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THE COMPETITION OF PASSENGER TRANSPORT MODES ALONG JAKARTA-BANDUNG CORRIDOR

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Abstract: Jakarta - Bandung corridor serves around 78.3 millions passengers, in 2004, as one of the most crowded passenger transportation in Indonesia. The distance is about 180 km and the modal split has been dominated by road i.e. 95.8%, meanwhile railroad and air modes serve only 4.17% and 0.064%, respectively.

In the near future, the existing unconnected expressway between the two metropolitans will be fully connected. Using stated preference data, this paper examines the competition amongst the land transport modes i.e rail and road. Three road modes travel are considered i.e. private cars, intercity buses and private minibuses, while rail services consist of business and executive classes.

When the expressway in operation, it is estimated that the potential passenger who will convert from train to road based modes is about 0.93 millions passenger out of 3.27 millions passenger choosing train as their mode of travel in recent years.

Key Words: modal competition, stated preference, passenger transport.

1. INTRODUCTION

Jakarta - Bandung corridor is known as one of the crowded passenger transportation corridor in Java Island, comparable to Java North Coast Corridor, one of the busiest in Indonesia. The distance between Jakarta and Bandung is about 180 km. Recently, the corridor is served by road, rail and air modes. Road mode covers several choices i.e. private car, buses and private minibuses, widely known as 'travel'. Travel time along Jakarta-Bandung is about 3 to 4 hours by road mode, about 3 up to 3.5 hours by train and 25 minutes by air mode. Figure 1 shows the desire line of passenger movement in Java. The corridor predicted would serve around 78.3 millions passengers in 2004.

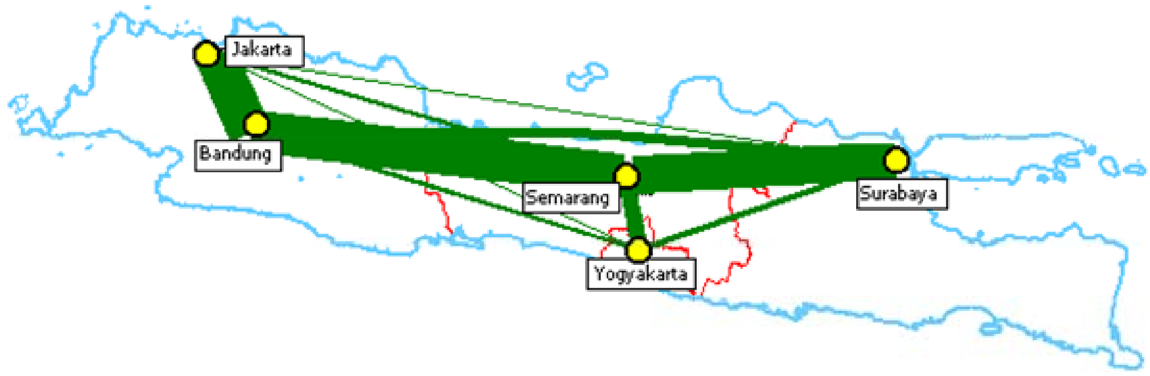

Figure 1. Desire Line of Passengers Movement in Java Island
(source: National Transportation Origin-Destination Data, Department of Communication, 1996)

Passenger transportation along the corridor is dominated by road mode that reaches about 95.8%, whereas rail and air mode serve only 4.17% and 0.064% respectively. The proportion of 4.17% rail passengers comprises 55% business class served by Parahyangan Business Class and 45% served by Parahyangan and Argo Gede executive class.

The enormous passenger travel demand along Jakarta – Bandung corridor has implied a demand for a supply of infrastructure development in the corridor. Recent, Jakarta – Bandung corridor is served by several transportation infrastructures and services as listed in Table 1.

Table 1 Transportation Infrastructure and Service Serve Jakarta – Bandung Corridor

Mode	Infrastructure and Service
Road	Padalarang – Purwakarta – Cikampek Toll Road
	Padalarang – Cipanas – Jagorawi Toll Road
	Lembang – Subang – Cikampek Toll Road
	Padalarang – Cianjur – Sukabumi – Jagorawi Toll Road
	Padalarang – Ciranjang – Jonggol – Gunung Putri Toll Gate
Rail	Executive Class (Parahyangan and Argo Gede Train) Business Class (Parahyangan Train)
Air	Husein Sastranegara Airport (Bandung) Halim Perdanakusumah Airport (Jakarta)

Recently, the development of toll road connecting Purwakarta – Padalarang link as part of Jakarta – Bandung corridor (Figure 2) is in progress and is going to be in operation in May 2005. After the operation of the toll road, then Jakarta – Bandung corridor will be fully connected by toll road and the travel time will reduce to 2 hours.

This will significantly affect passenger transport competition along Jakarta – Bandung corridor. In the absence of rail infrastructure improvement, it is predicted that rail mode will loss its share because passenger will significantly shift to road mode, either private car, bus or private minibuses.

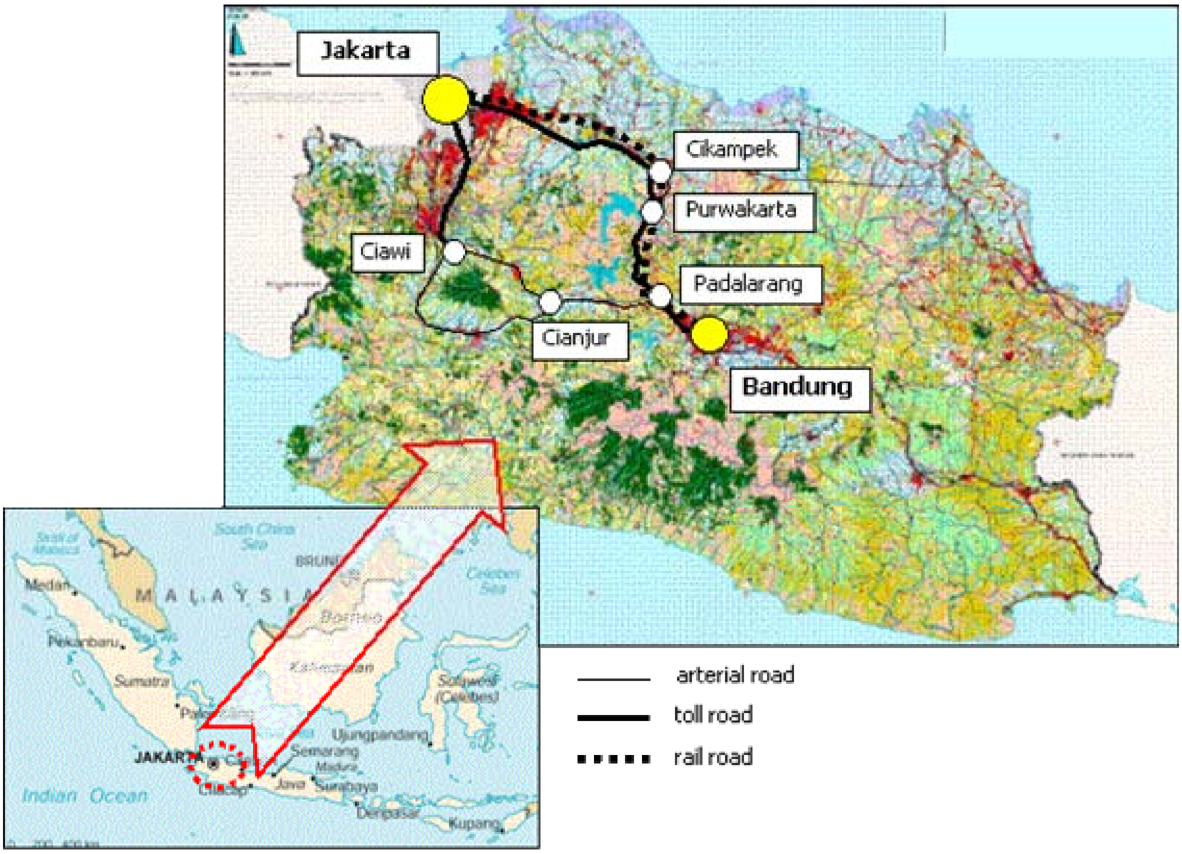

Figure 2. Toll Road Link of Jakarta – Bandung Corridor

This is very ironic, according to transportation characteristics, the short distance route, until 200 km, included Jakarta – Bandung corridor, and should be effectively served by bus and rail mode. The study on National Passengers Multimode Transportation Network carried out by Department of Communication in cooperation with Institute of Technology, Bandung, in the year 2003, has recommended the optimal mode choice alternatives for short, middle and long distance route. The study recommended that for short distance route, up to 200 km, the effective transport mode to serve is bus and rail mode. The detail recommendation for this short distance is shown in Table 2.

Table 2. Recommendation of Transport Mode Choice for Short Distance Route (up to 200 km)

	Bus	Train (business class)	Train (executive class)	Air Mode
Economic Class	++++	++++	++	+
Bussiness Class	++	++++	+++	+
Executive Class	+	++	++++	++

Note: ++++ more preferable +++ preferable ++ less preferable + not preferable

In Jakarta - Bandung corridor, rail should be able to serve more than what it served recently which is only 3.52%. In fact, in the period of 2001-2003, rail passengers decreased by 8%. The next part of the paper reports the result of the stated preference survey conducted in Jakarta-Bandung corridor. Rail users are questioned whether changing their modes of travel when toll road starts to operate. Then the competition between the land transport modes i.e.

rail and road is examined. Three road modes travel are considered i.e. private cars, coaches or intercity buses and private minibuses, while rail services consist of business and executive classes.

2. MODE CHOICE MODEL DEVELOPMENT

2.1 Basic Theory of Choice Behaviour

The basic theory of choice behaviour 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:

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

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:

$$\mathrm{U_{in} = V_{in} + \varepsilon_{in}} \tag{2}$$

and expression (1) can be written as

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

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,

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

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" (the basic properties are shown in Appendix A). 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

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

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

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

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.

In this case, with stated that j = train and i = car or existing mode, we have got a new function:

$$P_{Train} = \frac{\exp^{U_{Train}}}{\exp^{U_{Train}} + \exp^{U_{Carl}}} = \frac{\exp^{(U_{Train} - U_{Car})}}{1 + \exp^{(U_{Train} - U_{Car})}} \tag{9}$$

according to above function:

$$P_{Car} = 1 - P_{Train} = \frac{1}{1 + \exp^{(U_{Train} - U_{Carl})}} \tag{10}$$

where:
P_{Train} = Probability of selecting the train
P_{Car} = Probability of selecting private car (or other existing mode)
U_{Train} = Utility of rail mode
U_{Car} = Utility of private car mode (or other existing mode)

The formula stated that probability to choice train or bus depend on both utility functions difference. The utility functions shifted linearly consist of varied attributes. Therefore, the difference of both modes utility functions is expressed in term of attributes differences. Of course, the difference is the difference between each similar attributes in both utility functions. The formula is as follow:

$$U_{Train} - U_{Car} = a_0 + a_1(X_{1_{Train}} - X_{1_{Car}}) + a_2(X_{2_{Train}} - X_{2_{Car}}) + \ldots + a_n(X_{n_{Train}} - X_{n_{Car}}) \tag{11}$$

In the formula, a_1, a_2, until a_n are coefficient of attributes (X_1, X_2, until X_n) that are in the modes. The values of those coefficients are, furthermore, defined using least square concept with multiple linear regression or maximum likelihood method. Whereas a_0 is an constant accommodated error and undetermined attributes.

The above equation is in line with reality, where when someone would select a mode of transport he or she would consider the difference in benefits and the shortcomings of each competing mode. In another way, value of the utility can be definite as individual response as modal choice probability. It can be shown as formula:

$$Ln\left[\frac{P_{Train}}{1-P_{Train}}\right] = a_0 + a_1(X_{1_{Train}} - X_{1_{Car}}) + a_2(X_{2_{Train}} - X_{2_{Carl}}) + \ldots + a_n(X_{n_{Train}} - X_{n_{Car}}) \tag{12}$$

From equation (11) and (12), we can make new equation as shown:

$$Ln\left[\frac{P_{Train}}{1-P_{Train}}\right] = U_{Train} - U_{Car} \tag{13}$$

To convince and forecast the skewness, we use statistic method. Significance test concept gave a significantly of the influence factor and *goodness-of-fit (R-square)*.

3. THE STATED PREFERENCE SURVEY

3.1 Scenario Development and Structure of Modal Choice

Three models were developed based on binary choice between railway and bus, private car and private minibuses due to recent toll road infrastructure development in Jakarta-Bandung corridor. Since the development of transportation infrastructure is addressed to road infrastructure, as hypothesis, the mode splitting will tend to shift from railway to road mode either private car, taxi, or bus users. Then the interview are focused on train passengers who are grouped according to alternative mode they are able to access, i.e. private car, bus and private minibuses. The structure for modal choice by group or segmentation of respondents is shown in Figure 3.

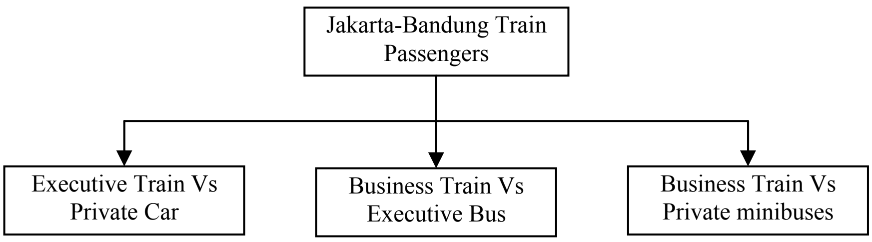

Figure 3. Structure of Modal Choice

3.2 Questionnaire Design

In this study the discrete choice and rating is considered to be an appropriate method to find individual responses. Rating types of responses require respondents to express the power of their choice on a value or semantic scale. Respondents may be required to express relative choices for each choice by indicating it with certain values. For example, respondents are required to choose among definitely using train, indecisive, or definitely not using train. This approach has the potential to offer the most extensive response types, if it can be assumed that the obtained score values are the main measurements.

Several pilot surveys are conducted before the main survey to test the efficiency of the design of the stated preference questionnaire. The attributes used in the questionnaire are selected in such a way so as to cover as far as possible all factors with a significant effect on modal choice. Also, levels for each attribute are selected in such a way so as to make respondents critical in seeing the difference in utility offered by the two modes. The objective of design of the attributes and their levels in the questionnaire is to obtain a picture of choice behaviour in the transitional zone where respondents start to convert from rail mode to the road mode. This behaviour is expressed with a certain level of attribute.

The design strategy called for choice sets to be constructed from the 5 component with 2 level, as listed in Table 3. Since an option can be either present or absent from the choice set of options, there are 32 alternatives.

Table 3. Choice Sets Attributes and Levels

No.	Attributes	(Low and High) Attributes Levels		
		Executive Train Vs Private Car	Business Train Vs Executive Bus	Business Train Vs Travel
1	Travel time (hours)	2.5 – 3	2 – 3.5	2.5 – 3
2	Fare (Rp)*	75,000 – 90,000	60,000 – 75,000	70,000 – 90,000
3	Time Headway (hours)	1 – 1.5	1 – 1.5	1 – 1.5
4	Delay (minutes)	10 – 20	15 – 20	15 – 20
5	Accessibility (minutes)	15 - 60	30 - 60	15 – 60

* 1 US$ ≈ Rp 9,100

In reducing the full factorial set of 32 choice set to a manageable fraction (8,16,32) it is given up some degrees of freedom in respect of the possible number of relationships between the attributes which can be examined. So many options will tend to induce fatigue in the respondent and reduce the value of responses. "Experimental Designs, Plan 6A.2, Cochran and Cox (1957) suggested designing the questionnaire to be 8 scenarios, as shown at Table 4.

Table 4. Combination of Skewness

Scenario	Combination Skewness	Level Atribut				
		Tariff	Time	Delay	Headway	Acces
1	-	-	-	-	-	-
2	Ab	+	+	-	-	-
3	Cd	-	-	+	+	-
4	Ace	+	-	+	-	+
5	Bce	-	+	+	-	+
6	Ade	+	-	-	+	+
7	Bde	-	+	-	+	+
8	Abcd	+	+	+	+	-

For the several times the pilot survey was executed, the questionnaire design refers to these combinations. These are shown in Table 5 until Table 7 for executive train vs private car, business train vs executive bus and business train vs private minibuses, respectively.

Table 5. Design of Stated Preference Questionnaire for Executive Train Vs Private Car

No.	Fare (x 1000 Rp)	Travel Time (hours)	Departure Headway (hours)	Maximum Delay (minutes)	Time to Reach Train Station (minutes)	Perception of Respondent				
						Definitely Use Train	May Use Train	Either One	May Not Use Train	Definitely Not Use Train
A	75	2.5	1	15	60	1	2	3	4	5
B	75	2.5	1,5	20	60	1	2	3	4	5
C	75	3	1,5	15	15	1	2	3	4	5
D	75	3	1	20	15	1	2	3	4	5
E	90	3	1	15	60	1	2	3	4	5
F	90	2.5	1	20	15	1	2	3	4	5
G	90	2.5	1,5	15	15	1	2	3	4	5
H	90	3	1,5	20	60	1	2	3	4	5

Table 6. Design of Stated Preference Questionnaire for Business Train Vs Executive Bus

No.	Fare (x 1000 Rp)	Travel Time (hours)	Departure Headway (hours)	Maximum Delay (minutes)	Time to Reach Train Station (minutes)	Perception of Respondent				
						Definitely Use Train	May Use Train	Either One	May Not Use Train	Definitely Not Use Train
A	60	2	1	15	60	1	2	3	4	5
B	60	2	1,5	30	60	1	2	3	4	5
C	60	3,5	1,5	15	30	1	2	3	4	5
D	60	3,5	1	30	30	1	2	3	4	5
E	75	2	1,5	15	30	1	2	3	4	5
F	75	2	1	30	30	1	2	3	4	5
G	75	3,5	1	15	60	1	2	3	4	5
H	75	3,5	1,5	30	60	1	2	3	4	5

Table 7. Design of Stated Preference Questionnaire for Business Train Vs Private minibuses

No.	Fare (x 1000 Rp)	Travel Time (hours)	Departure Headway (hours)	Maximum Delay (minutes)	Time to Reach Train Station (minutes)	Perception of Respondent				
						Definitely Use Train	May Use Train	Either One	May Not Use Train	Definitely Not Use Train
A	70	2.5	1	15	60	1	2	3	4	5
B	70	2.5	1,5	20	60	1	2	3	4	5
C	70	3	1,5	15	15	1	2	3	4	5
D	70	3	1	20	15	1	2	3	4	5
E	90	3	1	15	60	1	2	3	4	5
F	90	2.5	1	20	15	1	2	3	4	5
G	90	2.5	1,5	15	15	1	2	3	4	5
H	90	3	1,5	20	60	1	2	3	4	5

4. ANALYSIS

4.1 Mode Choice Model and Data Conformity Indicators

According to structure of modal choice there are three models competing for a share of the Jakarta-Bandung corridor, i.e.: train vs private car, train vs bus and train vs private minibuses. The three models are each developed with multiple regression and maximum likelihood method.

The main objective of analysis of stated preference data is to estimate the probability someone would convert their mode choice to road mode for the reason of better service due to infrastructure development. By assuming a function of utility is linear consisting of attributes for fare, time, delay, headway, and access, the difference in utility of the two modes can be stated in a form of difference in those attributes as shown in equation 11. Table 8 and Table 9 show the competitive choice model from the analysis for each mode, together with conformity indicators.

Table 8. Competitive Choice Model and Data Conformity Indicators: Multiple Linear Regression

No.	Attributes	Executive Train vs Private Car	Business Train vs Executive Bus	Business Train vs Private minibuses
1	Time	- 1.164	-1.027	-2.179
2	Fare	-0.00012	- 6.5E-05	- 4.7E-05
3	Headway	-0.285	- 0.193	-0.295
4	Delay	- 0.055	- 0.012	-0.013
5	Access Time	- 0.00067	- 0.0016	- 0.0018
6	Constants	1.514	0.884	2.120
	R^2	0,37	0.48	0,35

In general the signs of the resulting coefficients for each variable already show a sign in accordance with expectancy, i.e. negative. This is in line with logic thinking where an increase in fare, travel time, delay, headway and distance from a station are not preferred and thus reduce utility.

Table 9. Competitive Choice Model and Data Conformity Indicators: Maximum Likelihood

No.	Attributes	Executive Train vs Private Car	Business Train vs Executive Bus	Business Train vs Private minibuses
1	Time	- 0.763	-2.074	- 4.624
2	Fare	- 0.95E-04	- 0.00022	- 0.13E-03
3	Headway	- 0.205	- 0.373	-0.739
4	Delay	- 0.014	- 0.139	- 0.041
5	Access Time	- 0.0083	- 0.00104	- 0.007
6	Constants	2.256	2.153	4.863
	Rho^2	0.29	0.37	0.49

Values of coefficients for each equation vary according to variations in input size to each attribute. The value of an attribute shows the scale of effect the attribute has on utility of modal choice.

R^2 and Rho^2 values shown in Table 8 and Table 9 are reflections of conformity of modal choice model of train vs private car to choice behaviour data, or in theory represent choice behaviour. For example, the value of R^2 for choice model for train vs private car using multiple linear regressions is 0.37. From this value it can be assumed that the model represents the choice behaviour of 37% of market, or in other words that the effect of all attributes in model to modal choice is 37%.

Furthermore, the elasticity analysis is carried out to verify the responsiveness of each attributes affecting the competitive modal choice utility. The (direct) elasticity of rail mode choice due to the change of attribute difference between train and road modes is analysed using formula as shown in the equation 14.

$$\frac{E_{Train}}{(X_{n_{Train}} - X_{n_k})} = a_n \left[(X_{n_{Train}} - X_{n_k}).(1 - P_{Train}) \right] \quad (14)$$

In the formula, *a* is coefficient of attribute (n) that is reviewed, n is attribute to be compared between rail and road mode. Meanwhile k is the expression of road mode to be compared i.e. private car, bus, and private minibuses, and P is the probability of selecting a particular mode.

In general, the elasticity of the model shows fare and time are the most sensitive, followed by delay, headway and access time as shown in Table 10. Especially for executive train vs private car competition, delay is more sensitive compare to others model competition.

Table 10. Elasticity of Competitive Choice Model

	Fare	Time	Delay	Headway	Access Time
Executive Train Vs Private Car	0.41	0.42	0.33	0.17	0.01
Business Train Vs Bus	0.43	0.29	0.04	0.06	0.01
Business Train Vs Private minibuses	0.31	0.18	0.05	0.02	0.00

4.2 Travel Demand Analysis

This section discusses the estimation of potential train passengers who will convert to road mode, i.e. private car, bus or private minibuses due to road infrastructure development along Bandung - Jakarta Corridor. The analysis is done with the stated preference technique as described earlier.

An analysis for each mode choice competition model is conducted by substituting the difference between attributes of the existing train and road mode attribute values into the equation for the modal choice model given in Table 11 and Table 12. The analysis results use multiple linear regressions and maximum likelihood are shown in Figure 4 and Figure 5 respectively.

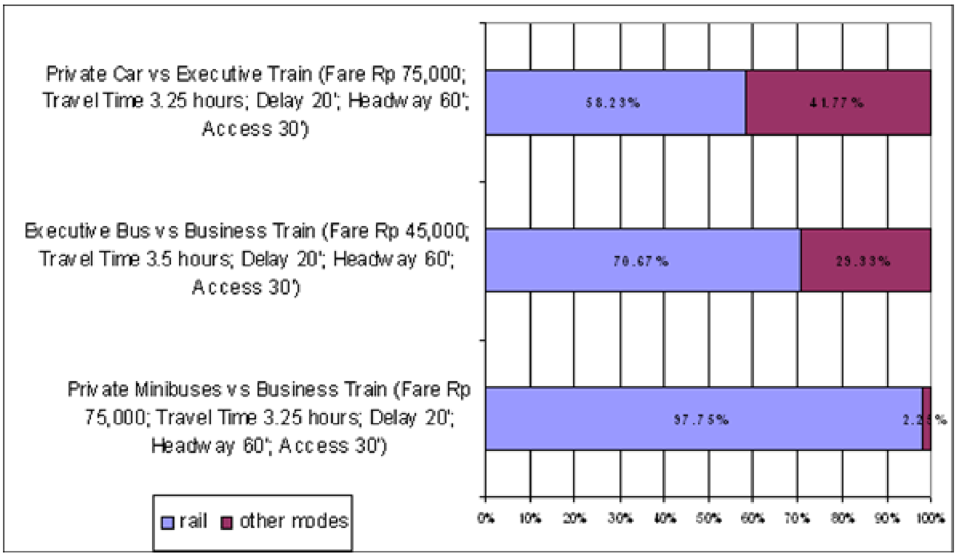

Figure 4. Potential Market Share of Jakarta-Bandung Corridor: Multiple Linear Regression

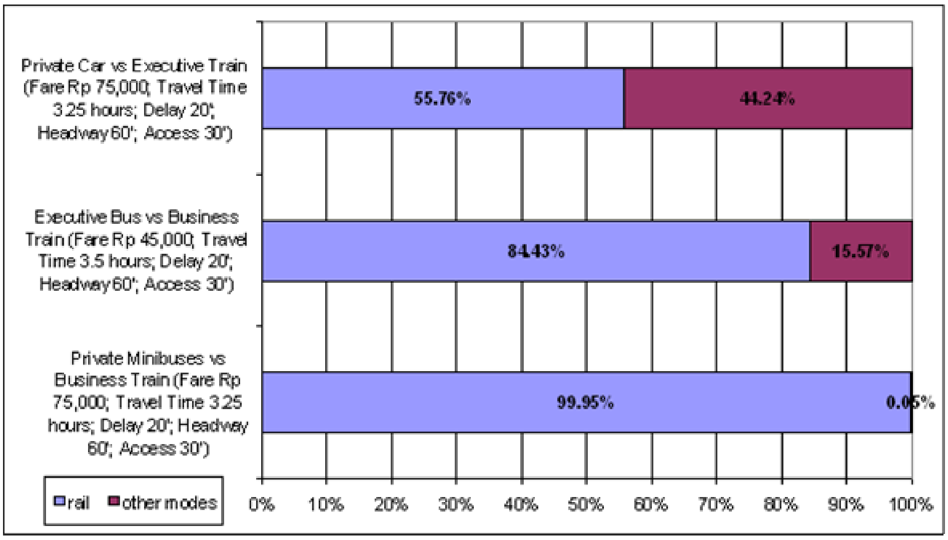

Figure 5. Potential Market Share of Jakarta-Bandung Corridor: Maximum Likelihood

The potential passenger who will convert their mode choice from train to private car, bus and private minibuses respectively are 41.77%, 29.33% and 2.25% for each modal competition using multiple linear regression method as shown in Figure 5. The percentages are 44.42%, 15.57% and 0.05% respectively for analysis using maximum likelihood as shown in Figure 6.

Figure 6 illustrates number of potential rail travel demand of Jakarta – Bandung corridor who is going to shift their mode choice in to road mode, either private car, bus or private minibuses due to toll road development, according to maximum likelihood analysis result. From about 3.27 million rail passengers in the year 2004, it is predicted about 0.93 million passengers or 28.44% are going to shift their choice from rail mode to road mode if Jakarta - Bandung is connected by toll road.

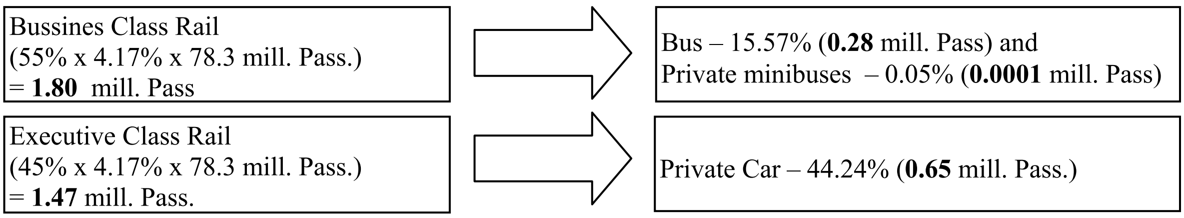

Figure 6. Potential Rail Travel Demand of Jakarta-Bandung Corridor Converts to Other Modes

In general the development of toll road connecting Jakarta - Bandung corridor will reduce a lot number of train passengers. As shown in Figure 6, private car will be the most significant 'threat' for train when the toll road operates.

5.3 Sensitivity Analysis

Figure 7, figure 8 and Figure 9 show the sensitivity of competitive modal choice to the difference attributes i.e. fare, travel time and delay, respectively, between train and road mode.

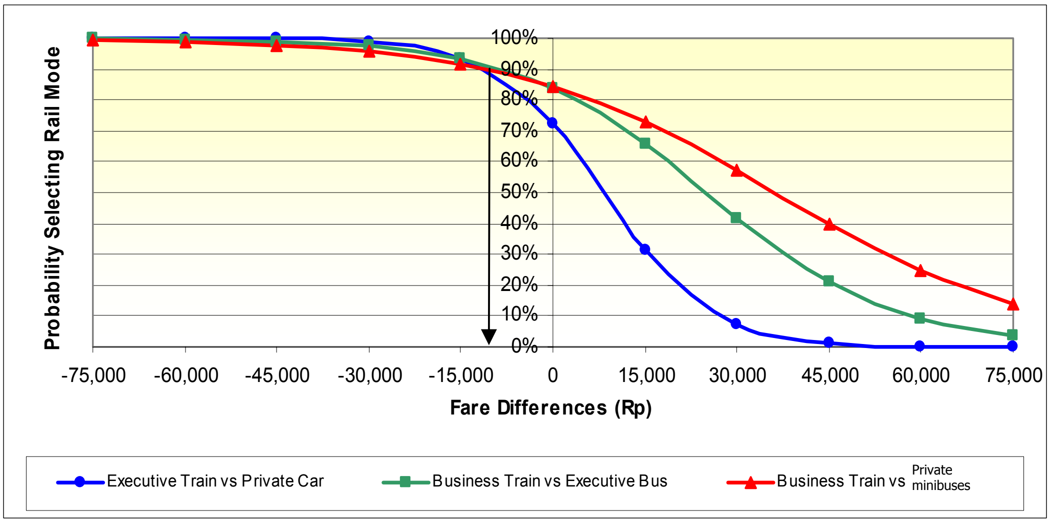

Figure 7. Sensitivity of Competitive Modal Choice to The Difference Fare Between Train and Road Mode

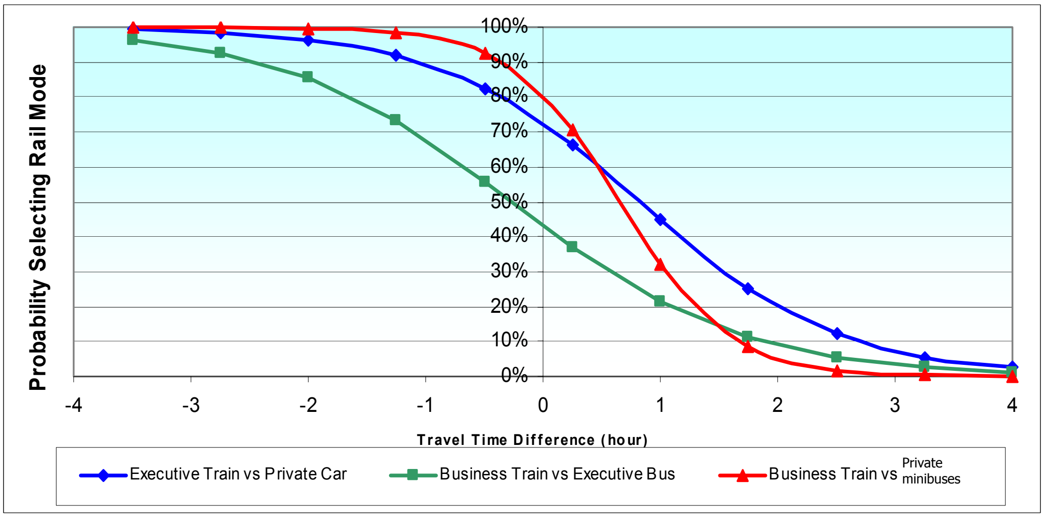

Figure 8. Sensitivity of Competitive Modal Choice to The Difference Travel Time Between Train and Road Mode

Each figure explains the pattern of probability of choosing rail mode due to the difference of attributes value of each competitive mode. For example, from figure 7, to reach 90% of train passengers not to shift their mode choice to private car, the train fare should be about Rp 10,000 less than private car at most. For the competition with bus and private minibuses the train fare is still allowed to be maximum Rp 7,500 and Rp 10,000 more than bus and private minibuses fare, respectively.

6. CONCLUDING REMARKS

Recently, passenger train users in Jakarta – Bandung corridor had been decreased by 8%. Rail only serves around 3.5% of the total passenger demand, the remainings are primarily served by road mode.

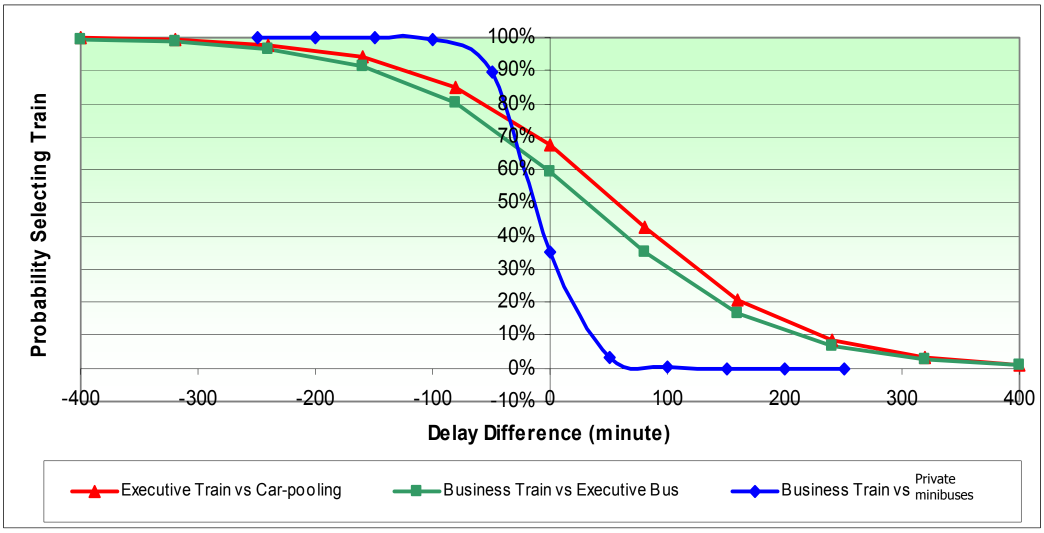

Figure 9. The Sensitivity of Competitive Modal Choice to The Difference Delay Between Train and Road Mode

When the toll road operate soon, it was estimated that the potential passenger who will convert from train to road based modes is about 0.93 millions passenger out of 3.27 millions passenger choosing train as their mode of travel in recent years. Fares and travel times were found as the most significant attributes affected the modal shift, followed by headway, delay and accessibility to the station.

For the scenario of Jakarta – Bandung toll road development is in operation and rail service is remain the same, the potential passenger who will convert their mode choice from train to private car, bus and private minibuses respectively are 41.77%, 29.33% and 2.25% for each modal competition using multiple linear regression method. The percentages are 44.42%, 15.57% and 0.05% respectively for analysis using maximum likelihood.

As maximum likelihood analysis result, from about 3.27 million rail passengers, in the year 2004, it is predicted about 0.93 million passengers or 28.44% are going to shift their choice from rail to road mode, either private car, bus or private minibuses, if Jakarta - Bandung is connected by toll road.

In general the development of toll road connecting Jakarta - Bandung corridor will reduce number of train users significantly. Private car will be the most significant 'threat' for train when the toll road operates.

As travel by roads becoming more dangerous, in the future, it is envisaged that safety would be an important attribute to be considered by traveler when choosing their mode of travel. Therefore safety attribute can be included in the future stated preference survey.

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