How Does Congestion Matter for Jakarta Citizens?[1]

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Abstract

Jakarta, as the biggest city in Indonesia, faces many problems, one of which is congestion, that produces a high cost economy. It is predicted that if the government does not take immediate action to solve this problem, there will be a potential loss of IDR65 trillion by 2020 (Bappenas, 2007). This consists of IDR28.1 trillion in operational costs and IDR36.9 trillion in opportunity costs from time lost. This study is aimed at estimating how much Jakarta citizens' are willing to pay to overcome the congestion problem. By using the stated preference method, the estimation result shows that the annual cost of congestion in Jakarta is estimated at IDR50.2 trillion a year. Furthermore, this result can be used as a baseline for a cost-benefit analysis by the government to generate a better public transportation policy in Jakarta.

Keywords*: willingness to pay, congestion, stated preference method, conditional logit*

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1. INTRODUCTION

Congestion is common phenomenon in every big city in the world, including in Jakarta. The increasing flows of vehicles into and out of Jakarta causes roads in Jakarta become increasingly congested. This is not surprising given the fact that Jakarta is the economic center on western Java area. In fact, one can also say that all of the Indonesian economic activity is centered in Jakarta.

Although congestion has become inevitable, the condition of congestion in Jakarta has reached worrying level. Congestion is a form of negative externalities that could lead to economic inefficiency. Time to travel from one place to another place becomes longer which implies greater opportunity cost. As a result, the cost to make one trip would also become larger. These conditions become one of the problems in the economic growth and development in Jakarta, which certainly also affect the development of area around Jakarta.

The travel time within Jakarta city has increased nearly twice since 1985 until 2000 (Harmadi, 2006). The estimated cost arose from congestion, car accidents, and pollution has reached about trillion of rupiah per year. Moreover, it is predicted that if congestion problem cannot be immediately resolved, then the potential loss will reach 65 trillion rupiah by the year 2020 (Bappenas, 2007). This predicted loss was calculated based on two parameters only, i.e. losses due to the vehicle operating costs amounting to 28.1 trillion rupiah and the time loss which is estimated around 36.9 trillion rupiah. These calculations have not included the costs of environmental deterioration (i.e. the costs arose from various kinds of pollution such as air pollution and noise pollution), failed transaction, declining productivity and competitiveness compared to other major cities in Southeast Asia region (Bappenas, 2007).

Certainly, congestion in Jakarta has fundamental problems that must be quickly resolved, one of which is the disproportional transportation structure and systems. The amount of vehicles on Jakarta's roads grows faster than the existing roads. As an illustration, the proportion of transportation modes in Jakarta and its surrounding areas is dominated by private vehicles (approximately 53.4 percent) at 2002. There is 40.3 percent of this proportion that are consisted of private passenger car, while the rest are motorcycles. Compared to the year 1998, the number of private passenger cars has risen by 40 percent, from 1 million to 1.4 million units of vehicles, while the number of motorcycles has increased by 60 percent, from 1.5 million to 2.4 million units (Asri and Hidayat, 2005).

It is well-known in transportation literature that adding a new link connecting two routes running between a common origin and a common destination may not reduce congestion in the network but instead increase the travel times for each network user. This phenomenon is called the Braess' paradox, named after Dietrich Braess, an operations researcher who first published the paper explaining this finding.

In the literature, the Braess' paradox is no longer a paradox because the cause of the paradox has already been identified. Therefore, according to Yosef Sheffi, it and similar traffic flow phenomena should be called as 'pseudo-paradoxes' (Pas and Principio, 1997). Zverovich and Avineri (2015) described discussion on development of the paradox. In their work, it is explained that Anna Nagurney had proved that the paradox disappears under higher demands as well as how to avoid it by adding resources to a network in an efficient manner.

The situation occurred at 2002 are most likely different when it is compared with current condition, especially for the number of motorcycles. The growth rate of motorcycles has increased due to the increasing economic stability since 2001. The worsening congestion condition also contributes in encouraging people, especially the middle class citizens, to use motorcycles as an alternative mode of transportation.

The growth rates of private vehicles operating on roads of Jakarta were not accompanied by the growth of roads number and width. Currently, the growth rates of roads construction within Jakarta are only reaching less than 2 percent per year. The same is true for public transportation facilities in which their quantity and quality are still less than standards. If this situation continues to happen, then it is predicted that Jakarta will experience a total congestion by the year 2020.

Currently, the local government of DKI (*Daerah Khusus Ibukota* or the capitol special region) Jakarta is reviewing various alternatives to solve congestion problems in the long run. One of which is to build mass transportation such as busway, which is now in the process of adding new corridor, monorail, and subway. The only problem with this solution is government is now faced with huge costs to conduct this solution while its obtained benefits cannot be properly estimated. Therefore, the benefit measurement of various transportation policies becomes very important and fundamental.

The benefit measurement of the provision of public transportation can be done through various approaches. The main point is to look at the costs that can be avoided if there is provision of public transportation, then it can compare whether the cost savings or benefits obtained is greater, equal, or less than the cost incurred to provide the public transportation. Public infrastructure will be realized if benefits obtained are greater than the incurred costs, vice versa.

So far, all studies ever conducted in Indonesia to measure benefits are based on the calculation of direct costs of congestion. In fact, the measurement of these benefits can also be viewed from the perspective of how much the society is willing to avoid congestion, which can be monetized in the amount of money. This calculation is more appropriate since this technique incorporates all the possible costs resulted from congestion problems. Therefore, the main objective of this study is to estimate the willingness to pay of people in Jakarta to avoid congestion problems. Congestion imposes greater travel costs for road users, thus they would have their own preferences to avoid congestion. These preferences are reflected through the amount of cost they are willing to pay to avoid congestion.

2. LITERATURE REVIEW

Congestion is one of the urban problems that always raise interesting discussion. Congestion is an example of negative externalities resulted from the traffic flow passing through roads. Externalities can be formed as an increase in travel time, noise pollution, air pollution, excessive fuel consumption, and car accidents (Button, 1995).

Of all the externalities arose from congestion, the problem of travel time has been the most discussed topic in researches about urban congestion. Each road user, particularly the vehicle users or drivers, will compete with other vehicle users up to certain degree. In other words, roads will have rivalry characteristic starting from certain stage. Therefore, any additional vehicles passing through the road must cause longer travel time faced by vehicle users. Hence, it would cause externalities in form of greater commuting costs for each vehicle users along with larger opportunity cost (Sullivan, 2006).

Figure 1. Externalities and Congestion Tax

Externality in form of greater commuting costs has caused the equilibrium not to reflect optimum number of vehicles on road. The nature of negative externality as uncalculated costs will eventually cause the number of vehicles on road exceeds its optimum level. The following result is the emergence of excessive traffic congestion or the so-called as congestion. The internalization of this external cost can be performed through imposing the instruments of congestion tax. This taxation shifts marginal private cost faced by each driver to be equal to marginal social cost of the economy, so the equilibrium will be finally an optimum point. Within the larger framework, the existence of marginal congestion costs should be included in the valuation scheme of the road pricing (Anderson and Bonsor, 1974) as shown in Figure 1.

Figure 1 shows how the congestion externalities occur and distort the economy. Equilibrium occurs at point *i* where marginal benefit equals to private trip cost faced by vehicle users on road. As there are externalities arose due to the increased travel time of each vehicle users resulted from the increased number of vehicle users, the cost that should be faced is marginal trip cost, which accommodates these externalities. Thus, the optimum level will occur at point *e*, where the number of vehicles on road is smaller (1400 vehicles) compared to the equilibrium level (1600 vehicles). The process of externality internalization is conducted through applying congestion tax that shifts the cost structure faced by vehicle users, i.e. shifting private trip cost to marginal social cost.

In practice, congestion tax has various forms such as toll road taxes, fuel taxes and parking taxes (Sullivan, 2006). Other forms of taxation are including tax on tire and other spare parts, as well as direct road taxes that electronically applied via smart cards, optical systems, infrared, etc. (Johansson and Mattsson, 1995; Johansson-Stenman, 2005). Those forms of taxation could be implemented as long as it satisfies benefit and equity principles (Stiglitz, 2000).

The optimal tax can be determined through the public road and vehicle users' preferences on the existing congestion. It is necessary to determine how much the willingness to pay of citizens for congestion since the main objective of congestion tax is to internalize the costs of congestion so that the existing congestion can be reduced. Congestion is also a loss to the economy, so what to be determined here is the willingness to pay of people to overcome this loss (Pearce and Turner, 1990). In this case, public road users must determine how much cost that they are willing to incur in averting congestion based on current traffic congestion condition.

One example of study concerned on willingness to pay for congestion is the study conducted by Tretvik (1995). In his study, Tretvik estimated the magnitude of willingness to pay for time savings of the users of Trondheim toll road. The simulations were carried out by using panel data and by dividing the toll road users into three groups based on the travel purposes, i.e. group of commuting, business, and others. According to the simulation results, it was found that the value of time saved by each group was different for each group. The group of business trip has the highest value of time saving, followed by the group of others trip and the group of commuting trip. Furthermore, the results of this study showed that the willingness to pay for time saving for each Trondheim toll road users were 73 NOK per hour for commuting group, 120 NOK per hour for others trip group, and 138 NOK per hour for business trip group.

Apart from using the approach applied by Tretvik, the calculation for willingness to pay can also be estimated by other methods, e.g. Stated Preference Method (SPM). This method, which will be used within this research, is often used to observe cases relating to natural resources and environment issues. There are several related studies that also use this method. Patunru et al. (2007) used SPM to estimate benefits obtained from the cleaning up of pollutant substances in Waukegan Harbor, Illinois. By developing the determined attributes, it was concluded that the willingness to pay of the homeowner for overall clean up would cost a minimum cost of US$582 million.

The method implemented by Tretvik can be classified as Contingent valuation method which is a common method to quantify, or, in some other occassions, to monetize, people's preferences. In the early 1990s, Contingent valuation (CV) method is critized as dubious, at best, or even hopeless. Hausman (2012) finds out three enduring problems: 1) hypothetical response bias leading contingent valuation to overstatements of value; 2) large differences between willingness to pay and willingness to accept; and 3) the embedding problem which encompasses scope problems. The last issue reflects that the answers of respondents to the survey are implausible and inconsistent. Problems of CV has been discussed for at least three decades.

Hypothetical bias means that the respondent has no market experience; in other words, the act differs from the statement. In terms of willingness to pay, the tendency of bias is in upward direction, meaning that the result measurement tend to be overstated. CV questions consist of two main ideas: how much the respondent would pay to avoid a negative outcome (or to achieve a positive outcome) and how much the respondent would need to accept the negative outcome (or not to receive a positive outcome). The first is commonly known as the willingness to pay approach and the later as the willingness to accept approach. Economic theory suggests that these two approaches should give, principally, the same answer, but large and persistent disparities commonly arise in answers to CV surveys. The most fundamental challenge to the CV method, according to Hausman (2012) comes from concerns that the answers given by the respondent are invented in response to the questions.

CV is not perfect, but the alternative is to place a zero value on goods that the public cares about. A considerable body of evidence now supports the view that CV done appropriately can provide a reliable basis for gauging what the public is willing to trade off to obtain well-defined public goods (Carson, 2012). In addition, despite the criticism, the last 20 years of research have shown that some carefully constructed number based is now likely to be more useful than no number in most instances for both cost-benefit analysis and damage assessment. It serves as a model for the evaluation of other policy-critical techniques (Kling, *et al*., 2012).

Similar to the study conducted by Patunru et al. above, Shrestha and Alavalapati (2004) tried to estimate the environmental benefits of silvopasture practice in the Lake Okeechobee, Florida. The attributes used in this study were including water quality, absorption of CO2, biodiversity, and the increase of state utility tax. This study concluded that the average willingness to pay of households was ranging from US$ 0.21 to 71.7 per year for a period of 5 years. This amount would eventually reach up to US$924.4 million for a moderate improvement if we sum up all the willingness to pay from all existing households.

3. METHODOLOGY

The benefits of government efforts in reducing traffic congestion problems in Jakarta can be measured through the amount of costs in which people are willing to pay to avoid congestion. The increasing social utility as a result of reduced congestion should be compensated with the amount of money that must be spent. This framework can be specifically described through the Hicksian demand curve which is often referred to as compensated demand curve and compensating variation.

With this rationale, the initial condition faced by people of Jakarta is a condition of severe congestion as perceived today. Longer travel time, coupled with low safety and connectivity in transportation simply describe what is perceived by transportation users in Jakarta today. On the other hand, improvement in transportation can be measured from shorten travel time, higher safety level, and better connectivity.

Traffic congestion has increased travel time, so public’s desire to avoid congestion can also be defined as public’s desire to shorten their travel time. In other words, public’s desire to increase time saving of a trip is an alternative definition of a desire to avoid congestion, such that utility increases along with the increasing time saving. This desired improvisation is then compensated by the extent to which people are willing to pay for that improvisation, which also represents the compensating variation of utility function.

In order to estimate the amount of welfare (utility) change that occurs if congestion problems in Jakarta were reducible, this study uses random utility model which includes the error term into the consumer utility function. This model is then approximated by choice-modeling analysis and is solved by econometric method of conditional logit. In addition, the estimation of willingness to pay for averting congestion in Jakarta involves primary data which are obtained by using questionnaires. The questionnaire is arranged based on predetermined attributes and is distributed to respondents, the Jakarta road users.

3.1. Sampling Procedures

In order to obtain accurate estimates and generalizations, probabilistic sampling is necessarily required. This technique requires a random sampling from the population list so it can provide equal opportunity for each individual in population to be selected as sample (Sugiyono, 2002). In this study, the unit of analysis of the population is the entire citizens, both of the citizens of Jakarta and outside Jakarta who use the transportation facilities within Jakarta. The best ideal technique to use is stratified random sampling, given the population structure. Hence, this study needs a list of entire population that uses transportation facilities in Jakarta.

Problems arose when it was finally realized that acquiring a list of transportation facilities users is almost impossible because the related population database is not available. Consequently, the sampling process that was originally planned to use stratified random sampling method cannot be done at all. In fact, all types of probabilistic sampling approach cannot be used, therefore, the method used in this study is non-probabilistic sampling, i.e. purposive sampling method.

The scope of this research is mostly located in business and office center areas in Jakarta. These areas are the targeted areas in which road pricing is going to be applied. The main criterion in determining the selected areas depends on the area characteristics itself. These areas are characterized as congested areas and also areas containing many working citizens having relatively high education level. The selected areas include: National Monument (Monas), Sudirman–Thamrin street, HR Rasuna Said street, Gatot Subroto street (i.e. the end of Sudirman street and HR. Rasuna Said street), and Prof. Dr. Satrio street (which is bounded by Sudirman street and HR. Rasuna Said street). Based on the Study on Integrated Transportation Master Plan for Jabodetabek (Jakarta, Bogor, Depok, Tangerang and Bekasi) (SITRAMP, 2004), these areas have the best qualifications based on the simulation results in observing which area is producing the highest percentage reduction in the number of vehicles due to the implementation of '3 in 1' policy.

3.2. Questionnaire Design

Estimation about how much cost the citizens are willing to pay in order to reduce congestion involves survey approach on primary data of roads users in Jakarta. The status quo is defined as the current condition faced by society in form of severe congestion problems. This ex ante condition becomes the basis for predicting how the people of Jakarta are willing to pay money compensation for reducing the current traffic congestion problems.

Conditional logit approach is used in this study to accommodate the discrete and binary dependent variable. The dependent variable is conditional probability in choosing travel scheme (i.e. the status quo or a new type of trip). Deterministic part of utility is represented by the various travel attributes, i.e. travel time, connectivity, safety, and transportation costs. The determination of these four attributes is carried out based on expert judgments on factors that people consider in travelling from and to Jakarta. In general, the operational definition of each attribute can be seen in table 1 at below.

Table 1. Operational Definition of Each Attribute

The use of multiple attributes in experiment design based on choice-modeling approach requires a code transformation as what has been done by Louviere (1988), which is also better known as effect codes. This effect transforms the ordinal variables into code system that can be used in econometric analysis. The code system is different from ordinary dummy variable approach. Its benchmark level is labeled with a value of -1. For example, the attributes of connectivity (K) has three levels, i.e. the status quo (KQ), moderate connectivity (KM), and excellent connectivity (TO) in which the status quo level becomes the benchmark level.

These levels, KQ, KM, and KE, are given a value of -1, 0, and 1 respectively. Thus, the value of the status quo level is negative summation of utilities obtained from moderate and excellent level. There are also other variables used in this study, i.e. travel time and safety. These variables do not need to use effect codes because both of these variables are ratio variables. Of the four attributes, only the connectivity attribute that requires a transformation by using effect codes given this attribute is not continuous. On the other hand, other attributes are continuous so they do not require similar transformation.

Survey method with primary data is the main point of experiment design in order to get the magnitude of welfare change. The core of survey is to ask questions to the Jakarta road users about their choices between the current travel conditions and the offered alternatives conditions. These options are explicitly asked by also including the four attributes that have been determined previously, i.e. travel time, connectivity, safety, and transportation costs.

There are three levels for each attribute, thus there are 81 possible types of trip that can be selected by respondents. Certainly, this amount is so much that can lead to weariness and bias for respondents. The option simplification is done through trivial game approach without reducing the existing generalities, so it can acquire 52 possible types of questions. The whole question is then divided into five sets in which respondents were asked to answer 10 sets of options in each set.

3.3. Attribute-Based Stated Choice Method

Technique used in estimating the willingness to pay for averting congestion is choice-based conjoint, which is part of the conjoint analysis. Choice-based conjoint, or often referred to as choice-modeling analysis, is a method often used in calculation of economic valuation. In the context of this research, an individual's decision in choosing trip is based on certain conditions. Thus, this decision is obtained through analysis of choice-modeling and Random Utility Model approach (RUM). Random Utility Model states that consumers obtain utility by choosing various alternative bundles of consumption. In fact, the observable information in determining consumer's preferences is the choices made by consumers along with its various attributes.

Random Utility Model (RUM) decomposes utility into two components, namely deterministic component and probabilistic (random) component. The random component can be taken either from the characteristics of consumer or the attributes of commodities which are defined by the researchers. On the other hand, consumer also knows that his utility can be completely determined. Thus, this model combines two great ideas that are the variation of individual preferences in the population and random components in econometrics (Hanemann, 1984). Formally, this utility function is written as follows (Adamowictz, Louviere, and Swait; 1998):

$$U_i = V_i + \varepsilon_i \quad (1)$$

U_i denotes the consumers' utility from consuming good i, V_i denotes the deterministic component of utility (systemic utility), and ε_i denotes the random component of utility.

The basic concept of the RUM model can be written into mathematical equations in utility maximization. In general, the RUM model is formally written as follows:

$$max\, U(t_i(A_i), z; \tilde{e}) \qquad i = 1, \dots, N \quad (2)$$

$$s.t. (i)\; y = \sum p_i t_i(A_i) + z \quad (3)$$

$$(ii)\; t_i t_j = 0\,;\;\; \forall_{i \neq j} \quad (4)$$

$$(iii)\; z \geq 0, t_i(A_i) \geq 0 \quad (5)$$

t denotes commodity (in this case, the commodity is travel), as a function of A, the vector of predetermined specific attributes (travel time, connectivity, and safety). z denotes a composite fraction of the consumption of other goods, y denotes income, and p denotes the price of each commodity. The last part of the utility function ($\tilde{e}$) is a random factor that shows stochastic nature of such utility function.

The RUM model in the four equations above reflects that consumers maximize their utility function in equation (2) subject to three constraints, i.e. equation (3), (4), and (5). The first constraint shows the budget constraint, where income is assumed to be allocated for travel and consumption of composite goods. The second constraint shows that either choice i or j cannot be simultaneously selected. Consumers cannot do travel in the attributes on the choice of i as well as on the choice of j at the same time. The third constraint ensures positive values for each consumed commodity.

The RUM model can then be derived into the unconditional utility function. This function is formally defined as follows:

$$\widetilde{U} = V(A, p, y, \tilde{e}) = max[V_1(A_1, y - p_1 t_1) + \tilde{e}_1, \dots, V_N(A_N, y - p_N t_N) + \tilde{e}_N] \quad (6)$$

The equation above illustrates how a consumer would decide his consumption decisions on various available choices. Rational consumer will maximize his utility of a number of N choices. Furthermore, if consumers have decided to choose to consume goods i, then it will formed the conditional utility function given the consumers have already selected travel t_i.

$$\widetilde{U}_i = V_i(t_i(A_i), p_i, y, z) + \tilde{e}_i = V_i(A_i, y - p_i t_i) + \tilde{e}_i \quad (7)$$

Then, the probability of the choice of travel i is being selected by consumers is given by following equation.

$$Pr(i = 1) = Pr\left(V_i + \tilde{e}_i > V_j + \tilde{e}_j\right) = Pr\left(V_i - V_j > \tilde{e}_i - \tilde{e}_j\right) \quad (8)$$

Rational consumers always prefer to consume goods that can give them greater utility, so the difference between utility levels of two goods is an important factor in determining the consumer choice. Consumers would prefer the choice of good i relative to good j if the difference between systemic utilities of good i and j $(V_i - V_j)$ is greater than the errors difference. The probabilistic approach used in estimating random utility function within this study is conditional logit model, which will be detailed in subsection 3.4 **Conditional Logit Model**.

Moreover, this study assumes the consumers want to increase their utility by reducing congestion, so they are willing to pay an amount of money as compensation. Hence, the Hicksian model of compensated demand function must be used to explain the consumers demand. Hanemann (1984) suggested that Marshallian demand function would be equal to Hicksian demand function when the utility function is monotonic transformation which is written as follows:

$$\widetilde{U} = f(t) + \gamma z + \tilde{e} \quad (9)$$

The symbol of γ denotes the marginal utility of income. By assuming that $f(.)$ satisfies the condition of weak complementary, equation (9) can be transformed into a conditional utility function as shown in equation (10) below.

$$\widetilde{U}_i = f_i(A_i) + \gamma(y - p_i t_i) + \tilde{e} \quad (10)$$

The conditional utility function in equation (10) above is then transformed into the unconditional utility function, which is then used to estimate welfare change. If this conditional utility function is applied for unconditional utility function, then the new function can be written as following equation.

$$\widetilde{U} = V(A, p, y, \tilde{e}) = \gamma y + max[f_1(A_1) - \gamma\, p_1 t_1 + \tilde{e}_1, \dots, f_N(A_N) - \gamma\, p_N t_N + \tilde{e}_N] \quad (11)$$

In order to calculate the amount of changes in welfare or the compensating variation (CV), one must determine the 'before and after' conditions. Suppose the 'before' and 'after' conditions are denoted by 1 and 0, respectively. A good management of transportation system will lead to an increase in time savings, so consumers' utility will also increase as well. Meanwhile, CV measures the amount of compensation paid by consumers to attain the increased utility level. In general, this condition is formally written as follows:

$$U_1(p_1, y_0 + CV) = U_0(p_0, y_0) \quad (12)$$

In this case, CV has negative value (Jehle and Reny, 2000). If the compensating variation (CV) is implemented into the unconditional utility function as defined before, then we can obtain the following equation (13).

$$\gamma(y - CV) + max[f_1(A_1^1) - \gamma\, p_1^1 t_1 + \tilde{e}_1, \dots, f_N(A_N^1) - \gamma\, p_N^1 t_N + \tilde{e}_N]$$
$$= \gamma y + max[f_1(A_1^0) - \gamma\, p_1^0 t_1 + \tilde{e}_1, \dots, f_N(A_N^0) - \gamma\, p_N^0 t_N + \tilde{e}_N] \quad (13)$$

Thus, the amount of unconditional CV is defined through equation as follows:

$$CV = \frac{1}{\gamma}\begin{bmatrix} max\{f_1(A_1^1) - p_1^1 t_1 + \tilde{e}_1, \dots, f_1(A_N^1) - p_N^1 t_N + \tilde{e}_N\} - \\ max\{f_1(A_1^0) - p_1^0 t_1 + \tilde{e}_1, \dots, f_1(A_N^0) - p_N^0 t_N + \tilde{e}_N\} \end{bmatrix} \quad (14)$$

By assuming the error value (ε_{ij}) is following the extreme value distribution within the conditional logit model, the value of CV is determined by following equation.

$$CV = \frac{1}{\gamma}\{ln \textstyle\sum_{i \epsilon S} \exp(V_i^1) - ln \sum_{i \epsilon S} exp\,(V_i^0)\} \quad (15)$$

The value of CV obtained from equation (14) above is a value for one single individual only, so the process of aggregating the willingness to pay for all population can be calculated as follows:

$$Aggregate\,WTP = N.\sum_{i=1}^{n} w_i . CV_i \qquad (16)$$

w_i denotes the weight used for each group of road users.

The estimation for utility function used in this study involves four predetermined attributes, i.e. travel time, connectivity, safety, and transportation costs. The linear equation is formally written as follows:

$$V_i = \propto_1 * ASC + \beta_1 * WKT + \beta_2 * KONMOD + \beta_3 * KONEX + \beta_4 * SAFE + \gamma * (Y - P) \qquad (17)$$

WKT denotes the travel time, KONEX and KONMOD denote excellent and moderate connectivity, respectively (the status quo condition is used as the basis variable), SAFE denotes safety, and (Y–P) is a numeraire, where Y and P denote monthly income and transportation costs, respectively.

Equation (17) represents the estimation of main effects of each attribute on utility function. It estimates only the effects of every single attribute on utility level without considering the interaction effects between these attributes. In fact, it is most likely that there is interaction between attributes and individual characteristics (e.g. income level). The resulted interaction effects reflect the preferences of individual characteristics on certain attribute. For instance, it is strongly predicted that high-income individuals would have higher parameter values than low-income individuals. In other words, individuals whose higher income would have larger decreased in utility level due to congestion (i.e. longer travel time) as they bear greater opportunity cost of congestion. Hence, the equation (17) is modified to include the interaction effects between attributes and individual characteristics.

Equation (18) represents the estimation of interaction effects of attributes and individual characteristics on utility function.

$$V_i = \propto_1 * ASC + WKT(\beta_{1a} + \beta_{1b} * INCM + \beta_{1c} * INCH)$$
$$+KONMOD(\beta_{2a} + \beta_{2b} * INCM + \beta_{2c} * INCH)$$
$$+KONEX(\beta_{3a} + \beta_{3b} * INCM + \beta_{3c} * INCH)$$
$$+SAFE(\beta_{4a} + \beta_{4b} * INCM + \beta_{4c} * INCH) + \gamma * (Y - P) \quad (18)$$

INCM and INCH are dummy variables used to represent middle-income group and high-income group of individuals, respectively. Thus, the parameter values (β) of each attribute will be different for each income group.

3.4. Conditional Logit Model

The usage of conditional logit was firstly introduced by McFadden (1974) through the Random Utility Model (RUM) analysis which has been discussed in the previous section. Conditional logit assumes that there is latent variable Y_i^* which is used to show the degree of indirect utility on the choice of i[2]. Therefore, Y_i can be defined as follows:

$$Y_i = 1 \quad if\ Y_i^* = \max(Y_1^*, \ldots, Y_m^*)$$
$$Y_i = 0 \quad if\ otherwise \quad (19)$$

Conditional logit also assumes the error term ε_{ij} follows the extreme value distribution, such that:

$$f(\varepsilon_{ij}) = e^{\varepsilon_{ij}}.e^{-e^{-\varepsilon_{ij}}}$$
$$F(\varepsilon_{ij}) = e^{-e^{-\varepsilon_{ij}}} \quad (20)$$

where $f(\varepsilon_{ij})$ and $F(\varepsilon_{ij})$ represent probability and cumulative distribution function of error

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[2] The same is also true for others dependent qualitative variables approach, e.g. logit and probit model. It assumes that there is a latent variable which is used to distinguish each response in the model. Also see Gujarati (2003).

term ε_{ij}. It also assumes the error term is independent and identically distributed (iid) with type I extreme value distribution, or better known as Gumbel distribution. Thus, the probability of individual *i* will select the choice of *j* is given by following equation.

$$P_{ij} = \frac{e^{\lambda V_{ij}}}{\sum_j e^{\lambda V_{ij}}} = \frac{e^{\alpha' Z_{ij}}}{\sum_j e^{\alpha' Z_{ij}}} \qquad (21)$$

The Gumbel distribution is characterized by the scale parameter λ and also location parameter δ. In practice, it also assumes that λ=1 and δ=0 (Ben-Akiva and Lerman (1985) in Seenprachawong, 2002).

The application of conditional logit model in the RUM model requires the inclusion of ASC (alternative specific constant), the constant used to distinguish between alternative options. ASC is required to accommodate the entire attributes that cannot be fully captured by the explanatory variables. ASC is constants for each of estimation that has been estimated, reflecting the average effects of factors that influence consumer choices but these factors are not included in the model. Thus, in this study, the ASC value is equal to zero for the status quo (current travel condition) and is equal to 1 for hypothetical choice (new selected travel route). The estimated results would violate the assumption of zero mean of error term if the alternative specific constant is not included in the estimation model (Train (1996) in Patunru, 2001).

The problem of heterogeneity is one of the problems that arise due to variations in respondents preferences. This is clearly inevitable given the respondents have heterogeneous individual characteristics. Heterogeneity can be either observed or not observed. Observed heterogeneity can be systemically calculated in the model through the interaction between individual characteristics.

4. FINDINGS AND DISCUSSION

4.1. Traffic Congestion in Jakarta

SITRAMP (2004) has identified some of the causes and sources of traffic congestion in Jakarta. Generally, there are four main causes of traffic congestion in Jakarta, in which if these issues were not being resolved soon it will develop into more severe congestion problems.

a. Road Network Problems

Road network performance can be measured through direct indicators perceived by road users, one of which is the speed of vehicles on a certain road. The lower is the average speed of road users; the lower is the road network performance. The performance of road intersection and each road segment are very influential on the overall road network performance. Congestion on one particular road segment, e.g. traffic congestion due to the road constringency or the railway line intersection, can develop and lead to congestion on other road segments. The problem of missing link, inconsistent functional classification of roads, road constringency, and improper intersection conditions may cause the traffic management becomes less effective. Inadequate road network system and disorganized road hierarchy may also lead to conflicts between transportation modes and conflicts between community activities (i.e. business, school activity, etc.).

Moreover, the number and length of roads in Jakarta is relatively small compared to the size of Jakarta. Table 2 shows that the ratio of road to land area in Jakarta is at 7.76 percent, which is under the ideal conditions for metropolitan cities (e.g. London and Tokyo), where it is supposed to be at 12−15 percent.

Table 2. Road Length and Road Area Ratio in Jakarta

The problems of infrastructure are also characterized by different road capacity causing the bottleneck effects, lack of traffic signs, signals or traffic control lights, mixed type of cargo and passenger transportation, and damaged road that are not immediately repaired.

b. The abuse of road facilities and undisciplined road users

The existence of illegal use and abuse of road facilities such as street vendors and illegal parking can decrease road capacity. Decreasing road capacity due to side friction can result in reduced performance of these roads. It is characterized by the slowing traffic flow which is thereby extending the travel time of road users. The behavior of road users such as pedestrians, passengers and drivers, either private or public transportation, can also affect the road network performance as a whole. Violation of traffic rules such as improperly crossing the road, passing through the red light, haphazardly stopping the vehicles, and loading the passenger at improper place are risky for the road users and likely to cause traffic congestion.

c. Insufficient growth of road infrastructures

Data of local transportation agencies of Jakarta state that there was road expansion in Jakarta by 159,293.99 meters or equivalently an increase of 2.09 percent during 2000-2003. This suggests that the road expansion was less than 1percent per year (Jakarta Macro Transportation Pattern, 2007). The slow road construction relative to the rapid increase of travel demand perhaps is one answer why traffic congestion became a daily routine in Jakarta. Road construction requires large amount of land, where for cities such as Jakarta, it will be very difficult to get as the price of land is expensive and also there are resistances from community to move away. The availability of substantial funds and the persuasion ability of local government become very important. Therefore, it can be expected that the construction process of new roads in urban areas such as Jakarta will require longer time in the process of socialization, planning, and implementation phase.

In addition, the rules and regulations restricting the land usage for construction of new roads, such as regulations regarding land usage and green area requirements can also hamper government efforts to increase the road network to offset the rapid growth of travel demand in Jakarta.

d. High growth rate of private vehicles

Growth rate of the number of vehicles far exceeds the growth rate of road network in Jakarta is a major cause of traffic congestion in Jakarta. In other words, huge demand for private motor vehicles is not accompanied by an adequate supply of road network. This condition is shown by table below which illustrates that during 2005-2009, growth in the number of motor vehicles in Jakarta in average reaches 9.7 percent per year. Although the growth rate has decreasing trend during 2005-2009, yet, the average growth rate of vehicles in Jakarta during period of 2005-2009 has increased compared to the average growth rate of vehicles during period of 1999-2004 which was about 6.3 percent per year.

Table 3. Number of Registered Motor Vehicles in Jakarta, 2005-2009

Despite of its decreasing growth rates during 2005-2009, motorcycles remain ranked as transportation mode whose highest growth rate among other transportation modes used by road users in Jakarta. Table 3 above shows that the growth rate of motorcycles during 2005-2009 was always above 10 percent in each year. It also shows that there is tendency of road users to prefer private motor vehicles (i.e. motorcycles and passenger cars) as their main transportation modes. If this trend is going to be continued in the future, then the number of private motor vehicles will continue to grow and experience enormous growth in the incoming years. Traffic congestion will become increasingly severe and more difficult to overcome.

On the other hand, travel demand in Jakarta has also been predicted to rapidly increase in the near future. Based on study results of SITRAMP (2004), the commuter trips from Bogor-Tangerang-Jakarta-Depok to Jakarta area reached about 76,340 trips per day in 2002. This number is predicted to increase almost ten times so it will reach 740,089 trips per day in 2010. The combination of ten-fold growth of travel demand and strong preference for private motor vehicles (motorcycles and passenger cars) will eventually lead to explosive number of private motor vehicles in the future. Thus, without taking effort to restrain the growth rate of private motor vehicles from now on, severe traffic congestion problems will likely to take place within the near future. Traffic congestion will occur almost evenly throughout all road networks and the public will experience total congestion since the existing road networks in Jakarta would not be able to accommodate all the existing vehicles.

4.2. Descriptive Results

A survey conducted for five days has collected 416 samples with validity rate of 100 percent. However, for certain information collected, the validity rate has not reached 100 percent. For instance, the validity rates reached 99 percent for information on alternative transportation modes, 97 percent for information related to transportation consideration, and 98 percent for each of information about the frequency of respondents troubled with congestion, information on respondents' opinion about congestion in Jakarta, and also information on respondents' educational level.

The sampled respondents consist of 58.8 percent of male and 41.2 percent of female respondents, while their ages ranging from 17 years old to 70 years old with also various minimum educational levels ranging from elementary school until doctoral degree. The number of respondents whose education level is only up to elementary level is 1 respondent, while 48 percent of respondents are undergraduates. There are 22 percent and 9 percent of total respondents who completed high school and diploma levels respectively, whereas 15 percent and 2 percent of total respondents are graduates and post-graduates.

According to figure 2 at below, the main transportation modes used by road users in Jakarta are private motorcycles with a proportion of 28 percent and private passenger car with a proportion of 23 percent. This implies the road users mainly rely on private vehicles. Meanwhile, there is an alternative and available transportation mode but is not selected as primary transportation mode, namely Metromini (public bus). There are only 14.9 percent of respondents choosing Metromini as an alternative mode of transportation. According to the SITRAMP, if there is no improvement in public transportation services such as bus (Metromini), then its share would decline because road users would switch their modes of transportation to private vehicles.

Figure 2. Share of Transportation Modes Usage

In addition, the main attributes that respondents emphasize in selecting transportation modes are travel time, safety, and transportation cost as shown in figure 3. The average time required for respondents to travel toward Jakarta is 70.9 minutes, despite the fact that it actually only requires 37.7 minutes if there were no traffic congestion. There are 222 (55 percent) of 416 respondents chose travel time as primary consideration in selecting transportation modes. Of these 222 respondents, 110 respondents use private vehicles, i.e. motorcycles and private passenger cars. Most respondents chose private vehicles, especially motorcycles as primary transportation mode because motorcycles can shorten travel time.

Furthermore, most respondents also consider transportation cost as an important factor in selecting transportation modes. The amount of transportation cost varies across respondents, ranging from IDR100 thousand per month to IDR4 million per month. Respondents must incur transportation cost of IDR654,506 per month on average. As much as 38 percent of private passenger car users are willing to pay an additional transportation cost for less than IDR100 thousand per month if only government can provide better alternative transportation modes. On average, respondents of private passenger car users are willing to pay 17 percent of additional transportation cost in order to avoid traffic congestion in Jakarta by using public transportation provided by government.

In addition, there are 80 percent of respondents of motorcycle users that are willing to pay no more than IDR 100 thousand of additional transportation cost if only government can provide better alternative transportation modes. This additional cost represents their compensation to use better public transportation mode provided by government which may help them for reducing traffic congestion. In general, respondents of train and bus users are also willing to pay an additional transportation cost for less than IDR 100 thousand per month to avert traffic congestion in Jakarta as well.

Figure 3. Important Attributes in Selecting Transportation Modes

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Figure 4 shows that the benefit of main transportation modes over the alternative modes lies in the factors of connectivity and cost. The main transportation modes are including private motorcycles and private passenger cars as previously shown in Figure 2. In case of motorcycles (as a mostly used transportation mode), the respondents need not to switch transportation modes during their trip to their destination.

Figure 4. Comparison between Main Transportation Mode and Alternative Transportation Mode

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4.3. Regression Results

4.3.1. Main Effects

The estimation results for main effects model as illustrated in the table below shows that the value of marginal willingness to pay (MWTP) for travel time is about IDR 40 thousand per minute. It is obtained from the ratio of the time-savings coefficient to marginal utility of income (MUI), the numeraire attribute (Y−P). This ratio shows the amount of additional utility measured in terms of money.

Table 4. Summary of Estimation Results with Main Effects

The estimation results show a significant negative value of constant of −1.626, meaning that in general, the respondents tend to choose the status quo condition rather than the offered alternative trips. There are two possible reasons behind this result. Firstly, respondents are already satisfied enough with current condition so they refuse to choose the offered alternative options. Secondly, the predetermined attributes level in the questionnaire are so high, especially for attribute of transportation cost, that respondents might tend to choose the status quo option. Besides, all attributes except attribute of moderate connectivity show significant positive values in line with the hypothesis which suggest that greater positive attribute values are preferred. In other words, respondents prefer shorter travel time (i.e. greater time savings), excellent connectivity, and also lower transportation cost. The insignificant value for attribute of moderate connectivity also shows that respondents prefer greater improvement on connectivity by reducing two transportation modes at once.

Moreover, the MWTP (marginal willingness to pay) of IDR40 thousand must be carefully interpreted. Such values cannot be directly interpreted as the money values of Jakarta road users put on the travel time. Instead, this estimation model is a model that estimates preferences, thus the value of MWTP is defined as the amount of Jakarta road users are willing to pay to reduce their travel time per minute for one trip per month. In other words, if an individual with current travel time of one hour, then the value of IDR40 thousand per month is the money amount that he is willing to pay to reduce his travel time from one hour to 59 minutes in each trip. Hence, IDR40 thousand represents his marginal willingness to pay in reducing travel time. It assumes that the reason for individual to make a trip to Jakarta is for working purposes, with an average of 25 working days each month. Hence, there are 50 times of trip per month per individual. Then, the value of IDR40 thousand is equivalent to 50 minutes of time savings per month or it is equal to IDR800 per minute of time savings[3].

4.3.2. Interaction Effects

[3] This assumption is quiet reasonable considering the survey results showing that more than 95 percent of respondents are going to Jakarta for working.

In order to accommodate the effect of income on utility function, this study also involves the interaction of all its attributes along with respondents which are classified into three income groups. These groups include the low-income group (whose income is less than IDR2.5 million), middle-income group (whose income is ranging from IDR2.5 to 8.5 million), and high-income group (whose income is more than IDR8.5 million). The estimation result is shown in Table 4 below. The MWTP values for attribute of travel time are specifically shown in Table 3.

The estimated result of MWTP for attribute of travel time is consistent with the previously proposed hypothesis. From table 3, it is concluded that income groups with lowest MWTP in each minute are the low-income group, middle-income, and high-income groups consecutively. As an illustration, for the joint estimation results, the MWTP per minute of low-income group is IDR18.2 thousand. Also, the MWTP per minute for middle-income group and high-income group are IDR33.8 thousand and IDR49.5 thousand, respectively. By using the same analogy as in the main effects, the benefits of time saving per minute for low-income, middle-income, and high-income groups are IDR364, IDR676, and IDR990 respectively.

Table 5. Marginal Willingness to Pay for Travel Time (In ten thousands IDR)

Other attributes besides the travel time that could also be the focus of discussion is attribute of connectivity. Estimation results show that in general, people who work in Jakarta do not just demand a moderate change in connectivity, but they tend to demand for excellent connectivity. In this case, there is no difference in MWTP between income groups, in which the MWTP is about IDR155.2 thousand per month.

Table 6. Summary of Estimation Results with Interaction Effects

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Private vehicle users are more sensitive to connectivity than mass/public transportation users. The estimation results show that there is no attributes of connectivity significant for the category of public transportation users. On the contrary, the attribute of connectivity is significant for the users of private vehicles. It can be concluded that the low quality of connectivity encourage road users to use private transportation modes rather than public transportation. For public transportation users, the existing connectivity has been deemed sufficient enough so they are likely not to demand for changes in connectivity improvement. This finding can be used as one of Jakarta mass transportation policy considerations that connectivity can encourage people to shift from private transportation to public transportation.

Safety condition in transportation also gets different responses based on different income groups. High-income group remains as a group with the highest MWTP, IDR14.3 thousand. It also found interesting finding that the value of MWTP for the middle-income group is lower than the low-income group. The value of MWTP for the middle-income group is estimated at around IDR3570, which is much below the value for the low-income group (IDR7860).

5. CONCLUSION

According to the SITRAMP (2004), there are at least four factors causing the worsening traffic congestion problem in Jakarta. These factors include (1) the problem of road network; (2) the abuse of road facilities and the indiscipline nature of many road users; (3) relatively low growth rate of road infrastructures; and (4) high growth rate of private vehicles. Of these four factors, the high growth rate of private vehicles is considered as the main factor in causing the severe traffic congestion in Jakarta.

Survey results show that most road users still rely on private vehicles as main transportation modes. The estimation results also justify that road users are willing to pay compensation in term of money for averting traffic congestion. It is estimated that the MWTP per minute of low-income group is IDR18.2 thousand. Also, the MWTP per minute for middle-income group and high-income group are IDR33.8 thousand and IDR49.5 thousand, respectively. Besides, the low quality of connectivity due to lack of public infrastructures also becomes a strong incentive for road users to prefer private transportation modes rather than public transportation. Therefore, improvement in connectivity of transportation modes becomes more important in encouraging people to shift to public transportation.

In summary, the aggregation process of the estimated results in section 4 will result in the total benefits of traffic congestion management. Therefore, it needs a set of underlying assumptions. By relying on the results obtained from SITRAMP, it was found that there were about 11,678 million trips per day by road users both from Jakarta and commuter areas such as Bogor-Depok-Tangerang-Bekasi[4].

By taking the estimation results which have been obtained earlier, there is around IDR 9.34 billion of benefits derived from time savings for each minute of all trips in Jakarta. Furthermore, by assuming that the desired time savings is 15 minutes, then the benefits that can be obtained is estimated to be around IDR51.3 trillion. In addition, by also assuming that the number of trips increases by ten percent per year, the number of trips in 2008 would reach 20.87 million trips per day, nearly twice as much as in 2002.

Further assumption that is also important to note is income structure. It certainly needs income structure adjustments in the estimation results with the income structure of Jakartans

[4] This value is obtained from the estimated calculation of the amount of trips toward Jakarta minus the users of non-motorized transport.

to determine the value of total benefits. Based on data Susenas 2006, the average income of Jakartans is IDR2.44 million with average values in the lowest and highest quartiles are IDR917.4 thousand and IDR5.4 million, respectively. According to that interval, the amount of total benefits is equal to an average of IDR43.2 trillion with interval of IDR16.2--95.9 trillion[5].

[5] The minimum and maximum values of each interval are obtained through assuming that the Jakartans' willingness to pay is categorized in low-income and high-income only.

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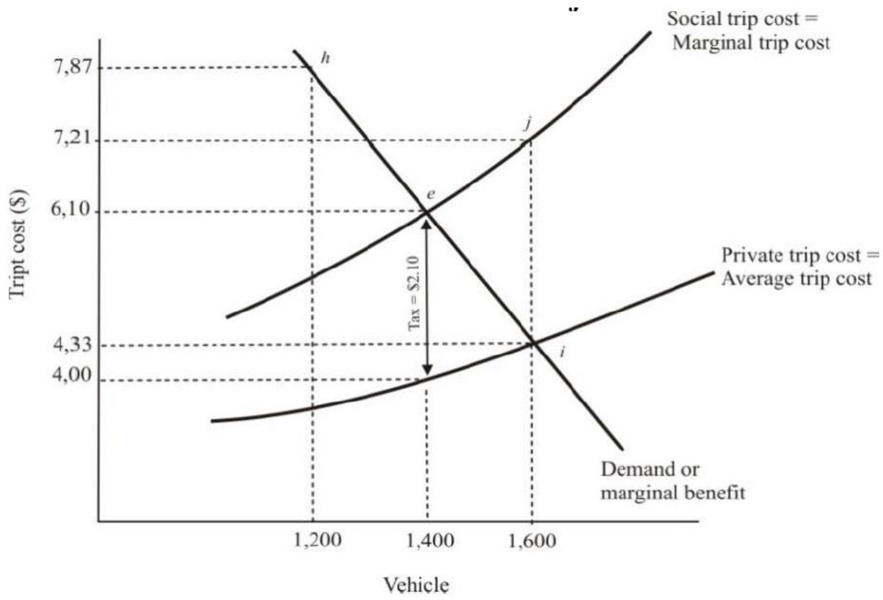
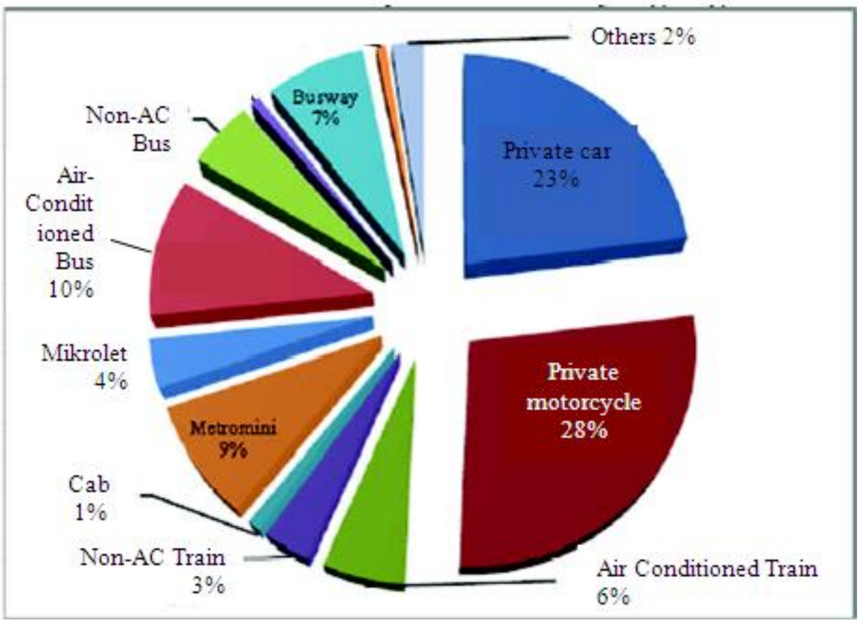
Figure 1. Externalities and Congestion Tax



Source: Sullivan (2006)

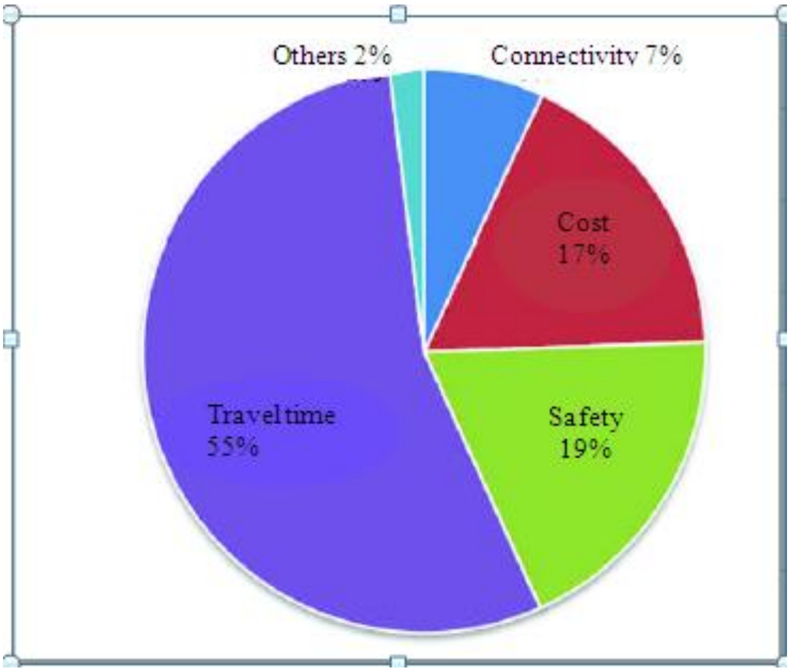
Figure 2. Share of Transportation Modes Usage



Source:: BPS, 2010

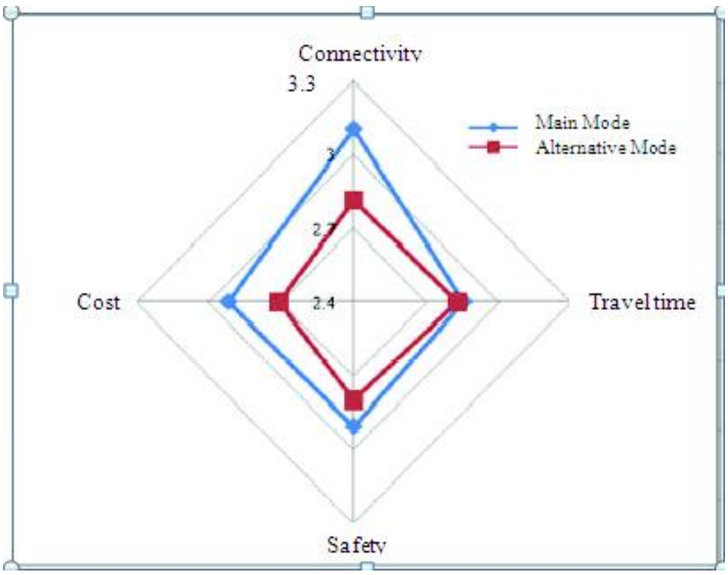
Note: Mikrolets are small public passenger cars ~~which is~~ run by private sector to provide transportation services based on different routes

Figure 3. Important Attributes in Selecting Transportation Modes



Source: based on authors' calculation

Figure 4. Comparison between Main Transportation Mode and Alternative Transportation Mode



Source: based on authors' calculation

Table 1. Operational Definition of Each Attribute

Variables	Description	Level
Travel Time	The amount of time spent to travel from origin to destination point	Status quo, moderate (decrease by15%), excellent (decrease by 30%)
Connectivity	Number of transits needed to reach destination point within one trip	a) Status Quo (no changes in the number of transits) b) Moderate (transportation mode usage is decreased by 1 mode) c) Excellent (transportation mode usage is decreased by 2 modes)
Safety	Safety measures in doing trip in Jakarta that consist of traffic safety and property security	a) Status Quo (no changes in transportation convenience and 100 deaths of traffic accident per year) b) Moderate (increasing convenience and 50% decrease in traffic accidents per year) c) Excellent (increasing convenience, 50% decrease in traffic accidents per year, 25% increase in the improved roads, and 25% increase in numbers of obedient road users)
Transportation Cost	The incurred transportation	Status quo, increase by 205, and increase by 40%

cost per month in

term of money

Table 2. Road Length and Road Area Ratio in Jakarta

Roads Classification	**Length (M)**	**Area (M^2)**	**Road Area Ratio**
Toll	112,960	2,472,680	0.37%
Primary Artery	114,592	2,323,110	0.35%
Primary Collector	55,131	739,384	0.11%
Secondary Artery	524,411	8,443,242	1.28%
Secondary Collector	779,971	6,644,660	1.00%
Local	5,621,472	30,724,918	4.65%
Total	7,208,537	51,347,994	7.76%

Source: Calculated from data of Jakarta in Figures 2010

Table 3. Number of Registered Motor Vehicles in Jakarta, 2005-2009

Year	**Motorcycles**	**Passenger Cars**	**Cargo Cars**	**Buses**	**Total**	**Growth Rates**
2009	7,518,098	2,116,282	550,924	309,385	10,494,689	8.78%
2008	6,765,723	2,034,943	538,731	308,528	9,647,925	10.54%
2007	5,974,173	1,916,469	518,991	318,332	8,727,965	9.54%
2006	5,310,068	1,835,653	504,727	317,050	7,967,498	10.20%
2005	4,647,435	1,766,801	499,581	316,502	7,230,319	

Source: Ditlantas Polda Metro Jaya in data of Jakarta in Figure 2010

Year	**Motorcycles**	**Growth Rates**	**Passenger Cars**	**Growth Rates**
2009	7,518,098	11.12%	2,116,282	4.00%
2008	6,765,723	13.25%	2,034,943	6.18%
2007	5,974,173	12.51%	1,916,469	4.40%
2006	5,310,068	14.26%	1,835,653	3.90%
2005	4,647,435		1,766,801	

Table 4. Summary of Estimation Results with Main Effects

Variables	Coefficients	Marginal WTP (ten thousands)
Constant	-1.626** (0.113)	
Travel time	0.036** (0.003)	4.00
Moderate Connectivity	-0.002 (0.046)	
Excellent Connectivity	0.167** (0.051)	19.3
Safety	0.009** (0.002)	1.00
Numeraire (Y-P)	0.009** (0.002)	
Pseudo R^2	0.068	
Log Likelihood	-4139.59	
LR Test	605.39	
Number of Observations	3663	

Source: authors' estimation.

Note: Values in parantheses are standard deviations. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% respectively.

Table 5. Marginal Willingness to Pay for Travel Time

Income Groups	**Joint Estimation**	**Private Transportation Modes**	**Public Transportation Modes**
Low-income	1.821	2.621	1.645
Middle-income	3.383	3.942	3.239
High-income	4.945	5.264	4.832

Source: authors' estimation

Table 6. Summary of Estimation Results with Interaction Effects

Variables	Joint Estimation	Private Transportation Modes	Public Transportation Modes
Constant (1=new condition, 0=status quo)	-1.558 (0.115)	-1.689 (0.164)	-1.520 (0.166)
Travel time (minute)	0.049 (0.005)	0.051 (0.006)	0.052 (0.008)
* Middle-income	-0.007 (0.005)	0.000 (0.007)	0.011 (0.008)
* High-income	0.023** (0.008)	0.017* (0.010)	0.026* (0.014)
Moderate Connectivity (reducing 1 mode)	-0.015 (0.061)	-0.107 (0.076)	0.114 (0.109)
* Middle-income	0.071 (0.071)	0.088 (0.093)	0.035 (0.122)
* High-income	-0.036 (0.105)	0.001 (0.126)	0.010 (0.201)
Excellent Connectivity (reducing 2 modes)	0.224*** (0.067)	0.397*** (0.085)	-0.013 (0.122)
* Middle-income	-0.121 (0.067)	-0.198** (0.099)	0.027 (0.136)
* High-income	0.153 (0.115)	0.135 (0.136)	0.009 (0.224)

Safety (deaths)	0.012***	0.012***	0.015***
	(0.002)	(0.003)	(0.004)
* Middle-income	-0.007***	-0.006	-0.010
	(0.002)	(0.003)	(0.004)
* High-income	0.008**	0.003	0.016***
	(0.003)	(0.004)	(0.006)
(Y-P) (IDR ten thousands)	0.014***	0.013***	0.016***
	(0.002)	(0.003)	(0.005)
Pseudo R^2	0.077	0.08	0.071
Log likelihood	-4102.35	-2096.44	-2006.95
LR test	679.81***	364.66***	305.1***
Number of Observation	3663	1880	1783

Source: authors' estimation

Note: Values in parentheses are standard deviations. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% respectively.