}$$

In the case of linear-in-parameters utilities, the parameter μ can not be distinguished from the overall scale of the β's. For convenience it is generally made an arbitrary assumption that μ = 1. Furthermore, maximum likelihood method is used to estimate the value of β's.

2.4 Maximum Likelihood With Discrete Data

The likelihood function is defined as

$$L^*(\beta_1, \beta_2, \beta_3, ..., \beta_K) = \prod_{n=1}^{N} P_n(i)^{y_{in}} P_n(j)^{y_{jn}} \tag{9}$$

Where:

L^* = likelihood function

$P_n(i)$ = function of $\beta_1, \beta_2, \beta_3, ..., \beta_K$

$$y_{in} = \begin{cases} 1 & \text{if individual } n \text{ choose alternative } i \\ 0 & \text{if individual } n \text{ choose alternative } j \end{cases}$$

In general it is more convenient to analyse the logarithm of L^*, denoted as L and written as follows:

$$L(\beta_1, \beta_2, \beta_3, ..., \beta_K) = \sum_{n=1}^{N} [y_{in} \log P_n(i) + y_{jn} \log P_n(j)] \tag{10}$$

y_{in}, noting that $y_{in} = 1 - y_{jn}$ *and* $P_n(j) = 1 - P_n(i)$,

$$L(\beta_1, \beta_2, \beta_3, ..., \beta_K) = \sum_{n=1}^{N} \{y_{in} \log P_n(i) + (1 - y_{in}) \log [1 - P_n(i)]\} \tag{11}$$

It will be solved for the maximum of L by differentiating it with respect to each of the β's and setting the partial derivatives equal to zero. Then the estimates $\beta_1, \beta_2, \beta_3, ..., \beta_K$ can be solved by

$$\max L(\beta_1, \beta_2, \beta_3, ..., \beta_K), \tag{12}$$

which, if they exist, must satisfy the necessary conditions that

$$\frac{\partial L}{\partial \beta_k} = \sum_{1=n}^{N} \left\{ y_{in} \frac{\partial P_n(i) / \partial \beta_k}{P_n(i)} + y_{jn} \frac{\partial P_n(j) / \partial \beta_k}{P_n(j)} \right\} = 0, \text{ for } k = 1, ..., K \tag{13}$$

Then the value of time is defined as ratio of the travel time coefficient to the travel cost coefficient (Hensher and Johnson, 1981).

2.5 Regression Analysis with Rating Data

Besides using discrete choice, it is also used the rating data. The rating data analyst sets to find a quantitative relation between the set of attributes and the response expressed in the semantic scale. For two alternatives route choice (toll and non-toll), then the binomial logit model can be stated as follow.

The probability in choosing toll:

$$P_1 = \frac{exp(U_1)}{exp(U_1) + exp(U_2)} = \frac{exp(U_1 - U_2)}{1 + exp(U_1 - U_2)} \tag{14}$$

The probability in choosing non-toll::

$$P_2 = 1 - P_2 = \frac{1}{1 + exp(U_1 - U_2)} \tag{15}$$

P_1 is defined as the difference between those two route choice functions. Since the utility function is linear, then the difference can be stated in term of the attributes differences (in this case toll tariff and travel time), as follow

$$(U_1 - U_2) = a_0 + \beta_1\left(X_1^{toll} - X_2^{non-toll}\right) + \beta_2\left(X_1^{tolltraveltime} - X_2^{non-tolltraveltime}\right) \quad (16)$$

Where U_1-U_2 represent individual respond to the choice statement, a_0 is a constant, β_1 and β_2 are coefficient for each attribute. Or in other words, the value of utility as individual respond can be represented in term of probability in choosing certain route (toll or non-toll), as shown below.

$$\ln\left(\frac{P_1}{1-P_1}\right) = a_0 + \beta_1\left(X_1^{toll} - X_2^{toll}\right) + \beta_2\left(X_1^{timeu} - X_2^{time}\right) \quad (17)$$

Furthermore, by defining the weight for each individual respond (j), in this case 1. definitely choose toll (0,8); 2. probably choose toll (0,6); 3. probably not choose toll (0,4); and 4. definitely not choose toll (0,2), then the value of β can be obtain using regression analysis.

Finally, for maximum likelihood as well as regression analysis, the value of time is defined as the result of the dividing between the coefficient of travel time and toll.

2.6 Logic of Stated Preference Data

Prior to further analysis of collected data, the data was identified whether they are suitable to the logic of stated preference. This logic has relation to the respondents' choice in cost/money and time trade-off, in the choice set. If respondent choose time in the lower level of time value, then his/her choice in the higher level of time value could be time or money, whereas, when money is the choice in the lower level of value of time, then, the choices in the higher level of time value have to be money. In other words, if respondent has difficulty related to money (the economic level is weak), then time would be insignificant.

3. STATED PREFERENCE QUESTIONNAIRE DESIGN

The basic concept is how to set up the cost and time trade-off in order to obtain the suitable design of questionnaire. In every trade-off value offered in the questionnaire, travellers would be asked to choose between toll road or non-toll road. The crucial matter is how to make sure that the trade-off values are in the transition range. Transition range is a range of trade-off value in which the choice change from toll road to non-toll road is occurred. In other word, the range in which travellers are not further willing to pay amount of money in order to save their travel time.

The questionnaire design discussed below is the final design after several pilot surveys have been carried out. Generally, two SP rating questionnaire were tested. First design is related to a purely hypothetical choice with travel time attribute consisting free move and delay time. Since the toll road is in existence, it seems not suitable to offer hypothetical choice to travelers without comparing with current condition. Therefore, it is considered to be necessary to modify the former design by offering the hypothetical choices that present the description of the current condition. Then the second was designed such that the choice was confronted with users' current experince choice condition. The main concept of the design is that the

respondent is offered to make a rating from "definitely choose toll road" to "definitely not choose toll road". The choice sets and the way utility is measured are shown in Table 1.

Table 1. The Second Questionnaire Design

No.	Travel Cost (compared with the current travel cost)	Travel Time (compared with the current travel time)	Choices			
			Definitely choose the toll road	Probably choose the toll road	Probably not choose the toll road	Definitely not choose the toll road
1	Current –Rp2.000,-	Current +30 minutes	1	2	3	4
2	Current –Rp2.000,-	Current +20 minutes	1	2	3	4
3	Current +Rp2.000,-	Current –10 minutes	1	2	3	4
4	Current +Rp3.000,-	Current –20 minutes	1	2	3	4
5	Current +Rp3.000,-	Current –10 minutes	1	2	3	4
6	Current +Rp4.000,-	Current –30 minutes	1	2	3	4
7	Current +Rp4.000,-	Current –10 minutes	1	2	3	4
8	Current +Rp5.000,-	Current –30 minutes	1	2	3	4
9	Current +Rp5.000,-	Current –20 minutes	1	2	3	4
10	Current +Rp5.000,-	Current -10 minutes	1	2	3	4

The obvious difference could probably be noted from the different questionnaire design. Data analysis from two hypothetical conditions i.e. 1st design tend to have a higher willingness to pay than what is obtained from the questionnaire that comparing hypothetical condition with the current condition i.e. 2nd design. This seems caused by a lot of influence that are not well accommodated by the form without comparing with any current conditions such presented in the first design.

From this pilot survey experience, it was also found that in a particular level of toll/time trade-off, respondents tend to consider the value of money as the main reason in their decision, then followed by time or even they do not consider the time at all.

Brief summary from the pilot surveys showed the low percentage of the valid data complied with the logic of stated preference. This result describes that the design obviously has to be modified.

The final questionnaire, used in this study, is resulted from those pilot surveys experience. The modification is focused on the change of attribute level and the elimination of tariff reduction choice (the first two choices in Table 1). The questionnaire was designed for two groups of respondents in distinct locations. The first location is Jakarta Intra Urban Toll Road (JIUTR) with the opened system tariff, in which the flat fare is applied. Second, is several links with closed system tariff, such as Jakarta Outer Ring Road (JORR), Jakarta-Tangerang, Jakarta Cikampek and Jakarta-Ciawi link (Non-JIUTR), in which the fare is applied as function of distance.

3.1 JIUTR Questionnaire Design

The experimental design involves asking each traveller to choose one of travel condition alternative in alternatives set that are offered. The condition of route alternative is defined in terms of two variables: a toll tariff and travel time. A toll tariff with levels of current, current+Rp 1,000, current+Rp 1,500, current+Rp 2,000, current+Rp 2,500 and current+Rp 3,000, and four levels of travel time: current, current-30 minutes, current-20 minutes and current-10 minutes.

The trade-off design is derived from the maximum number of combination of travel characteristic sets. The characteristic of travel, in this case, comprises travel cost represented by toll tariff and travel time. With two attributes, toll tariff with 6 levels and travel time with 4 levels, there are a maximum of $6^1 \times 4^1 = 24$ combinations. Even though, there are only 16 of these combinations are neither, considerably, dominated by or dominating any other alternatives. Dominance occurs when one alternative is superior to another on every attribute, so that no trade-off is involved in making a choice. The 16 non-dominant route alternatives are displayed in Table 1.

The design strategy called for choice sets to be constructed by comparing current condition (no. 1 in Table 2) with the one of the combinations of travel characteristics. By comparing to the current condition, then, there would be 15 possibility alternatives in the choice sets. As in first design, sets of route condition that are offered to the respondents were constructed based around the value attached to the attribute which ensure the competitive trade-off decision in any levels of value of time. So many options will tend to induce fatigue in the respondent and reduce the value of responses. Kroes and Sheldon (1988) suggest a range of 9 to 16 options as acceptable, then the 15 possibility alternatives should be reduced.

Table 2 Non-dominant Route Situation Alternatives for JIUTR

No.	Toll (Rp)	Travel Time (minutes)	Level of Value of Time (Rp/hour)
1	0	0	current
2	+1,000	-30	2,000
3	+1,000	-20	3,000
4	+1,000	-10	6,000
5	+1,500	-30	3,000
6	+1,500	-20	4,500
7	+1,500	-10	9,000
8	+2,000	-30	4,000
9	+2,000	-20	6,000
10	+2,000	-10	12,000
11	+2,500	-30	5,000
12	+2,500	-20	7,500
13	+2,500	-10	15,000
14	+2,500	-30	6,000
15	+3,000	-20	9,000
16	+3,000	-10	18,000

The alternatives that would be eliminated are the route condition that having the same level of value of time, because there should be only one pair represent every single level of value of time. Eventually, the travellers are offered to rate 9 route conditions (listed with shadow in Table 1). The considerations in choosing the condition are, first, avoiding the same the cost and time trade-off. Second, representing each level of cost attribute for different trade-off level (Rp 1,000, Rp 1,500, Rp 2,000, Rp 2,500 and Rp 3,000). The complete set of choice sets as the final design of the questionnaire for JIUTR is summarised in Table 3.

Table 3. The Final Questionnaire Design for JIUTR

No.	Travel Condition after Improvement		Choices			
	Travel Cost	Travel Time	Definitely choose the toll road	Probably choose the toll road	Probably not choose the toll road	Definitely not choose the toll road
1	Current +Rp1,000,-	Current –30 minutes	1	2	3	4
2	Current +Rp1,500,-	Current –30 minutes	1	2	3	4
3	Current +Rp1,500,-	Current –20 minutes	1	2	3	4
4	Current +Rp2,000,-	Current –20 minutes	1	2	3	4
5	Current +Rp2,000,-	Current –10 minutes	1	2	3	4
6	Current +Rp2,500,-	Current –20 minutes	1	2	3	4
7	Current +Rp2,500,-	Current –10 minutes	1	2	3	4
8	Current +Rp3,000,-	Current –20 minutes	1	2	3	4
9	Current +Rp3,000,-	Current –20 minutes	1	2	3	4

3.2 Non-JIUTR Questionnaire Design

The condition of route alternative for Non-JIUTR, the toll is defined with levels of current, current+Rp 5,00, current+Rp 1,000, current+Rp 1,500 and four levels of travel time: current, current-20 minutes, current-15 minutes and current-10 minutes. With the similar process, it is obtained 13 non-dominant route alternatives, displayed in Table 4.

Table 4 Non-dominant Route Situation Alternatives for Non-JIUTR

No.	Toll (Rp)	Travel Time (minutes)	Level of Value of Time (Rp/hour)
1	0	0	current
2	+500	-20	1,500
3	+500	-15	2,000
4	+500	-10	3,000
5	+500	-5	6,000
6	+1,000	-20	3,000
7	+1,000	-15	4,000
8	+1,000	-10	6,000
9	+1,000	-5	12,000
10	+1,500	-20	4,500
11	+1,500	-15	6,000
12	+1,500	-10	9,000
13	+1,500	-5	18,000

Again, with the comparing and reducing process and similar consideration, eventually, the travellers are offered to rate 8 route conditions (listed with shadow in Table 3). The complete set of choice sets as the final design of the questionnaire for Non-JIUTR is summarised in Table 5.

4. THE SURVEY

The extensive SP survey was carried out using the questionnaire commencing on mid of January, 2000. Two journey characteristics for each location are defined:

1. Home based trip (JIUTR and Non-JIUTR) or private commuter, defined as trip to work
2. Non-home based trip (JIUTR and Non-JIUTR) or business trip, defined as travel as part of work

Table 5. The Final Questionnaire Design for Non-JIUTR

No.	Travel Condition after Improvement		Choices			
	Travel Cost	Travel Time	Definitely choose the toll road	Probably choose the toll road	Probably not choose the toll road	Definitely not choose the toll road
1	Current +Rp500,-	Current –20 minutes	1	2	3	4
2	Current +Rp500,-	Current –15 minutes	1	2	3	4
3	Current +Rp500,-	Current –10 minutes	1	2	3	4
4	Current +Rp1,000,-	Current –15 minutes	1	2	3	4
5	Current +Rp1,000,-	Current –10 minutes	1	2	3	4
6	Current +Rp1,000,-	Current –5 minutes	1	2	3	4
7	Current +Rp1,500,-	Current –10 minutes	1	2	3	4
8	Current +Rp1,500,-	Current –5 minutes	1	2	3	4

In this survey, 457 respondents were interviewed. Refer to the logic of stated preference, there were 424 data remained valid, these data are subject to be analysed. Number of samples distribution based on market segmentation is listed in Table 6.

Table 6. Number of sample distribution for Each Market Segmentation

No.	Market Segmentation	No. of sample	No. of rejected sample
1.	JIUTR – home based trip	48	1
2.	JIUTR – non-home based trip	28	2
3.	Non-JIUTR – home based trip	251	23
4.	Non-JIUTR – non-home based trip	130	7

5. STATED PREFERENCE DATA ANALYSIS AND DERIVATION OF VALUE OF TIME

A general description of income level in each group of market segmentation, as a supported data in comparing the value of time, is shown in Table 7, in which income level is presented in terms of average monthly and hourly income.

Table 7. Average Income for Each Market Segmentation

Market Segmentation	Average Income per Month (in million rupiahs)	Average Hourly Wage Rate (in rupiahs)*)	
		Lower limit	Upper limit
home based trip	3.75	16,498	22,215
non-home based trip	2.70	10,692	14,721
Jakarta	3.38	14,024	19,543

*) 1 US $ ≈ 10,000 rupiahs

Meanwhile, the result of route choice using likelihood maximization and regression analysis is reported in Table 8 and Table 9 respectively.

The tables show the empirical parameter or coefficient estimates for deriving toll road users' value of time together with their standard error. The value of time is the ratio of coefficients on time and cost.

Table 8. Result of Route Choice Model and Value of time By Maximising The Likelihood

Market Segmentation	Toll Cost (Rp)			Travel Time (minute)			Time Value *) (Rp/person/hour)	No. of Sample	ρ^2 (0)	ρ^2 (c)
	Coefficient	Standard error	"T" ratio	Coefficient	Standard error	"T" ratio				
JIUTR-home based trip	-9.902×10^{-4}	2.27×10^{-4}	-4.4	-6.528×10^{-2}	2.00×10^{-2}	-3.3	**3.956**	48	0.18	0.16
Non-JIUTR-home based trip	-2.243×10^{-3}	1.80×10^{-4}	-12.4	-0.1217	1.52×10^{-2}	-8.0	**3.255**	229	0.24	0.23
Jakarta-home based trip	-1.644×10^{-3}	9.10×10^{-5}	18.1	-0.1126	8.78×10^{-3}	-12.8	**4.109**	277	0.22	0.21
JIUTR-non home based trip	-1.187×10^{-3}	2.99×10^{-4}	-4.0	-5.752×10^{-2}	2.63×10^{-2}	-2.2	**2.907**	26	0.17	0.17
Non-JIUTR-non home based trip	-1.575×10^{-3}	2.32×10^{-4}	-6.8	-0.1110	2.02×10^{-2}	-5.5	**4.229**	123	0.20	0.15
Jakarta-non home based trip	-1.268×10^{-3}	1.18×10^{-2}	-8.9	-0.1059	1.18×10^{-2}	-8.9	**5.011**	149	0.19	0.16
Jakarta	-1.494×10^{-3}	6.96×10^{-5}	-21.5	-0.1101	7.03×10^{-3}	-15.7	**4.422**	426	0.20	0.19

Table 9. Result of Route Choice Model and Value of time Using Regression Analysis

Market Segmentation	Toll Cost (Rp)			Travel Time (minute)			Time Value *) (Rp/person/hour)	No. of Sample	R^2
	Coefficient	Standard error	(Rp/person/hour)	Coefficient	Standard error	t stat.			
JIUTR-home based trip	-0.50×10^{-3}	8.67×10^{-5}	-5.75	-2.94×10^{-2}	7.73×10^{-3}	-3.81	**3.540**	48	0.24
Non-JIUTR-home based trip	-0.98×10^{-3}	6.83×10^{-5}	-14.41	-4.95×10^{-2}	5.50×10^{-3}	-8.99	**3.018**	229	0.29
Jakarta-home based trip	-0.71×10^{-3}	2.94×10^{-5}	-24.14	-4.81×10^{-2}	3.08×10^{-3}	-15.65	**4.065**	277	0.28
JIUTR-non home based trip	-5.00×10^{-4}	2.21×10^{-4}	-4.18	-1.88×10^{-2}	1.08×10^{-2}	-1.75	**2.234**	26	0.19
Non-JIUTR-non home based trip	-0.82×10^{-3}	1.20×10^{-4}	-8.28	-4.53×10^{-2}	0.81×10^{-2}	-5.59	**3.296**	123	0.20
Jakarta-non home based trip	-5.80×10^{-4}	4.26×10^{-5}	-13.58	-4.43×10^{-2}	4.45×10^{-3}	-9.95	**4.595**	149	0.20
Jakarta	-0.63×10^{-3}	2.59×10^{-5}	-24.50	-4.63×10^{-2}	2.78×10^{-3}	-16.65	**4.378**	426	0.26

Travel as part of work place a higher value of time savings than trip to work, about 22% higher using maximum likelihood or 13% using regression analysis, since travel as part of work can, on average, use the saved time in an activity which has a higher marginal productivity than that associated with trip to work. Finding that travel as part of work place a higher value of timesaving than trip to work is an interesting result. They are willing to pay a relatively higher percentage of income to save a unit of travel time. The value of travel as part of work time savings expressed as a percentage of wage rate is about 18.5%-25% compared to 34%-47% for trip to work using maximum likelihood, and 18%-24.5% compared to 31%-43% using regression analysis. Wage rate is defined as average hourly income, calculated by divide monthly income with number of work hour in a month.

Finally, the value of time for overall data, Jakarta without segmentation, is Rp 4,422/person hour using maximum likelihood and Rp 4,378/person hour using regression analysis. The value lies in mid of minimum and maximum value of time resulted for each market segmentation.

6. CONCLUSIONS

The conditions are considerably affected by the ability of questionnaire to accommodate the factors that influence individual's choice. However, interview experience found some comments from the respondents that may considerably influence the perception about the toll tariff. These comments are believed influence the level of individual value of time saving as well. Most of the comments tend to be pessimist or negative thinking when facing the increase of toll tariff.

One of the comments gathered from interview said that even the travel time is shorter than current condition, by increasing the toll tariff, it would not be maintained or sustained for a longer period. Other comment said that increasing toll tariff is only as a tool to extent the benefit for PT Jasa Marga, as the single authority of Indonesian toll road co-operation, rather than for users. Even, one of the respondents was so pessimistic, for the current condition, as the questions how come the travel time could be reduced in traffic like Jakarta.

There was also complaint from respondent about current condition of the toll road. They said that even they have to pay Rp 3,000 for using the toll road, the condition is as bad as the ordinary arterial road (non-toll road). Other comments are related to the respondents' attributes, such as work. Some persons have to arrive on time just in a particular occasion, not in every moment of their travel. This indicates that value of time saving is fluctuated depend on individual condition. Another was said that, saving 10 or 20 minutes is not quite significant. Some respondents prefer to change their departure time and avoid using toll road. This phenomenon is also believed influence the level of individual value of time saving.

It was also found that in a particular level of toll/time trade-off, respondents tend to consider the value of money as the main reason in their decision, then followed by time or even they do not consider the time at all.

The value of travel time saving reported in Table 7 and Table 8, as discussed before, represent the amount of money (in rupiahs) an individual is willing to outlay in order to save a unit of time (in hours). The absolute and relative magnitudes are very plausible, given the history and experience with the selection of time values. As mention before, there are several market

segmentations which have very low level of confidence are very low, therefore, they exclude in the discussion in this section, except for some particular case.

Travel as part of work place a higher value of time savings than trip to work, about 22% higher using maximum likelihood or 13% using regression analysis, since travel as part of work can, on average, use the saved time in an activity which has a higher marginal productivity than that associated with trip to work. The value of travel as part of work time savings expressed as a percentage of wage rate is about 18.5%-25% compared to 34%-47% for trip to work using maximum likelihood, and 18%-24.5% compared to 31%-43% using regression analysis. Finally, the value of time for overall data, Jakarta without segmentation, is Rp 4,422/person hour using maximum likelihood and Rp 4,378/person hour using regression analysis. The value lies in mid of minimum and maximum value of time resulted for each market segmentation.

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