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The Analysis of Ability to Pay (ATP) and Willingness to Pay (WTP) on Light Rail Transit (LRT) Tariff in Palembang

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Abstract. Light Rail Transit (LRT) is an alternative mode to overcome transportation problems in Palembang. The travel cost factor is assumed to be a major factor in the selection of transportation mode. It is necessary to do research about how much ability to pay (ATP) and willingness to pay (WTP) toward LRT planned tariff. In this study, the data were collected by interviewing people. There were 400 respondents from scattered area in sixteen (16) sub-districts in Palembang. The data was collected by using multistage random and purposive sampling with questionnaires as the instrument as well as using household budget and perception methods as statistical analysis. The data collected in the form of respondent characteristics, travel characteristics and perception of tariff. The analysis result shows the average ATP was 543 IDR/passenger-km and the average WTP was 412 IDR/ passenger-km. The ideal LRT rate based on ATP and WTP analysis was below IDR 10,000 and maximum IDR 13,300 for the furthest distance from the airport to Jakabaring Sport City with a progressive payment system per km. The subsidized tariff scenario is up to IDR. 5,000 and will create 93% of passengers per day. From 93% of the passengers, about 65,8% passengers agreed to choose LRT mode.

1. Introduction

Light Rail Transit (LRT), the ideal alternative solution for public transportation medium for metropolis like Palembang, is a new moda transportation in Palembang with an investment value of IDR. 11.49 trillion was chosen by the government to become a solution of transportation problems in Palembang. The 24.5 km project with a maximum transport capacity of 800-1000 passengers per one way is funded from the State Budget (APBN) [1], consisting of 5 (five) zones and 13 (thirteen) halts constructed from Sultan Mahmud Badaruddin II Airport up to Jakabaring area. LRT planned tariff by the government through the minister of transportation, communication and information was IDR. 15.000,-. Planned tariff had been analyzed by South Sumatera provincial government through Basic Design Report of LRT South Sumatra Department of transportation, communication and information in 2014 [2].

The government has conducted basic design studies and financial studies. However, a balancing study is needed perceptions from the aspect of the prospective LRT user community related to the LRT planned tariff. The LRT planned tariff review that will be applied to the ability to pay and willingness to pay for services can be the ideal budget allocation proportion from the total expenditure budget and

perceptions of planned tariff. The study of tariff based on ability to pay approach is in accordance with the mandate of Law No. 14 of 1992 which explains that public transport is organized with attention to cost factors that are affordable with people's ability to pay [3].

In this paper, data collection method is done by interviewing randomly in sixteen (16) sub-districts in Palembang City. Determination of sample from population Palembang City. The number of samples is distributed proportionally based on the number of occupations in each sub-district in Palembang City. The questionnaire became a data collection tool designed with the proportion of household budget approach.

The purpose of this research is to determine the appropriate LRT tariff for the people. So this research is expected to increase knowledge and information for the people about the level of ability and willingness to pay and also public perception of LRT planned tariff, and give the information and inputs to stakeholders related to the ideal tariff setting for the people of Palembang, and also give the information of the desire to move to LRT mode based on ATP and WTP.

2. Literature Review
2.1 Light Rail Transit (LRT)
LRT (Light Rail Transit) is one type of rail transport that carries passengers commonly operates in urban areas, has light construction and can run with other traffic or on special tracks, plots or not. LRT has been used in 50 (fifty) cities and 20 (twenty) countries. The LRT in Palembang consists of 5 (five) zones, 13 (thirteen) stations, and a total length of 24.5 kilometers (km) stretching from Sultan Mahmud Badaruddin II Airport to Jakabaring Sport City.

2.2 Ability to Pay (ATP)
According to [4] ability to pay is a measurement of a person's ability to pay for the services he received and is considered ideal based on income. The approach method used was household budget method which was derived from the overall transportation allocation for public transport from monthly income per total distance of travel for a month. Ability to Pay (ATP) is formulated as follows:

$$ATP = \frac{It \times Pp \times Pt}{Tt} \tag{1}$$

Noted:
   It = Total respondent's income per month (IDR/month)
   Pp = Percentage of income for transportation per month of total income
   Pt = Percentage for public transport from monthly transport income
   Tt = Total length of family trip per month per trip (trip/family/month)

2.3 Willingness to Pay (WTP)
Willingness to Pay (WTP) according to [5] is the willingness of people in paying or issuing rewards for the services they get each trip per mileage.

Willingness to pay (WTP) is formulated as follows:

$$WTP = \frac{Perceptive\ Tariff\ (IDR)}{Distance\ /day\ (km)} \tag{2}$$

2.4 Tariff Based on ATP and WTP
Based on ATP and WTP parameters, the aspect of users treated as subjects in determining tariffs applies to the following principles:
   a. ATP as a function of the ability to pay, the value of tariff to be enforced should not exceed the ATP value of the target users. The location of subsidy as government intervention is needed in the circumstances where the tariff rate to be applied is higher than ATP so that the highest tariff value obtained as equal to the value of ATP.
   b. WTP as a public transport service level. If the value of WTP is still below the ATP then it is possible to increase the tariff with the improvement of public transport service.

The following illustration of discretion in the determination of tariffs based on ATP and WTP:
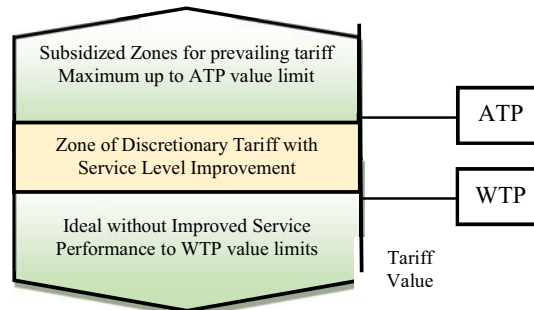
Figure 1. Tariff Determination based on ATP and WTP

The Illustration in Fig. 1 above showing how to determine tariff based on ATP and WTP. The ideal tariff zone is between ATP and WTP. If the value of WTP is below the value of ATP, it is possible to increase the tariff with the condition of service improvement. When the tariff plans are above the ATP then this is in the subsidy zone by the government. If the plan tariff is below the WTP value, then without service improvement until the increase reaches the value of WTP.

3. Methodology
In this research collected primary and secondary data. Primary data were collected from the field of study by distributing questionnaires to prospective users of LRT. Before sampling was determined, first the number of samples collected by using with Slovin formula so the total samples were 400 respondents. This sample was distributed proportionally based on population per sub-districts in Palembang. Interviews were conducted at respondents' homes chosen randomly in 16 sub-districts determined by each number of respondents. While secondary data needed were: population per sub-districts, tracks or routes of LRT line, and location of LRT zones and stations from airport of SMB II to Jakabaring Sport City area.

3.1 Sampling Method
In this paper sampling method use the Slovin formula, the number of samples as follows:

$$n = \frac{N}{1 + N\,e^2} \tag{3}$$

3.2 Household budget Method
This method uses the calculation method of ability to pay (ATP) for each family member per unit kilometer traveled taken. The ATP is in the form of overall transportation allocation and allocation for public transport from monthly incomes per total travel distance for a month

3.3 Perception method
The perception method is a willingness to pay (WTP) approach with the perception of prospective users in paying transportation rates influenced by income as well as other factors such as quantity and quality of services offered as well as user utilities. This method assumes that each user has different perceptions and desires to pay the prevailing rate (one way or progressive per kilometer). A variable that must be collected from the respondents is related to the user's perception of the tariff plan [13].

4. Analysis and Discussion

In this work, ATP calculation variables consists of respondent income per month, allocation of income for transportation and daily travel patterns of respondents. As for the calculation of WTP is a direct result of the perceptions of respondents users of public transport on the current public tariff rates and tariffs that are considered in accordance with the daily distance.
4.1 Value of Tariff From Analysis of Ability To Pay (ATP) and Willingness To Pay (WTP)

The results showed that Ability to Pay (ATP) and Willingness to Pay (WTP) respondents are grouped based on income per month, consists of the income group is less than IDR. 1,500,000 per month, IDR. 1,500,001 to IDR. 3,000,000 per month, IDR. 3,000,001 to IDR. 5,000,000 per month, IDR. 5,000,001 to IDR. 10,000,000 per month, and more than IDR. 10,000,000 per month.

In this research, the approach method of ability to pay used was household budget method which was derived from the overall transportation allocation for public transport from monthly income per total distance of travel for a month. The result of ATP score is showed in the frequency distribution table as in table 1.

Table 1 Frequency Distribution of ATP

ATP Interval (IDR/passanger-km)	Median	Frequency	Frequency Percentage (%)	Cumulative Frequency (%)
910-997	953,5	25	6	6
882-909	895,5	39	10	16
734-821	777,5	24	6	22
646-733	689,5	49	12	34
558-645	601,5	49	12	47
470-557	513,5	52	13	60
382-469	425,5	54	14	73
294-381	337,5	47	12	85
206-293	249,5	33	8	93
118-205	161,5	28	7	100

In Table 1 can be seen the frequency distribution ability to pay. Average ATP score of respondents is 543 idr/pnp-km. In this study, the approach method of willingness to pay used was the perceptions of respondents users of public transport on the current public tariff rates and tariffs that are considered in accordance with the daily distance. The result of WTP score is showed in the frequency distribution table as in table 2.

Table 2 Frequency Distribution of WTP

WTP Interval IDR/passanger-km)	Median	Frequency	Frequency Percentage (%)	Cumulative Frequency (%)
903-990	947	6	2	2
815-902	859	15	4	5
727-814	771	23	6	11
639-726	683	22	6	17
551-638	595	35	9	25
463-550	507	35	9	34
375-462	419	50	13	47
287-374	331	83	21	67
199-286	243	79	20	87
111-198	155	52	13	100

In Table 2 can be seen the frequency distribution willingness to pay. Average WTP score of respondents is 412 IDR/passanger-km.

Based on Tabel 1 and 2, the respondents had various values; it was related to ability and willingness to pay and also respondents perception on the planned tariff vary. IDR 15,000 is a the planned tariff from The National Transportation Department. IDR 15,000 per passenger-km can be written with 612 IDR/passanger-km. The relationship of ATP and WTP value to the planned tariff can be seen in Figure 2 below,
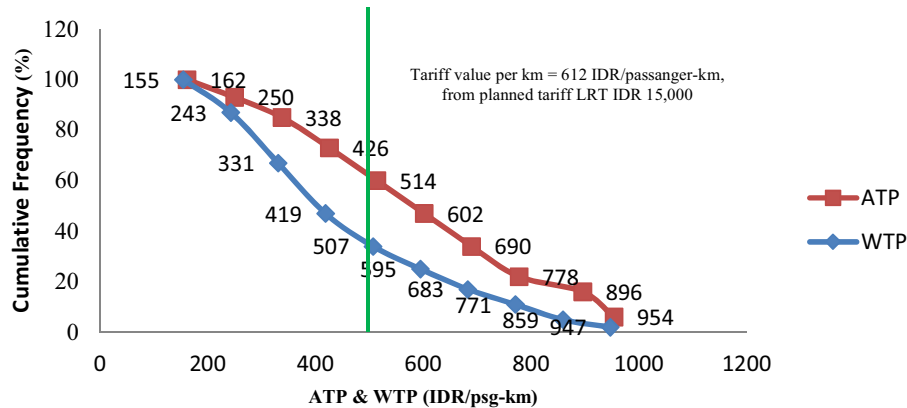
Figure 2. Relationship between ATP and WTP value with the planned tariff

In Figure 2 above it can be seen that ATP value above IDR 15,000 is a the planned tariff from Department of Transportation, per km is 612 IDR/psg-km between 20%-40%, while the value of WTP is between 0%-20%. Then converted to data table 1 based on the real data from the following interview.

From the cumulative percentage of all respondents about the possibility of using LRT with the planned tariff value above, the value of ATP and WTP is 39% based on ATP and 18% based on WTP.

In the final, we can see that the average ATP is 543 IDR/passanger-km and the average WTP is 412 IDR/passanger-km. The average value of ATP is higher than the average WTP, this condition indicates that the ability to pay for the services is greater than the willingness to pay for the services. It occurs to users who have relatively low incomes but the utility for these services is very high, so the user's willingness to pay for these services is more affected by the utility.

Value of planned tariff based on ATP and WTP based on figure 1 can be concluded that the ideal rate is below the average value of ATP because ATP value above WTP value, which if it is multiplied by the length of the track of 24.5 km obtained the result that the ideal rate should apply IDR. 10,000 and maximum IDR. 13,300.

4.2. Scenario Analysis of Tariff Change on ATP and WTP

4.2.1 Scenario 1: No Subsidized LRT Tariff (Non Subsidized)

The pre-subsidized tariff rate of IDR 20,000 per one-way trip with 24.5 km the total length of the LRT track, so total average measured that the maximum LRT plan tariff is IDR. 816 per km. The relationship between ATP and WTP with non-subsidized tariff of IDR. 20,000 can be seen in figure 3 below.
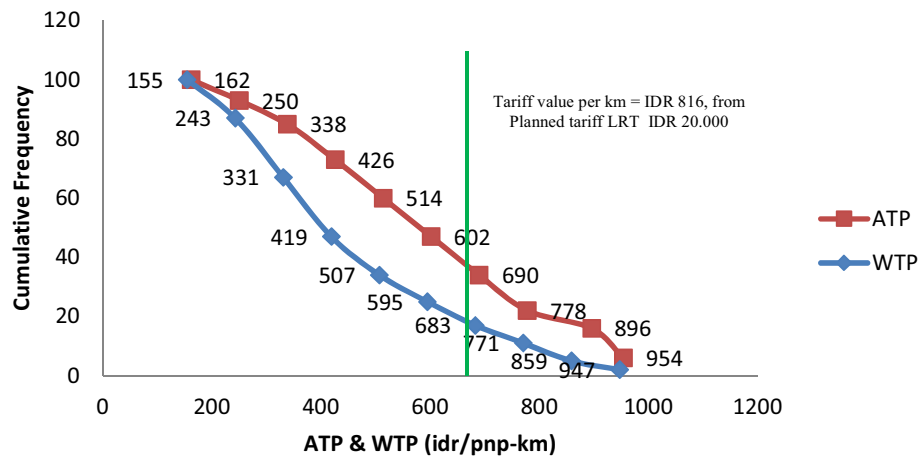
Figure 3. The relationship between ATP value with tariff scenario of IDR. 20,000, -

Based on the Figure 3 above can be concluded that the value of ATP is more than 816 IDR/passanger-km or 50 respondents or 12% and the value of WTP is more than 816 IDR/passanger-km or 21 respondents or 5%.

4.2.2 Scenario 2 : Subsidized LRT Tariff Up To IDR. 5,000, -

The subsidized tariff up to IDR. 5,000 per 1 trip, with the total length of LRT track is 24.5 km ,so when the total average of LRT planned tariff is IDR 204 per km then the relationship between ATP and WTP with subsidy rate is IDR. 5,000 it can be seen in Figure 4.
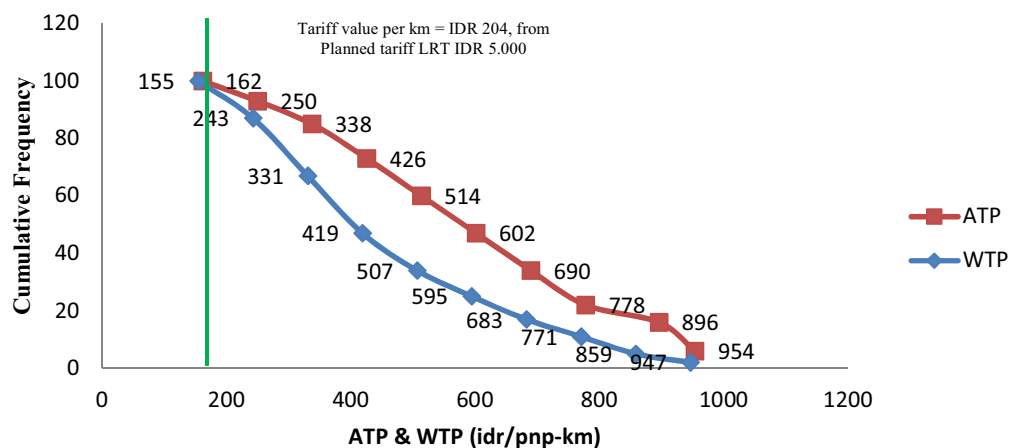

Figure 4. The relationship between ATP value and tariff scenario of IDR. 5,000, -

Based on the figure 4 above it can be concluded that the value of ATP is more than 204 IDR/passanger-km or as many as 372 respondents or 93% while the value of WTP is 204 IDR/passanger-km or 342 respondents or 85%.

4.3 An analysis of the desire to move to LRT mode based on ATP and WTP

In this section will be discussed related to how much the respondent's desire to move the modes of the ordinary vehicle used everyday switch using LRT.

4.3.1 An Analysis move to LRT based on planned tariff
In this section will be seen how many respondents want to move to LRT from existing mode based on planned tariff of IDR 15,000. It can be seen in table 3,

Table 3 The willingness of the respondents moved to LRT mode with Planned Tariff IDR 15,000

Willingness to move to LRT	Number of Respondents	Respondents' Percentage of ATP & WTP >612 IDR/psg-km	Previous Mode	Number of Respondents	Respondents' Percentage who Agree to Move to LRT Mode from All Respondents (400 respondents)
ATP > 612 (IDR/passanger-km)	118	29,5%	1. Angkot	32	8,0%
			2. Bus/ TM	10	2,5%
			3. Delivered	17	4,3%
			4. Car	12	3,0%
			5. Motor cycle	47	11,8%
WTP > 612 (IDR/passanger-km)	55	13,8%	1. Angkot	14	3,5%
			2. Bus/ TM	2	0,5%
			3. Delivered	4	1,0%
			4. Car	3	0,8%
			5. Bicycle	1	0,3%
			6. Motor Cycle	31	7,8%

Based on the results presented in table 3 can be seen that of the overall respondents with planned tariff IDR 15,000, 118 of 400 respondents or 29,5% are willing to move the mode to LRT with ATP > 612 IDR/passanger-km, and while 55 of 400 respondents or 13,8% are willing to move the mode to LRT with WTP > 612 IDR/passanger-km. It means, respondents who have the ability to pay the LRT planned tariff are greater in number than those willing to pay according to the planned tariff. From respondents' percentage who agree to move to LRT mode can be concluded that in terms of ability and willingness to pay, respondents who previously used motorcycles mostly agree to move to LRT mode, 47 respondents of 400 respondents or 11,8% based on ATP and 31 respondents of 400 respondents or 7,8% based on WTP.

Based on tariff determination formula, if ATP is bigger than WTP then ATP value becomes determination. So, respondents' percentage who agree to move to LRT mode from respondents' percentage of ATP >612 IDR/passanger-km were used as a result of research.

4.3.2 An Analysis move to LRT based on subsidized tariff
In this section will be seen how many respondents want to move to LRT from existing mode based on subsidized tariff LRT of IDR 5,000. It can be seen in table 4.

Based on the results presented in table 4 can be seen that of the overall respondents with subsidized tariff IDR 5,000, 263 of 400 respondents or 65,8% are willing to move the mode to LRT with ATP > 204 IDR/passanger-km, and while 242 of 400 respondents or 60,5% willing to move the mode to LRT with WTP > 204 IDR/passanger-km. It means, respondents who have the ability to pay the LRT planned tariff are greater in number than those willing to pay according to the planned tariff. From respondents' percentage who agree to move to LRT mode can be concluded that in terms of ability and willingness to pay, respondents who previously used motorcycles mostly agree to move to LRT mode, 131 respondents of 400 respondents or 32,8% based on ATP and 118 respondents of 400 respondents or 29,5% based on WTP.

Table 4 The willingness of the respondents moved to LRT mode with Subsidized Tariff IDR 5,000

Willingness to move to LRT	Number of Respondents	Respondents' Percentage of ATP & WTP >612 IDR/psg-km	Previous Mode	Number of Respondents	Respondents' Percentage who Agree to Move to LRT Mode from All Respondents (400 respondents)
ATP > 204 (IDR/passanger-km)	263	65,8%	1. Angkot	63	15,8%
			2. Bus/ TM	19	4,8%
			3. Delivered	27	6,8%
			4. Car	23	5,8%
			5. Motor cycle	131	32,8%
WTP > 204 (IDR/passanger-km)	242	60,5%	1. Angkot	59	14,8%
			2. Bus/ TM	16	4,0%
			3. Delivered	30	7,5%
			4. Car	18	4,5%
			5. Bicycle	1	0,3%
			6. Motor Cycle	118	29,5%

However, when compared with the planned rate of IDR 15,000, the number of respondents increased dramatically. This proves that the tariff factor is closely related to the ability and willingness of respondents to use LRT mode.

5. Conclusion

Based on the results of research analysis on the ability to pay, willingness to pay and willingness to use potential train users LRT Palembang can be summed up as follows:

a. Average ATP of 543 idr/pnp-km and average WTP of 412 idr/pnp-km. Because the average ATP value was higher than the average of WTP value. So that The determination of the ideal ATP and WTP tariff was below the average ATP value, when it was multiplied by the length of the track 24.5 km, it was found that the ideal rate should be maximally IDR. 13,000. From 283 of 400 respondents or 71% willing to move the mode to LRT there are 43% -59% respondents have the ability to pay LRT plan tariff.

b. The result of the tariff change scenario analysis according to the initial plan of IDR. 20.000, then the people who are able to pay based on ATP there were 50 respondents or 12%, while based on the WTP there were 21 respondents or 5%. If the tariff was subsidized up to IDR. 5,000 then the percentage of people who can pay based on ATP there were 372 respondents or 93%, while based on the WTP were 342 respondents or 85%.

c. The results of *desire to move to LRT mode based on ATP and WTP* in conclusion are more people are willing to move to LRT mode if the tariffs are lower. Based on the data, there was an increase of respondents who use LRT mode from 24,5% to 65,8% when the tariffs are lower.

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