EVALUATION OF PUBLIC TRANSPORT TARIFF POLICY IN THE BASIS OF POSSIBLE OPTIMAL REGULATION OR NATURAL MONOPOLY

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Abstract: The public transport, especially the city bus, is a transport means that has an important role in supporting the daily activities of the Jakarta community. As an element of the transport system, ideally the public transport has the ability to reach each region and also the ability to provide a good service to the community. One of the obstacles that faced the operator in implementing a good service is the limited resource, especially in finance. Financial main resources or the financing of the public transport originated from the tariff receipts. The present valid tariff is the tariff determined by the government. For the operator, the present tariff is economically unfair due to that it is not in proportion with the operating cost that are relatively much larger if compared to the tariff in force. Besides this, the vehicle operating cost were still burdened with various legal and illegal retributions, so that it is impossible to materialize a realistic tariff structure and so operator's profit. Pricing of public transport tariff is crucial task that involves various interests, from user, operator and even regulator. There are various failure causal factors of the tariff system available at present, such as, irrelevant approaches, poor management and unrealistic cost components. This paper discusses on a strategy of the tariff determination under an optimal regulation approach which is an approach that may optimize the interest of the above three by considering the economies of scale, willingness to pay, demand elasticity as well as economies of scope. This analysis is further expected to be a basis of tariff determination for urban public transport in common cities in the country.

1. INTRODUCTION

The public transport, especially the city bus, is a transport means that has an important role in supporting daily activities of the community in Jakarta as well as other urban areas in Indonesia. From the 16.160.979 trips per day in 1997, an amount of 52,90% utilized the public transport and 47,10% utilized the private transport. From the 52,90 users of the public transport, 89,30% utilized the public bus including city bus (RUTR DKI Jakarta 1985 – 2005). Recently the city buses in service in Jakarta city amount to 4.032 vehicles serving 281 routes through 3 types of services, the Regular, the Patas (Non Air Conditioning) and the Patas AC (Air conditioning). There were 4,032 vehicles managed by 14 operators (private, cooperatives and state owned companies) with vehicle ownership around 17 up to 2,000 vehicles. In the case of large bus service the major share of service is provided by two major operators (e.g., PPD and Mayasari Bakti). Furthermore, the number of buses is operated based on percentage of the number of licenses held by operator as can be shown in Table 1.

Table 1. Level of Operation by Operator (1998)

Service Type	Operator	Licenses Held By Operator	Average Buses Operated per day	Per cent Buses Operated
Large Bus	Perum PPD	2,565	612	24 %
	PT Mayasari Bakti	1,266	602	48 %
	PT Ikawali P.J.	34	21	62 %
	PT Pahala Kenyan	62	39	63 %
	PT Bianglala	219	82	37 %
	PT Steady Save	581	193	33 %
	PT G.I. Andalan	93	49	53 %
	H.A.M. Damanik	17	11	65 %
	Kop. A.R.H.	25	15	60 %
	PT Koda Jaya / AJA	97	34	35 %
	PT Hiba Utama	40	33	83 %
	PT Himpurna	100	70	70 %
	PT Metromini	42	29	69 %
	Kopaja	88	62	70 %
	Total	5,229	1,852	35 %

The main finance or public transport is obtained from receipt of tariff. The present valid tariff is the tariff that was determined by the government. Based on the Minister of Communications' Decree PR 306/I/9/PHB dated the 19th of May 1998 bus tariffs were set as followings (flat tariff);

* Regular City Bus is RP.300 per passenger and for scholars/students is RP.100/passenger
* Patas Bus (Non AC) is at maximum RP. 700 per passenger
* Patas Bus (AC) is at maximum RP.2,300 per passenger

To the operator, the present tariff is economically not fair due to unbalance set with the operating cost that relatively is much larger as compared to the tariff in force. Besides the vehicle operating costs are still burdened with various legal and illegal retributions, so that it is impossible to bring into reality the realistic tariff structure that may provide profit to the operators.

In supporting various economic activities ideally the public transport service should be profitable. With the tariffs that are relatively low and not in proportion with the operating costs have often cause of sacrificing the service quality, such as comfort, safety. Therefore, in order to support the presence of the public transport that may operate viably where operators earn sufficient revenue to maintain buses adequately and operate sufficient buses on each route without excessive overcrowding. It is necessary to conduct an evaluation to the incumbent tariff system and its structure. In this evaluation it is necessary to consider the basis of the tariff determination, that is the cost component structure, economies of scale, economies of scope and demand elasticity. Result of such analysis could be an important input for the tariff system determination that has almost never been considered so far.

To reach the above intention and objective as a whole, the scope of analysis would cover:

* Determination of real transport costs, as: average variable costs, average fixed costs, total costs and the marginal costs.
* Determination of demand function and demand elasticity.
* Determination of optimal tariff and considering the economies of scale, economies of scope and demand elasticity.

* Furthermore, this research is limited to the city bus public of large buses, according to the Decree of the Jakarta Governor No.1.204 0f 1991. Large city buses are equipped with 35 to 102 seats excluding the driver's seat. In parallel with such city bus size three types of services are evaluated (i.e., Regular, Patas Non AC and Patas AC).

2. LITERATUR REVIEW

Cost analyses have been done in many researches in the past. In this research cost is represented in terms of one independent variable that is fleet size. Accordingly, there are several microeconomics theories applied in this analysis as followings:

a. Variable Cost (*VC*) is a cost that varies, in total, in direct proportion to changes in the level of activity.
b. Fixed Cost (*FC*) is a cost that remains constant, in total, regardless of changes in the level of activity within the relevant range. Fixed cost is not affected by changes in activity during a period, it remains constant in total amount unless it is influenced by some external force.
c. Direct Cost is defined as the cost that directly relates to the total number of buses in operation.
d. Indirect Cost is defined as the cost that does not directly relate to the total buses in operation.
e. Total Cost (*TC*) is the sum of Fixed Cost and Variable Cost. It is expressed as a function of output X (number of buses in operation).
f. Average Cost (*AC*) in the total cost per unit output

$$AC = TC/X \qquad \text{(1)}$$

g. Marginal Cost: The cost involved in producing one more units of product.

The marginal cost function, $MC(x) = \delta TC(x)/\delta x$ .... (2)

It relates to the gradient of the total cost function to output and represents the cost of marginal increase of the output of the system.

h. Marginal Revenue (*MR*) can be obtained from selling one more unit of product. Marginal revenue curve is commonly used in analyzing pricing policies

$MR = \delta TR(x)/\delta x$, TR = Total Revenue .... (3)

i. Elasticity: As a measure of the response of demand to changes in the variables that affect it. Level elasticity analysis is conducted based on various approaches; point elasticity, midpoint elasticity or average elasticity and shrinkage elasticity.

3. THE METHODOLOGY

As already explained above there are two management system scenarios considered in the analysis, they are:

a. If different operators manage the regular, Patas Non AC and Patas AC separately (economies of scale context).
b. If only one operator manages all three types of services (economies of scope context)

3.1. The Demand for City Bus

A demand function may also be interpreted and used to indicate the willingness of passenger to pay for a trip. To obtain such information, a primary survey is held among the city bus users with a questionnaire form (i.e., Regular, Patas Non AC, Patas AC). The survey is held for 6 days. There are 106 selected respondents for each respective service so that the total respondents become 318 persons.

The items of questionnaire are:

a. What is the utilization frequency of the city bus (i.e., Regular, Patas Non AC, Patas AC) if the tariff is decreased, and if the tariff is increased?
b. Attributes of the city bus user that comprise of:
   * Occupation, Age, Sex
   * Level of income
   * Daily expenditures for transport
   * Ownership of vehicle
   * Purpose of trip with the city bus
   * Reason for using the city bus
   * Type of city bus utilized as routine
   * The average number of transfers within a trip
   * Comments on the service

3.2. The Supply for City Bus

The Supply function is analogous to a cost function. That is why that the operating cost components are required to be known. The operation cost component consists of the fixed cost and the variable costs. The information collected from the secondary survey has been conducted in DLLAJ DKI, Organda DKI, (the Regional Transport Association of the Special Region of Jakarta Municipality), PPD operator (the Jakarta Transport Company Operator) and Mayasari Bhakti (the private company), the spare parts, oil distributors and the car manufacturers. In evaluation bus operating cost was calculated in two versions of which one without subsidy and one with subsidy. This subsidy includes costs for the construction and the maintenance of the shelter and, in general, both costs are borne by the local government.

The calculation of operating cost includes the subsidy, it means that the construction and the maintenance costs of the shelters are burdened to the government. On contrary, operation cost without a subsidy means that the construction and the maintenance costs of shelters will be burdened to the operators. In this evaluation, the observed unit is the total number of buses in operation. Total costs are then composed of variable cost and fixed operating cost. Furthermore, components of variable and fixed operating cost are as follows:

Table 2. Variable and Fixed Operating Cost Components

Variable Operating Cost	Fixed Operating Cost
1. Depreciation of vehicles.	1. Expenses for employees in the head office;
2. Capital interest;	2. Other expenditures;
3. Vehicles insurance;	3. Principle license;
4. License for the designated route;	4. Shelter expenditures;
5. Business license;	5. Maintenance of shelter.
6. Vehicle inspection license.	
7. Salaries and allowance for the bus crew (driver and conductor);	
8. Fuel ;	
9. Expenses for the tires;	
10. Light service (engine oil, differential gear oil, transmission oil, lubricants, oil filter, diesel fuel filter);	
11. Large service (engine, differential gear and transmission oil, lubricants, oil filter, air filter, brake fluid) overhaul ;	
12. Addition of oil;	
13. Overhaul;	
14. Car wash;	
15. Car License number;	
16. Tax;	
17. Storage;	
18. Office administration.	
19. Overhead.	
20. Terminal Retribution;	
21. Depot depreciation;	
22. Workshop;	
23. Office equipment;	
24. Maintenance of office: Car pool: Workshop.	
25. Expenses for employees in depot	

3.3. Average Vehicle Operating Cost

To be aware of the operating costs of a bus, the characteristics of each service should be recognized (i.e., Regular, Patas Non AC and Patas AC). Characteristics comprise of:

a. Characteristic of the vehicle (i.e., type, service classification).
b. Production characteristics (i.e., total trip/day, total kilometer per trip, total kilometer traveled per day, total day/month, passenger capacity), see Table 3.
c. Requirements for each component.

Table 3. Characteristic of City Bus

Characteristic	Regular	Patas Non AC	Patas AC
Type of vehicle Price	Single Decker	Single Decker	Single Decker
Service	Regular	Non AC	AC
Total trip/day	12	10	10
Total km/trip	21	25	25
Total km/day	252	250	250
Total day/month	25	25	25
Total km/year	75600	75000	75000
Passenger Seat	60	54	54
Fuel consumption Km/liter	2.70	2.70	2.40

Calculation for one bus can be done as follows:

$$ACb\ (Rp/day) = FC\,/\,(month \times day) + VC \times TL \qquad \text{........................(4)}$$

where,

ACb = Average Cost/Bus
FC = Fixed Cost
VC = Variable Cost
Month = Operating Month/Bus

Day = Operating Day/Bus
TD = Trip Length

Furthermore, the operating cost (Rp/day) should be converted into Rp/trip.

3.1.4. Average Cost per Passenger (AC per Passenger)

The cost borne by passengers is :

$$\frac{\text{Average Cost per bus (Rp/Trip)}}{\text{Total Passengers Carried}} \qquad \text{..............................(5)}$$

Total passenger is calculated based on the average load factor of the city bus according to the type of service. The information is collected through secondary data. Maximum load factor is different for each type of service. For the Patas AC, the maximum load factor is 1. While the Regular and the Patas Non AC is larger than 1, and average cost per passenger depends on total passenger carried (load factor).

3.1.5. Calculating the Economies of Scale

In the calculation of the economies of scale it is assumed that each operator respectively monopolizes one type of service.

3.1.6. Calculating the Economies of Scope

The assumption adopted is that one operator manages all 3 service types at the same proportion. By this assumption, the value of every direct cost component is the same as mean cost one service operator. For indirect cost component, the value of cost is assessed in similar way with the calculation of economies of scale based on standard cost for number of buses operated. The cost of economies of scope is then compared with average cost of the three kinds of bus services which is managed by one operator. The average cost of the three kinds of bus services is the sum of cost for Regular, Patas Non AC, Patas AC in the same number of buses with number buses for economies of scope, and then divided by three. Therefore there is a cost component that can be utilized together, so that total operation cost can be reduced substantially as compared to single operator operation.

3.1.7. Calculating the *AC* and *MC*

The average bus cost (*AC*) is calculated by equation (1) and average passenger cost is calculated by equation (4) while marginal cost (*MC*) is calculated by equation (2).

3.1.8 Calculating the Tariff

The level of tariff is calculated in various approaches such as;

- Maximization of operator profit that gives the optimum tariff as $MC = MR$.
- Maximization of user's profit that gives the optimum tariff as maximum consumer surplus.
- Maximization of regulator profit (government) that gives the optimum tariff as recently.

4. ESTIMATION RESULTS

4.1. Demand Function

The demand function is modeled by linear regression. From the three equations obtained (e.g., linear, geometrical and exponential) the best equation is the exponential equation.

Thus, the demand function is specified as:

Regular Bus	$Y_R = 2{,}168.4\, e^{-0.0027x}$	$R^2 = 0.9027$, $SE = 0.0609$	.... (6)
Patas Non AC	$Y_{NAC} = 1{,}538.4\, e^{-0.0005x}$	$R^2 = 0.9638$, $SE = 0.0352$	.... (7)
Patas Non AC	$Y_{AC} = 5{,}017.1\, e^{-0.0014x}$	$R^2 = 0.8840$, $SE = 0.0790$	.... (8)

4.2. Demand Elasticity

The demand elasticity is calculated by the elasticity arc formula, because the demand curve is exponentially formed. Thus the demand elasticity is specified as;

- ☐ Regular Bus $E_R = -0.5$
- ☐ Patas Non AC $E_{NAC} = -1.4$
- ☐ Patas AC $E_{AC} = -1.4$

4.3 Specification Cost Function

Average Cost (*AC*) function and Marginal Cost (*MC*) function are given as follows:

Regular bus with load factor = 1.5:

With subsidy :	$Y_{AC} = 0.0002\, X^2 - 0.3512\, X + 534.21$	$R\text{-squared} = 0.99$	...... (9)
	$Y_{MC} = 0.0006\, X^2 - 0.7850\, X + 580.16$	$R\text{-squared} = 0.95$	..... (10)
Without subsidy :	$Y_{AC} = 0.0002\, X^2 - 0.3925\, X + 551.60$	$R\text{-squared} = 0.98$	....(11)
	$Y_{MC} = 0.0006\, X^2 - 0.8737\, X + 603.98$	$R\text{-squared} = 0.95$	......(12)

Patas Non AC, with load factor = 1.0:

With subsidy :	$Y_{AC} = 0.0001\, X^2 - 0.4320\, X + 1{,}083.0$	$R\text{-squared} = 0.92$	..... (13)
	$Y_{MC} = 0.0003\, X^2 - 0.9193\, X + 1{,}134.6$	$R\text{-squared} = 0.99$	..... (14)
Without subsidy :	$Y_{AC} = 0.0001\, X^2 - 0.4763\, X + 1{,}118.1$	$R\text{-squared} = 0.91$	..... (15)
	$Y_{MC} = 0.0003\, X^2 - 1.0127\, X + 1{,}175.5$	$R\text{-squared} = 0.99$	..... (16)

Patas AC, with load factor = 0.6:

With subsidy	$Y_{AC} = 0.0005\, X^2 - 1.3054\, X + 2{,}054.6$	$R\text{-squared} = 0.99$	..... (17)
	$Y_{MC} = 0.0016\, X^2 - 2.9235\, X + 2{,}244.0$	$R\text{-squared} = 0.96$	..... (18)
Without subsidy :	$Y_{AC} = 0.0006\, X^2 - 1.3888\, X + 2{,}093.9$	$R\text{-squared} = 0.99$	..... (19)
	$Y_{MC} = 0.0019\, X^2 - 3.1140\, X + 2{,}291.2$	$R\text{-squared} = 0.96$	..... (20)

Furthermore, the graphs of these equations are illustrated in Figure1 to 6.

4.4. Economies of Scale

Economies of scale exist when the average cost (*AC*) is minimum, see Table 4.

TABLE 4. ECONOMIES OF SCALE FOR EACH RESPECTIVE CITY BUS AT VARIOUS LOAD FACTORS

	REGULAR BUS	
LF	With subsidy	Without subsidy
1.0	x = 878 ; y = 570	x = 981 ; y = 538
1.5	x = 878 ; y = 380	x = 981 ; y = 359
2.0	x = 1,317 ; y = 227	x = 1,472 ; y = 197
	PATAS NON AC BUS	
LF	With subsidy	Without Subsidy
0.8	x = 1,350 ; y = 989	x = 1,488 ; y = 954
1.0	x = 2,160 ; y = 616	x = 2,381 ; y = 551
1.2	x = 1,800 ; y = 578	x = 1,984 ; y = 538
	PATAS AC BUS	
LF	With subsidy	Without subsidy
0.6	x = 1,305 ; y = 1.203	x = 1,157 ; y = 1.290
0.8	x = 1.224 ; y = 942	x = 1,302 ; y = 892
1.0	x = 1.305 ; y = 721	x = 1.041 ; y = 822

x = Bus Operated y = Minimum Tariff (Rp)

4.5. The Break Event Point (BEP)

The break event point exists when the average cost curve crossing the demand curve, see Table 5.

TABLE 5. THE BREAK EVEN POINT (BEP) OF EACH RESPECTIVE CITY BUS AT VARIOUS LOAD FACTORS

	REGULAR BUS	
LF	With Subsidy	Without Subsidy
1.0	x = 463 ; y = 622	x = 465 ; y = 618
1.5	x = 634 ; y = 392	x = 643 ; y = 382
2.0	x = 793 ; y = 255	x = 815 ; y = 240
	PATAS NON AC BUS	
LF	With Subsidy	Without Subsidy
0.8	x = 721 ; y = 1.072	x = 737 ; y = 1.067
1.0	x = 2,002 ; y = 565	x = 1,784 ; y = 630
1.2	x = 2,097 ; y = 539	x = 1,949 ; y = 580
	PATAS AC BUS	
LF	With Subsidy	Without Subsidy
0.6	x = 957 ; y = 1.314	x = 992 ; y = 1.252
0.8	x = 1.232 ; y = 894	x = 1.156 ; y = 994
1.0	x = 1,273 ; y = 844	x = 1.384 ; y = 723

x = Bus Operated y = Minimum Tariff (Rp)

4.6. Tariff Calculation

Comparisons of the tariff with various load factors are shown in Table 6.

Table 6. Tariff Comparisons with Various Load Factors

	REGULAR BUS WITH SUBSIDY					REGULAR BUS WITHOUT SUBSIDY				
L.F.	P_1	P_2	P_3	P_4	P_5	P_1	P_2	P_3	P_4	P_5
1.0	300	300	570	622	1,009	300	300	538	618	1,007
Bus	*246*	*737*	*878*	*463*	*283*	*246*	*737*	*981*	*465*	*284*
1.5	300	300	380	392	867	300	300	359	382	863
Bus	*246*	*737*	*878*	*634*	*339*	*246*	*737*	*981*	*643*	*341*
2.0	300	300	227	255	794	300	300	197	240	789
Bus	*246*	*737*	*1,373*	*793*	*372*	*246*	*737*	*1,472*	*815*	*374*

	PATAS NON AC BUS WITH SUBSIDY					PATAS NON AC BUS WITHOUT SUBSIDY				
L.F.	P_1	P_2	P_3	P_4	P_5	P_1	P_2	P_3	P_4	P_5
0.8	700	700	989	1,072	1,230	700	700	954	1,067	1,232
Bus	*368*	*508*	*1,350*	*721*	*447*	*368*	*508*	*1,488*	*737*	*443*
1.0	700	700	616	565	747	700	700	551	630	862
Bus	*368*	*508*	*2,160*	*2,002*	*1444*	*368*	*508*	*2,381*	*1,784*	*1,157*
1.2	700	700	578	539	790	700	700	538	580	850
Bus	*368*	*508*	*1,800*	*2,097*	*1,332*	*368*	*508*	*1,984*	*1,949*	*1,187*

	PATAS AC BUS WITH SUBSIDY					PATAS AC BUS WITHOUT SUBSIDY				
L.F.	P_1	P_2	P_3	P_4	P_5	P_1	P_2	P_3	P_4	P_5
0.6	2,300	2,300	1,203	1,314	4,795	2,300	2,300	1,290	1,252	4,798
Bus	*182*	*546*	*1,305*	*957*	*451*	*182*	*546*	*1,157*	*992*	*447*
0.8	2,300	2,300	942	894	4,825	2,300	2,300	892	994	4,825
Bus	*182*	*546*	*1,224*	*1,232*	*389*	*182*	*546*	*1,302*	*1,156*	*391*
1.0	2,300	2,300	721	844	4,817	2,300	2,300	822	723	4,816
Bus	*182*	*546*	*1,305*	*1,273*	*407*	*182*	*546*	*1,041*	*1,384*	*409*

Where : *P1* = Tariff Based on Bus Operated
P2 = Tariff Based on Bus Licensed
P3 = Tariff Based on Minimum Average Cost (economies of scale)
P4 = Tariff Based on Break Event Point
P5 = Tariff Based on Operator's Maximum Profit, $MC = MR$

4.7. Economies of Scope

Average Operating cost is calculated by economies of scope shown in Table 7, and graph 7 - 8.

Table 7. Operating Cost at Economies of Scope

	WITH SUBSIDY			WITHOUT SUBSIDY		
BUS OPERATED	Cost by Ec.Scope (1 operator)	Average Cost (3 Operator)	Difference Cost Bus/trip	Cost by Ec.Scope (1 operator)	Average Cost (3 Operator)	Difference Cost Bus/trip
100	956.49	983.30	26.81	1,103.70	1,006.68	-97.01
400	816.29	844.09	27.81	853.09	856.84	3.76
450	803.95	824.98	21.02	836.67	836.54	-0.13
500	786.15	807.02	20.88	815.59	817.56	1.98
550	765.64	790.24	24.60	792.40	799.92	7.52
600	749.40	774.62	25.22	773.93	783.62	9.68
650	738.76	760.17	21.41	761.40	768.64	7.24
700	726.35	746.88	20.53	747.38	755.00	7.62
750	713.14	734.77	21.62	732.77	742.70	9.93
800	699.97	723.81	23.84	718.37	731.72	13.35
850	691.57	714.03	22.46	708.89	722.08	13.19
900	678.35	705.41	27.06	694.70	713.78	19.07
950	666.24	697.96	31.72	681.73	706.80	25.07
1,000	654.34	691.67	37.33	669.06	701.16	32.10
1,050	654.99	686.56	31.57	669.01	696.86	27.85
1,100	651.84	682.60	30.76	665.22	693.88	28.66
1,150	652.33	679.82	27.49	665.13	692.24	27.11
1,200	649.32	678.20	28.88	661.59	691.94	30.35
1,250	649.16	677.75	28.59	660.94	692.96	32.03
1,300	646.43	678.46	32.04	657.75	695.32	37.57
1,350	646.59	680.35	33.76	657.49	699.02	41.53
1,400	645.55	683.39	37.84	656.06	704.04	47.98
1,450	643.96	687.61	43.65	654.11	710.40	56.29
1,500	643.17	692.99	49.82	654.11	718.10	63.98

5. ANALYSIS AND INTERPRETATION

There are various interpretations that could be drawn from the analysis results. Interpretation is not only based on the theory, but also by comparing the analysis results with the existing condition.

5.1. The Regular Bus

The Regular bus user is captive user with a limited income level (e.g., low income set), which is lower than the income of the other two types of service (e.g., Patas Non AC and Patas AC).

Based on calculations, managing the Regular bus is not profitable for the operator except at the LF = 2.0 with the minimum operation of 475 buses. If the regular bus operates in the economies of scale situation, that is at the time where the AC is minimum (with or without the shelter subsidy), and at the load factor of 1.0 and 1.5 the tariff should actually be higher than the existing tariff, except for LF = 2.0. So it is also similar if the bus is operated in the condition of BEP (crossing point between AC curve and D curve) for LF's of 1.0 and 1.5 of its tariff above the present tariff except at load factor 2.0. See Table5.

If connected with the present condition, the bus is operated in accordance with SO, that is 246 units and a tariff of RP.300, the operator is therefore at a total loss of Rp.5,741,640,- per trip (see table 8 - 9). If operated in accordance with SGO, that is 737 units, the loss of the operator becomes bigger for the same load factor except at load factor of 2.0, see table 10-11.

TABLE 8. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS OPERATED (SO) REGULAR BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(3)x(2))	(5=60x(1)x((2)x(7))	(6 = 4 - 5)	(7)
1.0	246	300	4,428,000	10,169,640.00	-5,741,640.00	689
1.5	246	300	6,642,000	10,162,260.00	-3,520,260.00	459
2.0	246	300	8,856,000	10,066,320.00	-1,210,320.00	341

TABLE 9. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS OPERATED (SO) REGULAR BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(3)x(2))	(5=60x(1)x((2)x(7))	(6 = 4 - 5)	(7)
1.0	246	300	4,428,000	10,346,760.00	-5,918,760.00	701
1.5	246	300	6,642,000	10,339,380.00	-3,697,380.00	467
2.0	246	300	8,856,000	10,243,440.00	-1,387,440.00	347

TABLE 10. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS LICENSED (SGO) REGULAR BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(3)x(2))	(5=60x(1)x((2)x(7))	(6 = 4 - 5)	(7)
1.0	737	300	13,266,000	25,470,720.00	-12,204,720.00	576
1.5	737	300	19,899,000	25,470,720.00	-5,571,720.00	384
2.0	737	300	26,532,000	23,082,840.00	3,449,160.00	261

TABLE 11. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS LICENSED (SGO) REGULAR BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(3)x(2))	(5=60x(1)x((2)x(7))	(6 = 4 - 5)	(7)
1.0	737	300	13,266,000	24,586,320.00	-11,320,320.00	556
1.5	737	300	19,899,000	24,608,430.00	-4,709,430.00	371
2.0	737	300	26,532,000	22,198,440.00	4,333,560.00	251

With the above condition, there are several scenarios for the management of the Regular bus.

The government (monopoly) manages the Regular bus.
The Regular bus is managed privately, but subsidized by the government in order that the operator does not experience a loss. The subsidy value is adjusted with the expected load factor (see Tables 12 and 13).

If subsidy is not available, the tariff should be increased up to a minimum that is equal to AC of Rp.689 at a load factor of 1.0, and Rp.459 at a load factor of 1.5. And becoming Rp.341 at a load factor of 2.0 in order that the operators do not experience any loss.

TABLE 12. OPERATOR'S MAXIMUM PROFIT *MC* = *MR* REGULAR BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
1.0	283	1,009	17,132,820	11,478,480	5,654,340.00	676
1.5	339	867	26,452,170	13,363,380	13,088,790.00	438
2.0	372	794	35,444,160	14,106,240	21,337,920.00	316

TABLE 13. OPERATOR'S MAXIMUM PROFIT *MC* = *MR* REGULAR BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
1.0	284	1,007	17,159,280	11,655,360	5,503,920.00	684
1.5	341	863	26,485,470	13,503,600	12,981,870.00	440
2.0	374	789	35,410,320	14,226,960	21,183,360.00	317

The most profitable tariff to the operator is when *MC* = *MR*. This tariff is Rp.676 for a load factor of 1.0 and total number of 284 buses in operation, Rp. 438 for a load factor of 1.5 and total number of 339 buses in operation, Rp. 794 for a load factor of 2.0 and total number of 372 buses in operation with subsidized shelter (see Table 14 and Table 15). If the tariff is not increased, the operator shall therefore not be in operation as it should be. The quality of service, comfort, safety, shall be sacrificed through the vehicle operation age extension, postponement of maintenance, escalation of transport capacity until exceeding the load factor of 2.0.

TABLE 14. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS OPERATED (SO) PATAS NON AC BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.8	368	700	11,128,320	19,172,505.60	-8,044,185.60	1,205
1.0	368	700	13,910,400	18,997,632.00	-5,087,232.00	956
1.2	368	700	16,692,480	19,053,273.60	-2,360,793.60	799

TABLE 15. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY)
BASED ON BUS OPERATED (SO) PATAS NON AC BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.8	368	700	11,128,320	18,790,963.20	-7,662,643.20	1,182
1.0	368	700	13,910,400	18,620,064.00	-4,709,664.00	937
1.2	368	700	16,692,480	18,671,731.20	-1,979,251.20	783

In demand if the tariff is increased, the consequence is that there will be a reaction from the community that might cause a social unrest because generally the users of the Regular bus transport means are the captive community with low-income level.

5.2. Patas Non AC Bus

Users of the Patas Non AC are captive users with income level that is above the Regular bus users.

Based on calculations, management of the Patas Non AC bus at present according to SO totals 368 units with a tariff of Rp.700 is not profitable. The minimum tariff with a total of 368 buses is RP. 1,205 for a load factor of 0,8, Rp.956 for a load factor of 1.0 and Rp.799 for a load factor 1.2 (equal to the AC value), see Table 16 and 17. If operated in accordance with SGO, see Table 18 and 19.

TABLE 16. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS LICENSE (SGO) PATAS NON AC BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.8	508	700	15,361,920	25,171,603.20	-9,809,683.20	1,147
1.0	508	700	19,202,400	24,743,664.00	-5,541,264.00	902
1.2	508	700	23,042,880	24,886,310.40	-1,843,430.40	756

TABLE 17. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS LICENSE (SGO) PATAS NON AC BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.8	508	700	15,361,920	24,820,473.60	-9,458,553.60	1,131
1.0	508	700	19,202,400	24,387,048.00	-5,184,648.00	889
1.2	508	700	23,042,880	24,524,208.00	-1,481,328.00	745

TABLE 18. OPERATOR'S MAXIMUM PROFIT *MC* = *MR* PATAS NON AC BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
0.8	443	1,232	26,197,248	24,942,672	1,254,576.00	1,173
1.0	1,157	862	59,840,040	48,594,000	11,246,040.00	700
1.2	1,187	850	72,644,400	51,363,864	21,280,536.00	601

TABLE 19. OPERATOR'S MAXIMUM PROFIT *MC* = *MR* PATAS NON AC BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
0.8	447	1,230	26,390,880	24,717,312	1,673,568.00	1,152
1.0	1,444	747	64,720,080	57,788,880	6,931,200.00	667
1.2	1,332	790	75,764,160	57,542,400	18,221,760.00	600

The tariff is most profitable to the operator is when *MC=MR*. This tariff is Rp. 1,230 with load factor of 0.8 and total number of 447 buses in operation, Rp. 747 with load factor of 1.0 and total number of 1,444 buses, and Rp. 790 with load factor of 1.2 and total number of 1,332 buses in operation. Furthermore, Table 20 summarizes the figures without subsidized shelter, and Table 21 summarizes the figures for with subsidized shelter.

TABLE 20. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS OPERATED (SO) PATAS AC BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.6	182	2,300	13,562,640	10,808,834.40	2,753,805.60	1,833
0.8	182	2,300	18,083,520	10,818,662.40	7,264,857.60	1,376
1.0	182	2,300	22,604,400	10,810,800.00	11,793,600.00	1,100

TABLE 21. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS OPERATED (SO) PATAS AC BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.6	182	2,300	13,562,640	10,973,944.80	2,588,695.20	1,861
0.8	182	2,300	18,083,520	10,960,185.60	7,123,334.40	1,394
1.0	182	2,300	22,604,400	10,977,876.00	11,626,524.00	1,117

In calculations, management of the Patas Non AC is also a loss so that a subsidy is required. In table 22 and 23, the subsidy value that should be borne for every one trip is pointed out. If the subsidy is not applied, the tariff should be increased or the load factor should be added (larger than 1.2). The subsidy awarded by the government may be in the form of a soft loan, spare parts (tires) that are dominant components in the variable cost.

TABLE 22. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS LICENSED (SGO) PATAS AC BUS WITH SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.6	546	2,300	40,687,920	26,376,386.40	14,311,533.60	1,491
0.8	546	2,300	54,250,560	26,559,187.20	27,691,372.80	1,126
1.0	546	2,300	67,813,200	26,388,180.00	41,425,020.00	895

TABLE 23. TOTAL REVENUE AND OPERATOR'S PROFIT (MONOPOLY) BASED ON BUS LICENSED (SGO) PATAS AC BUS WITHOUT SUBSIDY

Load Factor	Bus Operated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ Passenger (AC)
(1)	(2)	(3)	(4=54x(1)x(3)x(2))	(5=54x(1)x((2)x(7))	(6 = 4 - 5)	(7)
0.6	546	2,300	40,687,920	26,783,265.60	13,904,654.40	1,514
0.8	546	2,300	54,250,560	26,441,251.20	27,809,308.80	1,121
1.0	546	2,300	67,813,200	27,154,764.00	40,658,436.00	921

5.3. Patas AC Bus

The Patas AC users are users with high *choice* nature and access to other vehicles like private cars. The Patas AC users have incomes that are relatively higher than that of the other two types of services.

It is learnt from observation that the management of the Patas Ac bus gives profit to the operator for each load factor that is analyzed. Due to such management of the Patas AC bus, it is very reasonable to think that it may be handed over to the private sector rather than government. And furthermore, should the management be handed over to the private sector, it is expected that government does not control the tariff any longer. To have an illustration on how beneficial the operation of Patas AC is, Table 24 and 25 denote its profits when $MC = MR$, and within the schemes of with and without subsidy respectively.

TABLE 24. OPERATOR'S MAXIMUM PROFIT $MC = MR$ PATAS AC BUS WITH SUBSIDY

Load Factor	Bus Op Erated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
0.6	451	4,795	77,851,620	25,441,812	52,409,808.00	1,567
0.8	389	4,825	90,092,400	22,798,512	67,293,888.00	1,221
1.0	407	4,817	117,631,140	23,540,880	94,090,260.00	964

TABLE 25. OPERATOR'S MAXIMUM PROFIT $MC = MR$ PATAS AC BUS WITHOUT SUBSIDY

Load Factor	Bus Op Erated (Q)	Tariff (P)	Total Revenue (TR)/trip	Total Cost (TC)/trip	Total Profit (TP)/trip	Average Cost/ passenger (AC)
(1)	(2)	(3)	(4=60x(1)x(2)x(3))	(5=60x(1)x(2)x(7))	(6 = 4 - 5)	(7)
0.6	447	4,798	77,209,416	25,634,556	51,574,860.00	1,593
0.8	391	4,825	90,555,600	21,095,232	69,460,368.00	1,124
1.0	409	4,816	118,184,640	24,122,820	94,061,820.00	983

5.4. Economies of Scope

The management by economies of scope is cheaper compared to individual management for each type of service. The management with a model like this may also cope with loss in the operation of the Regular bus if the management is handed over to the private sector without subsidy from the government. With a model like this it is hoped for a cross subsidy among the three types of service operated. The comparison of the operating costs between economies of scope with a separate management is available in Table 7.

6. CONCLUSIONS

From the analysis results several conclusions may be summarized as follows:

- The users of the Regular and Patas Non AC buses are captive users that are very much depending on the presence of the public transport. While users of the Patas AC bus are choice riders' natured and have access to private vehicles, like cars.
- The management of the Regular bus is economically not profitable for the operator, especially the private sector. Because the operation expenses are much larger than the present tariff in force, except at load factor 2.0 and the total number of buses operated are minimum 475 units.
- Government (monopoly) ideally manages the Regular buses.
- The management of the Patas Non AC bus is profitable if the load factor more than 1. The Patas Non AC is proposed managed by private company. If the management is handed to the private sector with the consequence that the tariff is not arranged by the government. Consequently it is necessary to monitor bus operations on a regular basis to ensure that operator provide the number of uses for which they are licensed and to eliminate excessive passenger over crowding. The purpose of monitoring is simply to find out the level of service operated on each route and the number of passenger carried. These figures can then be compared with the level of service which the operator was licensed to provide and with the target passenger load.
- The Patas AC bus is economically profitable, even though with a load factor of 0.6 (with or without the shelter subsidy) because the AC graph is at present far beneath the tariff. The Patas AC is proposed to be managed by government and private sector.
- Tariff for travelling on buses system is dependent on load factor and elasticity of demand.
- The economies of scale and diseconomies of scale exist in behavior cost of bus. It is suggested that government have to make a regulation that restricts the number of operators (e.g., private and government operators) that can manage bus services, so they can operate number of buses in zone of economies of scale.
- Operating Regular and Patas Non AC not all of them generated surplus to the operator. And from the past, it is known that subsidy of government was not effective. We suggest that regular bus service is managed by government meanwhile Patas Non AC is managed by private operator. Patas AC, since it generates high surplus both to operator, government and private operator, it can be allowed to be managed with market tariff but government have to set regulation about standard quality licensing.

TABLE 26. THE VALUE OF SUBSIDY REGULAR BUS WITHOUT SHELTER SUBSIDY

LF	USER CHARAC TERISTIC	E	TARIFF	S.O	TP1	S.G.O	TP2	THE VALUE OF SUBSIDY BASED ON S.O			THE VALUE OF SUBSIDY BASED ON S.G.O		
								DAY	MONTH	YEAR	DAY	MONTH	YEAR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8=5x12 trip)	(9=8x25 day)	(10=9x12 month)	(11=7x12 trip)	(12=11x25 day)	(13=11x12 month)
1.0	CAPTIVE RIDERS	-0.5	300	246	-5,918,760.00	737	-11,320,320	-71,025,120	-1,775,628,000	-21,307,536,000	-135,843,840	-3,396,096,000	-40,753,152,000
1.5	CAPTIVE RIDERS	-0.5	300	246	-3,697,380.00	737	-4,709,430	-44,368,560	-1,109,214,000	-13,310,568,000	-56,513,160	-1,412,829,000	-16,953,948,000
2.0	CAPTIVE RIDERS	-0.5	300	246	-1,387,440.00	737	0	-16,649,280	-416,232,000	-4,994,784,000	0	0	0

TABLE 27. THE VALUE OF SUBSIDY REGULAR BUS WITH SHELTER SUBSIDY

LF	USER CHARAC TERISTIC	E	TARIFF	S.O	TP1	S.G.O	TP2	THE VALUE OF SUBSIDY BASED ON S.O			THE VALUE OF SUBSIDY BASED ON S.G.O		
								DAY	MONTH	YEAR	DAY	MONTH	YEAR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8=5x12 trip)	(9=8x25 Day)	(10=9x12 Month)	(11=7x12 trip)	(12=11x25 Day)	(13=11x12 Month)
1.0	CAPTIVE RIDERS	-0.5	300	246	-5,741,640.00	737	-12,204,720	-68,899,680	-1,722,492,000	-20,669,904,000	-146,456,640	-3,661,416,000	-43,936,992,000
1.5	CAPTIVE RIDERS	-0.5	300	246	-3,520,260.00	737	-5,571,720	-42,243,120	-1,056,078,000	-12,672,936,000	-66,860,640	-1,671,516,000	-20,058,192,000
2.0	CAPTIVE RIDERS	-0.5	300	246	-1,210,320.00	737	0	-14,523,840	-363,096,000	-4,357,152,000	0	0	0

TABLE 28. THE VALUE OF SUBSIDY PATAS NON AC BUS WITHOUT SHELTER SUBSIDY

LF	USER CHARAC TERISTIC	E	TARIFF	S.O	TP1	S.G.O	TP2	THE VALUE OF SUBSIDY BASED ON S.O			THE VALUE OF SUBSIDY BASED ON S.G.O		
								DAY	MONTH	YEAR	DAY	MONTH	YEAR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8=5x10 trip)	(9=8x25 Day)	(10=9x12 Month)	(11=7x10 trip)	(12=11x25 Day)	(13=11x12 Month)
0.8	CAPTIVE RIDERS	-1.4	700	368	-7,662,643.20	508	-9,458,553.5	-76,626,432	-1,915,660,800	-22,987,929,600	-94,585,535	-2,364,638,375	-28,375,660,500
1.0	CAPTIVE RIDERS	-1.4	700	368	-4,709,664.00	508	-5,184,648.0	-47,096,640	-1,177,416,000	-14,128,992,000	-51,846,480	-1,296,162,000	-15,553,944,000
1.2	CAPTIVE RIDERS	-1.4	700	368	-1,979,251.20	508	-1,481,328.0	-19,792,512	-494,812,800	-5,937,753,600	-14,813,280	-370,332,000	-4,443,984,000

TABLE 29. THE VALUE OF SUBSIDY PATAS NON AC BUS WITH SHELTER SUBSIDY

LF	USER CHARAC TERISTIC	E	TARIFF	S.O	TP1	S.G.O	TP2	THE VALUE OF SUBSIDY BASED ON S.O			THE VALUE OF SUBSIDY BASED ON S.G.O		
								DAY	MONTH	YEAR	DAY	MONTH	YEAR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8=5x10 trip)	(9=8x25 Day)	(10=9x12 Month)	(11=7x10 trip)	(12=11x25 Day)	(13=11x12 Month)
0.8	CAPTIVE RIDERS	-1.4	700	368	-8,044,185.60	508	-9,809,683.2	-80,441,856	-2,011,046,400	-24,132,556,800	-98,096,832	-2,452,420,800	-29,429,049,600
1.0	CAPTIVE RIDERS	-1.4	700	368	-5,087,232.00	508	-5,541,264.0	-50,872,320	-1,271,808,000	-15,261,696,000	-55,412,640	-1,385,316,000	-16,623,792,000
1.2	CAPTIVE RIDERS	-1.4	700	368	-2,360,793.60	508	-1,843,430.4	-23,607,936	-590,198,400	-7,082,380,800	-18,434,304	-460,857,600	-5,530,291,200

Where :

SO = The number of bus operated
SGO = The number of buses licensed
E = Elasticity

TP_1 = Total Profit based on bus operated
TP_2 = Total Profit based on bus licensed

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