

The modal transfer analysis by adding transport costs. Case study: The use of bus and private vehicle student Institut Teknologi Sumatera

H Muliarto¹, Alhamidi, and M Syahbandi

Department of Urban and Regional Planning, Institut Teknologi Sumatera (ITERA),
South Lampung, Indonesia hor addresses here

hendro.muliarto@gmail.com

Abstract. Since the last two years the Institut Teknologi Sumatera to accept new students in large numbers. Increasing the number of students is directly proportional to the increase of private vehicles that enter the campus it is not in line with the policy of the Institut Teknologi Sumatera as Smart, Friendly, and Forest Campus. Institut Teknologi Sumatera as Smart, Friendly, and Forest Campus fact has made some deal with mass public transport, Damri, to provide bus transportation to the Institut Teknologi Sumatera, but the number of bus users is still inferior to the number of private vehicle users. This study was conducted to see the modal transfer of the entire academic community ITERA, from private cars to public transport such as buses, with the addition of transportation costs in the form of parking rates. This study shows the dominant displacement can occur if the respondent charged parking fees of IDR 4.000. Besides the displacement mode of transportation from using private vehicles be using the bus can occur if Trans Lampung fix three systems including bus departure and arrival schedules, facility service providers that support, and the addition of the Bus Trans Lampung.

1. Introduction

Transportation became an important part in human life, because it acts as a transport carriage of goods and human beings in order to facilitate human activities in terms of economic, social and territorial. In accordance with the target goal number 11 on Sustainable Cities and Communities that are discussed in the general assembly of the United Nations (UN) on 25 September 2015 authorizing the Sustainable Development Goals (SDGs) that by 2030, providing access to safe, affordable, accessible and systems sustainable transport for all citizens, improve road safety, particularly by expanding public transport, with special attention to those who need a vulnerable situation such as women, children, the disabled and the elderly [1]. Sustainable public transport system a own positive impact on the sustainability of the economic, social, cultural, and environmental diversity of the community being served [2]. The existence of the transport system is to meet the needs of economic and social relevance, and give people an opportunity to improve mobility [3]. Where the influence of public transport so have a major impact in reducing traffic congestion, reduce air pollution, and reduce costs.

ITERA admit students every year with large numbers, in 2015 ITERA received the students as much as approximately 400 students and in 2016 ITERA received the students as much as approximately 1200 students. This is a new problem that is where the increasing number of students who use private vehicles, with limited parking space on campus ITERA lead to less availability of parking spaces on campus



ITERA. In this study, researchers conducted a survey when the vehicle parking fee imposed on the campus of ITERA, the extent of the student's ability to pay for services it receives to switch modes from using private transport be using public transportation. This study aims to determine how much a student's ability to pay for transportation services ITERA received based on income and is considered ideal (Ability to pay) to the parking area on campus ITERA applied regardless of the location of a student residence.

2. Basis Theory

In this study researchers conducted a study on students ITERA to be able to switch modes from using private vehicles be using the bus. Taking into account the ability and willingness of users to pay the cost of transport, with a view Ability to pay and willingness to pay student. Ability to pay (ATP) is a person's ability to pay for transportation services received based on income and is considered ideal. ATP analysis is viewed allocation of transport costs and travel intensity with a great view of ATP or the ratio of the budget. Ability to pay travel expenses influenced by family income per month, the allocation of transport costs, the intensity and number of family members [4]. Willingness to pay (WTP) is the willingness of users to issue a reward for services obtained. WTP analysis with user perception of the rates of the bus transport service as well as the factors affecting including service quality, quantity of services, utilities, and the user's income. Mode selection model aims to determine the proportion of people who will use each mode. This process is done with the intention to calibrate models of modal choice between a base year to determine independent variables (attributes) that affect the modal choice. Factors that may affect the selection of these modes can be grouped into four (Ben-Akiva and Lerman, 1985), namely: (1) Characteristics of road users; (2) Characteristics of the movement; (3) Characteristics of transportation facilities; and (4) Feature town or zone [5].

Model forms modal choice in European countries is dominated by a model of the distribution of the movement, so that the modal choice models should be used after dispersion modeling stage movement. In this study, there are two types of modes of transportation are: buses and private transport, the analysis in this study using a modal choice model of cost. Costs in modeling modal choice, it is important to distinguish between the estimated cost and the actual cost. Cost estimates are the costs that feel pressure by road users and basic decision-making, while the actual cost is the actual cost incurred after the electoral process modes do.

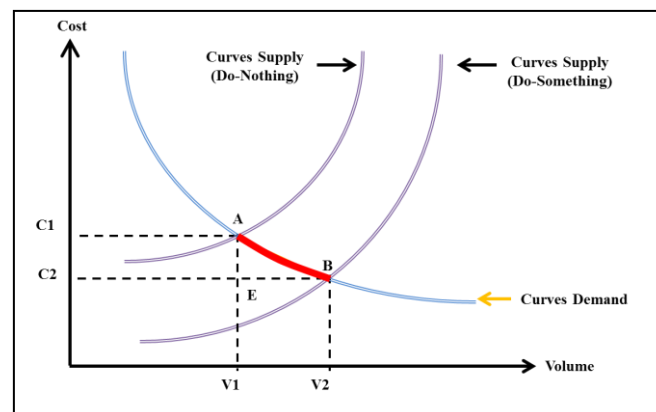


Figure 1. Supply curve Do-Nothing and Do-Something [5]

Demand and supply curves occur when the policies in effect between producers and consumers in achieving equilibrium point. Where the point of equilibrium will shift as a result of their influencing factors demand and supply. The curve above explains that shift the equilibrium point on the supply curve of a do-nothing to do-something. At the moment the number of do-nothing volume v_1 at a cost c_1 . Meanwhile, when the do-something with the amount of volume v_2 c_2 costs. Because the supply curve is

perfectly elastic at c_1 , then if there is additional volume of the number of vehicles to v_2 will benefit (surplus) for producers of area above the line AB.

3. Analysis Method

ITERA to analyze student data, researchers used a descriptive statistical analysis methods. Through methods relating to the collection and presentation of a range of data so as to provide useful information is called Descriptive Statistics [6]. In this study the determination of the number of samples is 100 people with a 90% confidence level using Taro Yamane formula (Cluster Random Sampling) where:

$$n = \frac{N}{\left(N \cdot (d)^2 + (1) \right)} \quad (1)$$

Description :

n = Samples; N = Population; d = Precision

$$n = \frac{1700}{\left(1700 \cdot (0,1)^2 + (1) \right)} = 94,4 \text{ percent} \quad (2)$$

To simplify the calculations the researchers used a sample of 100 of the total population of 1700 students ITERA.

3.1. Data

Researchers conducted a survey directly to all students of the Institut Teknologi Sumatera obtained a sample of 100 students with a variety of diverse opinions on the policy smokeless day. In order to keep transportation costs for the students in a day, the data necessary expenses or income students ITERA. Researchers obtain data on the percentage of students ITERA spending per day in the following diagram.

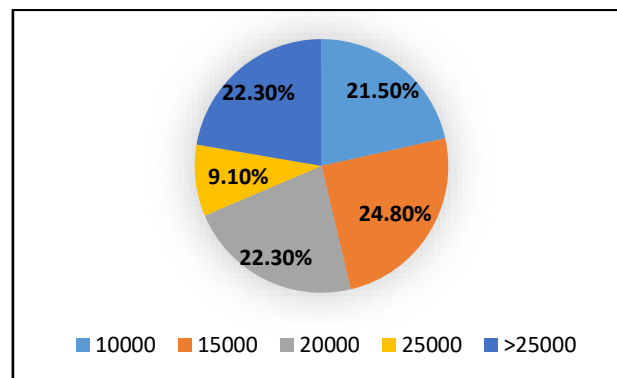


Figure 2. Diagram of a percentage of students ITERA per-day (Source: Survey researchers, processed)

Based on the above data that as many as 24.80% of the students have the IDR 15.000 per day, and while the cost incurred by the person for transport costs in the everyday is 30% of the revenue or expenditure of a person in a day. If the student spending a day fifteen thousand rupiah, the transport costs incurred in a day is as follows.

$$\text{Transport fee} = 30\% \cdot \text{Spending per day} = \frac{30}{100} \cdot 15000 = \text{Rp } 4.500 \quad (3)$$

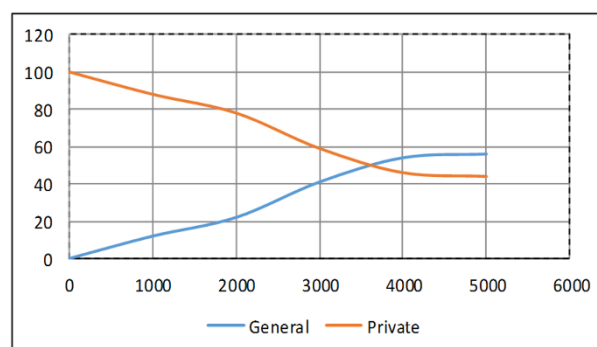
Then the cost of transport students in a day good ITERA is IDR 4.500. From research conducted in the Institut Teknologi Sumatera on the analysis of the transfer modes of transportation from using private vehicles into Bus Trans Lampung with the enforcement of the parking fee using a questionnaire obtained data as follows.

Table 1. Comparison of the percentage of the number of private vehicles and a bus ride will take effect when the parking rates.

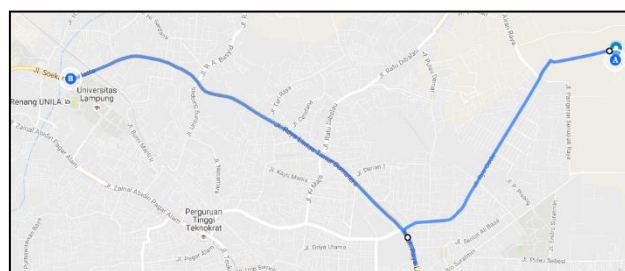
Parking fee	The number of users of private vehicles	The number of bus users
IDR 1.000	88%	12%
IDR 2.000	78%	22%
IDR 3.000	59%	41%
IDR 4.000	46%	54%
IDR 5.000	44%	56%

(Source: Survey researchers, processed)

From Table 1 above shows that at the time of parking charges applied to IDR 1,000 the percentage of students who ride personal vehicles 88% and the number of students who ride buses 12% of the total student ITERA. In the parking fee is applied IDR 2.000 the percentage of students who ride personal vehicles 78% and the number of students who ride buses to 22% of the total student ITERA. Then at the parking fees applied IDR 3.000 the percentage of students who ride personal vehicles to 59% and the number of students who ride buses 41%. Furthermore, when the parking fee is applied IDR 4.000 the percentage of students who ride personal vehicles to 46% and the number of students who ride buses 54%. Then when the parking fee was raised to IDR 5.000 the percentage of students who ride personal vehicles dropped to 44% and the number of students who use the bus transport 56% of the total student ITERA. It showed that when the parking fee increase occurred in transportation modal transfer from private cars to bus transportation. So at certain parking charges can hit up all the students ITERA use bus transportation.

**Figure 3.** Graph private vehicle transfer to the bus (Source: Survey researchers, processed).

The graph above that at the time of parking fees applied will make the student make the shift mode of transportation to the bus, due to the ATP and WTP owned by ITERA student than he paid parking is more expensive than paying the cost of bus transportation. So if the parking fee to be increased, it will cause all students ITERA use bus transportation.

**Figure 4.** Trans Bus Route Lampung ITERA - UNILA (Source: Google maps)

Trans Lampung Bus is the only bus that has the purpose to the University of Lampung without transit transport to another. The bus route Trans-ITERA Lampung Unila Ryacudu through the canal road, turn left onto the street Hi Pangeran Suhaimi, continue past the primary collector road Mayjend Riyakudu, and turn right into primary arterial road Soekarno-Hatta to a stop in front of the campus of the University of Lampung. From interviews with the Trans Lampung income earned by Trans Lampung property of Lampung Province which operate on routes ITERA-UNILA calculated based on the average income of the seven Trans Lampung which operates on this route is the lowest incomes per day IDR 16.000 and the largest revenue per day IDR 250.000 with a 1-trip transportation costs for students / student is IDR 2.000. As for public transport costs 1 trip IDR 4.000.

Table 2. Revenue Lampung Trans Bus Route ITERA - UNILA

No	Day	Income (Rupiah)
1	Monday	± 50.000
2	Tuesday	± 200.000
3	Wednesday	± 30.000
4	Thursday	± 30.000
5	Friday	± 30.000
6	Saturday	± 30.000 ± 100.000
7	Sunday	± 30.000 ± 100.000

(Sources: *Results of Interview*, 1 November 2016)

From Table 2 above illustrates the low income obtained by the Trans Lampung every day. The low revenue showed no effective and efficient operation on the route. Though bus takes money to do maintenance, employee salaries, and so forth. However, from the interviews of the Trans Lampung no bus maintenance costs to date for free bus maintenance costs. After that, the bus departure schedule no one has made irregular bus arrivals. However, the earliest departure time 05:30 pm and the afternoon return schedule at 17.30 pm. With a capacity buses that can accommodate 30 people seated passengers and 40 standing passengers, so the total capacity of the bus is 70 people. With the capacity and the service bus every day can take a trip ITERA - UNILA - ITERA 3-4 times.

4. Discussion

In August 2016 regarding the regulation of smokeless was made by the rector, with the aim to make a transfer mode of transportation to the entire academic community ITERA. With the implementation of the policy of smokeless implemented within one week. However the policy is not entirely well received by the entire academic community ITERA, supported by the lack of public transport leading ITERA. Bus Trans Lampung be the only public transportation that operate to ITERA to stretch Unila-ITERA.

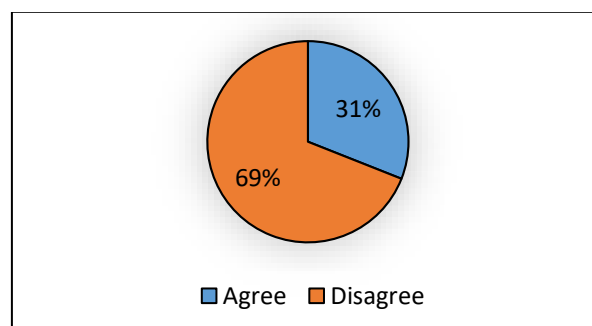


Figure 5. Percentage of student opinion against the policy of smokeless (Source: Survey researchers, processed)

In the diagram above illustrates that not all academic community ITERA agree with this policy. That as many as 69% of students ITERA did not agree with this policy even though there are 31% of students

who agree with this policy. This indicates that the policy of smokeless is a program that seems inappropriate to make a transfer mode of the entire academic community of the Institut Teknologi Sumatera.

Table 3. Percentage of ITERA student opinion against the smokeless policy based on the most frequent.

Student opinion	Stake	Percentage
Maintain the environment by reducing air pollution		21%
Assessing the "Day without smoke" is "moving day parking"		11%
Lack of service providers		9%
The bus route does not pass through a student residence		16%
Bus schedule uncertain		15%
All others		28%

Source: *Data and Analysis, 2016*

In the table above is explained that the percentage of student opinion on policy ITERA's smokeless day. Around 21% of students suggested that the smokeless in the good sense to be implemented because of the need for the movement to care about protecting the environment by reducing air pollution produced by motor vehicles and vehicle private cars. We know that the reaction of organic compounds from the combustion of fossil reaction incomplete combustion in vehicle engines, resulting in residual or air pollution. Especially now that global warming is disturbing the Earth's ozone layer, plus more air pollution from vehicles and fossil fuel exacerbating the situation. The solution is clear policies and systems in tackling this problem, one day smokeless policy in ITERA and afforestation / tree planting. Policies days without a smoke removal methods mode of personal transportation to bus transportation / mass. So from 1700 students and plus employees ITERA everyday use of private vehicles alone were transferred to bus transportation capacity of 30 seated passengers and 40 standing passengers, a significant reduction in air pollution occur and decomposition of traffic jams in the city of Bandar Lampung also be resolved. And also the bus used by the Trans Lampung have to use fuel gas, biogas, or electricity. But as much as 11% of the students considered that "Day without smoke" is "Day moved park" because they lack careful planning, less effective and efficient, because at the time of the day without the smoke was still there academicians who bring personal vehicles and parked his car in front of the gate ITERA. A total of 9% of the students assess violations committed by the academic community because of the lack of provision of service facilities which are not optimal that caused them to have a private vehicle. Furthermore, there are as many as 16% of students who have difficulties in their mobility access from the residence to the campus, is caused by the Bus Trans Lampung is no coverage area of the entire academic campus ITERA. Airport Bus Trans Lampung is not coverage area thoroughly for the entire academic community residence ITERA, this raises new problems that result are often late arriving students into campus. In addition to a range of less than optimal bus service is also caused by scheduled bus departure is uncertain, as many as 15% of the students found Bus Trans Lampung not have a definite timetable and result in delayed students entering college at that hour. And there is also a 28% sample of college students having a different opinion, one of the students found the smokeless needs to be done to make the academic community ITERA switching modes of use of private vehicles into using public transport.

Solving the problem in this case is the need to reform the transportation system Bus Trans Lampung Unila-ITERA is currently being implemented. The system needs to be improved is (1) the scheduled departure and arrival of buses, (2) service providers and support facilities, (3) the addition of Trans Lampung route bus. Schedule bus departures and arrivals are sure to be important in serving the entire

academic ITERA in everyday activities. As an example every day bus operates from 05.30 pm with departures every 30 minutes from early departures. If this is applied to the entire academic community ITERA will have confidence in terms of time to Bus Trans Lampung, so that the entire academic community ITERA comfortable with the services provided by the Bus Trans Lampung and reduce violations occurring on a day without smoke in ITERA. Lack of service providers that support the activities of Trans Lampung bus, as the bus stop is not yet available, the little bus fleet. Thus making passengers uncomfortable with the situation. Solving the problem is the need to build a bus stop at strategic points that facilitate passengers to reach the bus, not only for the entire academic community ITERA but also for the surrounding community. By building a shelter around the residential area and schools could be me-coverage area several schools, because in the RTRW Bandar Lampung area traversed by bus was one of which the District Sukarama is the area of education. So that it can increase revenue Bus Trans Lampung. Additionally Bus Trans Lampung can also be felt by the local community to access mobility. Bus Trans Lampung route via Jl. Canal next next Ryacudu through Jl. Hi Pangeran-suhaimi primary collector road passing through Jl. Mayjend Ryacudu primary arterial road next to the turnpike middle Sumatran Jl. Soekarno-Hatta and the final destination of Lampung University. This is the route that passed by Bus Trans-ITERA Unila Lampung. The region is an area of education in 2011-2030 RTRW Bandar Lampung. If this is only the route of the bus then causes unscheduled departure and arrival of buses is at least the bus passengers were also due to the service can't be the coverage area of the overall residential district bus passengers, especially the academic community ITERA. The solution for this is to be done adding bus routes and fleet units to be coverage area is mainly residential area that has crowds and high activity.



Figure 6. The addition of these buses Trans Lampung (Source: Google Maps)

The addition of these buses could be dilakukan as in figure 7 bus passing through Jl. Terusan Ryacudu then to Jl. Hi Pangeransuhaimi passing through Jl. Raya subsequent flow through Jl. Ratu Dibalau and last through primary arterial road turnpike middle Sumatran Jl. Soekarno-Hatta to a stop in front of the campus of the University of Lampung. Selection of the 2nd because in those areas there are many traditional markets and the way kandis-medium residential housing such as housing griya beautiful promontory, housing the image of the earth scenic, residential scenic headlands highway. So that in the area may ter-coverage area by Bus Trans Lampung. In other responses assess student days without smoke is less decisive because there are still some vehicles such as cars and motorcycles parked in front of the gate ITERA, and it is a thing that deviate towards the smokeless in ITERA. Today smokeless not prove to be a good way to be able to realize the transfer of the mode of transportation to the entire academic community ITERA, considering the vehicle parked in front of the gates of ITERA and violate regulations smokeless day is not without reason. Solving the problem in this case study is to be able to transfer the mode of the entire academic community ITERA, researchers analyzed that need enactment parking rates. In Table 1 produced the data that ITERA students will switch modes when the tariff is parking at a cost of IDR 4.000 per one parking, with this the students will switch from using private vehicles into public transport. In accordance with the calculations performed in the data that the cost of transport a person is 30% of a person's income or income per month or per day, according to the

viewpoint taken into account. ITERA that students spend a day transport as many as four thousand five hundred rupiah. In this study the researchers were unable to calculate the amount Ability to pay student ITERA as limitation of this study that the researchers did not see the location of every student residence ITERA, so the absence of data on the total length of the trip respondents per month (T_1).

5. Conclusion

Based on the analysis performed, it can be deduced that to make a transfer mode of personal transportation to the bus transportation should pay attention to three systems (perception of respondents), including: (1) the scheduled departure and arrival of buses, (2) facilities service providers and support, (3) the addition of bus route Trans Lampung. Three systems are related to each other, and the system also greatly affect the level of willingness of people to use the bus transportation is convenient. After that, should the addition of parking fees high enough outstrip capacity transport costs of issuance, which is IDR 4.500. So if a parking fee to be paid beyond that will make the entire academic community ITERA switch to bus transport Trans Lampung with the support by the supporting facilities.

Furthermore the Trans Lampung also have to add bus lines to meet demand. Extra bus route can be done is a bus passing through Jl. Terusan Ryacudu then to Jl. Hi Pangeransuhaimi passing through Jl. Raya subsequent flow through Jl. Ratu Dibalau and last through primary arterial road turnpike middle Sumatran Jl. Soekarno-Hatta to a stop in front of the campus of the University of Lampung. On the route was done to coverage area around the road there are many residential and traditional markets.

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